


ORIGINAL ARTICLE

Intention to maintain and willingness to stop: Applying a dual-process model to understanding the maintenance of COVID-19 preventive behaviors

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Abstract

Preventive behaviors have played an essential role in coping with COVID-19 and may continue to exerting a crucial impact on pandemic control in the future. This study aimed to evaluate the effectiveness of social-cognitive factors on maintenance of COVID-19 preventive behaviors based on a dual-process model, which encompasses a reasoned path via the intention to maintain and a social reaction path via the willingness to stop. We collected a probability sample of 472 community-dwelling adults. Social-cognitive factors, behavioral tendencies, and preventive behaviors of COVID-19 were measured. The results supported that the dual-process framework could account for individual differences in preventive behaviors. Self-efficacy and response cost significantly explained the intention to maintain preventive behaviors, while favorability of risk image and subjective norm significantly explained the willingness to stop preventive behaviors. Our findings proposed strategies for promoting individuals' maintenance of preventive behaviors during a pandemic. The development of prevention policies may focus on two paths: strengthening the intended path by enhancing self-efficacy and decreasing response cost of

preventive behaviors and monitoring and improving social influences, such as risk prototype and subjective norm, which can reduce the willingness to stop preventive behaviors.

KEYWORDS

COVID-19, mask wearing, protection motivation theory, prototype-willingness model, social distancing, theory of planned behavior

INTRODUCTION

Since the emergence of coronavirus disease 2019 (COVID-19) in December 2019, there have been over five hundred million confirmed cases and six million deaths as of May 2022 (World Health Organization [WHO], 2022a). Preventive measures have been proposed to slow down or cut the transmission of the coronavirus, primarily through individuals' direct contact (Rothan & Byrareddy, 2020), with strategies of reducing social contacts and nurturing new hygiene routines (Breakwell et al., 2021; Dalton et al., 2020). Preventive behaviors have contributed to a noticeable decrease in new infections, especially in the early stage of the pandemic when no vaccine was available (Anderson et al., 2020; Kwok et al., 2020; Lee & You, 2020). Among various preventive behaviors, social distancing and mask wearing are considered the most effective means (Liao et al., 2021; Sen-Crowe et al., 2020). However, individual differences in practicing preventive behaviors have discounted the effect of preventive behaviors on containing the pandemic (Griffith et al., 2020; Tong et al., 2020). Furthermore, with the COVID-19 vaccination rate increasing, some people may stop preventive behaviors due to overreliance on vaccines (Troger & Caplan, 2021) or optimism about the pandemic (Park et al., 2021). The loosening of preventive behaviors contradicts the WHO's (2022b) advocacy on the indispensability of preventive behaviors despite the availability of vaccines, and it may lead to a rebound of the COVID-19 pandemic (Jiao et al., 2022; Malki et al., 2021; Pham et al., 2021). The knowledge about which factors affect individuals' tendency to maintain or stop preventive behaviors may not only help to limit the spread and harm of COVID-19 but also allow us to contain epidemics more efficiently and effectively in the future. Because psychological factors such as social-cognitive variables are suggested to be a cost-effective means to promote health (Bandura, 2004; Pinkerton et al., 2000; Prenger et al., 2016), the present study aims at evaluating the effectiveness of social-cognitive factors in the maintenance of COVID-19 preventive behaviors.

Abundant research on preventive behaviors of COVID-19 has focused on behavioral initiation and addressed factors influencing the intention to implement preventive behaviors (e.g. Ahmad et al., 2020; Duong et al., 2021; Lin et al., 2020) based on established health-promotion models, such as Ajzen's (1991) theory of planned behavior (TPB; it postulates that one's behavior is determined by behavioral intention, which is shaped by attitude, subjective norms, and perceived behavioral control; e.g. Gibson et al., 2021; Irfan et al., 2021) and Rogers's (1983) protection motivation theory (PMT; it proposes that people's protection-related behaviors arise from appraisals of threat and coping; e.g. Bashirian et al., 2020; Yazdanpanah et al., 2020). Although these models displayed compatibility in accounting for the initiation of COVID-19 preventive behaviors, they may fall short in explaining the intention-behavior gap that occurs

in the maintenance of those preventive behaviors (Gibson et al., 2021). For instance, individuals would occasionally stop performing preventive behaviors despite that such behavioral discontinuation is against their intentions (Gerrard et al., 2008). After reviewing more than one hundred behavior theories, Kwasnicka et al. (2016) suggested that health behaviors' maintenance differs from their initiation in nature and theoretical explanations as the former is under more environmental and social influences. To account for the idiosyncrasies of the maintenance process, many researchers adopted dual-process models (e.g. Aulbach et al., 2021; Magnan et al., 2021; Phipps et al., 2021; Presseau et al., 2014; Wiers et al., 2018), which usually include an analytic system based on conscious intention and a heuristic system responding to situational impulses (Strack & Deutsch, 2004).

Among a variety of dual-process models, the prototype-willingness model (PWM; Gerrard et al., 2008) is one of the most frequently adopted in explaining individuals' planned and unplanned decisions to start, continue, or stop health behaviors, such as smoking (Gerrard et al., 2005), drinking (Davies et al., 2013), illegal drug use (Whitaker et al., 2014), unprotected sex (Todd et al., 2016), and dangerous driving (Elliott et al., 2017). The PWM postulates that people seldomly perform health-risk behaviors out of intentions but rather due to their automatic social reaction under risk-conducive situations (Gerrard et al., 2008). The dual decision-making processes involved in the PWM are a reasoned path and a social reaction path. The reasoned path, adapted from the expectancy-value perspectives such as the TPB, refers to more analytic processing and presents the planned, deliberative, and effortful cognitions in deciding whether or not to perform health behaviors. The social reaction path concerns more heuristic, unintended, and intuitive decisions, with its core elements being the prototype (i.e. the image of people who engage in health-risk behaviors) and the willingness (i.e. openness to engaging in such health-risk behaviors; Gerrard et al., 2005; Gibbons et al., 1998). The PWM provides a promising theoretical framework to understand the gap between individuals' behavioral intention and behavior (Gerrard et al., 2008).

In the present study, we aimed to adopt the PWM in explaining individuals' maintenance of COVID-19 preventive behaviors. By incorporating both the reasoned process (i.e. intention) and the social reaction process (i.e. willingness), we intended to provide a novel social-cognitive perspective to understand the topic of interest and offer suggestions to promote the maintenance of COVID-19 preventive behaviors. Specifically, we conceptualized a dual-process model based on an extended PWM to test whether social-cognitive factors would exert impacts on preventive behaviors via behavioral tendencies from the reasoned and the social reaction path (see Figure 1).

Hypothesis 1. For the reasoned path, we hypothesised that the following social-cognitive factors would be associated with the intention to maintain COVID-19 preventive behaviors: self-efficacy, subjective norm, perceived severity, perceived vulnerability, and response efficacy would be positively related to the intention to maintain preventive behaviors; on the contrary, response cost and maladaptive response reward would be negatively related to the intention to maintain preventive behaviors.

Hypothesis 2. Regarding the social reaction path, we hypothesized that another set of social-cognitive factors would be associated with the willingness to stop preventive behaviors: favorability of risk image would be positively related to the willingness to stop; in contrast, subjective norm would be negatively associated with the willingness to stop.

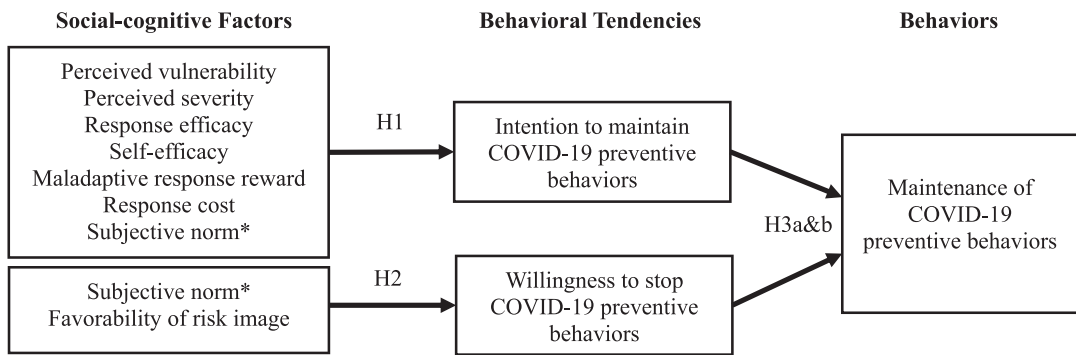


FIGURE 1 The hypothesized dual-process model. *Note:* * denotes a social-cognitive factor that activates both paths. H = hypothesis

Hypothesis 3. Consistent with a dual-process approach to behavioral maintenance, we hypothesized that the intention to maintain preventive behaviors would be positively related to the maintenance of preventive behaviors, while a willingness to stop would be negatively related to the maintenance of preventive behaviors (Hypothesis 3a, H3a). The intention to maintain and a willingness to stop would each exert a unique contribution to the maintenance of preventive behaviors on top of the variance explained by the other (Hypothesis 3b, H3b).

METHODS

Procedure and participants

In order to obtain a representative community sample in Macao, China, during the pandemic period, we specifically chose the telephone survey approach over other alternatives that require face-to-face interactions (e.g. a household survey) and hence are deemed as infeasible in the local context. Although a telephone survey can only reach residents with a fixed-line telephone on the household level, the high tele-density of fixed-line telephones in Macao (19.5 telephone connections every 100 individuals; CEIC Data, 2018; c.f., the world's average of 12.8; International Telecommunication Union, 2018) ensures sufficiently adequate representativeness of the overall population of Macao residents. The telephone survey was conducted from January to February 2021 with a two-step random-sampling method. A random sample of households was selected from the latest residential phonebook, and a respondent was selected from each household using the last birthday rule (Gaziano, 2008). People were considered eligible for the study if they were local Chinese adult residents (≥ 18 years old) and being able to speak Cantonese or Mandarin Chinese. Participation was voluntary without monetary incentives. Participants were informed of their rights during participation, and verbal consent was obtained before the interview. All the eligible participants could refuse to take the interview or withdraw in the middle. Prior ethical approval for this study was obtained from the affiliated university of the corresponding author.

A probability sample of 472 Chinese adults in Macao, China (232 men, 49.2%, 95% CI [44.7%, 53.7%]; 240 women, 50.8%, 95% CI [46.3%, 55.3%]) participated in the survey. Based on the calculation method proposed by American Association for Public Opinion Research (2016), the cooperation rate was 83.9 per cent. The mean interview time was 36 min. The average age of the participants was 40.28 years ($SD = 13.67$; range = 18 to 81), and more than half of them attained education at college or a higher level.

Measures

Items for measuring all the variables were either adapted from previous studies or constructed based on the current study's context. Additional demographic data, including gender, age, and educational attainment, were collected. A pilot sample including 10 college students was recruited for testing these items, and all of the participants endorsed good comprehensibility and suitability of the items.

Preventive behaviors of COVID-19

According to the advice of the WHO (2021) and the Health Bureau of Macao (Macao SAR Centre for Disease Control and Prevention, 2020), this study focused on two primary preventive behaviors of COVID-19, namely, mask wearing and social distancing. Respondents were prompted to report their frequency of mask wearing and social distancing on a 5-point Likert scale (1 = *never* to 5 = *always*). The two items were "How often did you wear a mask in public places last week" and "How often did you keep a one-meter distance from others in public places last week."

Intention to maintain preventive behaviors

The intention to maintain preventive behaviors was measured on a 5-point Likert scale (1 = *never* to 5 = *always*). The two items were "At which frequency do you intend to maintain mask wearing in public places next month" and "At which frequency do you intend to maintain the one-meter social distancing in public places next month."

Willingness to stop preventive behaviors

Willingness to stop each preventive behavior was measured by a single item adapted from Gibbons et al. (1995). The item of mask wearing was "If you are meeting a group of friends in a public place and you notice that some of them do not wear a mask, how likely will you take off your mask?" The item of social distancing was "If you are meeting a group of friends in a public place and you notice that some of them do not obey the one-meter social distancing requirement, how likely will you ignore the social distancing requirement?" The items were measured on a 5-point Likert scale (1 = *not at all* to 5 = *very likely*).

Subjective norm

Subjective norm was adapted from Lin et al. (2020) and assessed on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The two items were “Your family or friends think you should wear a mask in public places” and “Your family or friends think you should maintain a one-meter social distance in public places.”

Self-efficacy

Items of self-efficacy was adapted from Lin et al. (2020) and rated on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The two items were “You feel you are able to wear a mask in public places in the next month” and “You feel you are able to maintain a one-meter social distance in public places in the next month.”

Perceived severity

Perceived severity was adapted from Tong et al. (2020), containing three items assessed on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The three items were “If you have COVID-19, your body functions will be severely damaged,” “If you have COVID-19, your study or work may be impaired,” and “If you have COVID-19, the negative labels may harm your personal relationships.” The internal consistency was .69 in this study.

Perceived vulnerability

Adapted from Tong et al. (2020), the three-item perceived vulnerability adopted a 5-point Likert scale response format (1 = *strongly disagree* to 5 = *strongly agree*) and had an internal consistency of .69 in the present study. The three items were “You feel like that there is a high chance for you to have COVID-19,” “You are worried about having COVID-19,” and “People of your age are at high risk of having COVID-19.”

Response efficacy

Items of response efficacy were constructed based on the current study's context. Each preventive behavior was indicated by two items on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The two mask wearing items were “Wearing a mask in public places reduces your chance of having COVID-19” and “Wearing a mask in public places is an effective preventive measure against COVID-19.” The two social distancing items were “Maintaining a one-meter social distance in public places reduces your chance of having COVID-19” and “Maintaining a one-meter social distance in public places is an effective preventive measure against COVID-19.” The internal consistency was .91 and .93 for the two mask wearing items and the two social distancing items, respectively.

Maladaptive response reward

Items of maladaptive response reward were composed to fit the context of the current study with a set of two items for each preventive behavior on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The items of mask wearing were “Not wearing a mask in public places makes my life more convenient (e.g. easier to clean up my face)” and “I feel more comfortable when I do not wear a mask in public places.” The items of social distancing were “Not maintaining a one-meter social distance in public places makes my life more convenient” and “I feel more comfortable to talk with others when I do not maintain a one-meter social distance in public places.” The internal consistency was .71 and .86 for the two mask wearing items and the two social distancing items, respectively.

Response cost

A three-item response cost scale was created for each preventive behavior on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The items of mask wearing were “Wearing a mask in public places interferes with my daily life,” “Wearing a mask in public places greatly reduces my enjoyment of life,” and “Wearing a mask in public places makes me feel embarrassed.” The items of social distancing were “Maintaining a one-meter social distance in public places interferes with my daily life,” “Maintaining a one-meter social distance in public places greatly reduces my enjoyment of life,” and “Maintaining a one-meter social distance in public places makes me feel embarrassed.” The internal consistency was .90 and .93 for the three mask wearing items and the three social distancing items, respectively.

Favorability of risk image

We adopted the procedure suggested by Gibbons et al. (1995) to measure the favorability of risk image. The participants rated their favorability on three traits (i.e. popular, independent, and smart) of the two groups of risk image, who were “some people of your age who are not wearing masks in public places” and “some people of your age who are not keeping a social distance of one meter from other people in public places.” Items were assessed on a 5-point Likert scale (1 = *extremely not* to 5 = *extremely*). Higher scores indicated higher levels of favorability over the corresponding risk image. The internal consistency was .80 and .89 for the three mask wearing items and the three social distancing items, respectively.

Data analyses

This study tested the hypothesized dual-process model in two steps. First, we investigated the relationship between social-cognitive factors and behavioral tendencies (i.e. intention and willingness) with two path analysis using AMOS 24. The corresponding path model would be accepted if it meets all the following goodness of fit criteria: (1) relative chi-square value (chi-square divided by the degree of freedom) < 3; (2) comparative fit index (*CFI*) \geq .95; (3) root mean square error of approximation (*RMSEA*) < .08; and (4) standardised root mean square residual (*SRMR*) < .08 (McDonald & Ho, 2002; Schreiber, 2008). Subsequently, we utilized the

partial correlation analysis in SPSS 26 to assess the hypothesized associations of the two behavioral tendencies with preventive behaviors and compare their unique contribution to explaining preventive behaviors.

RESULTS

Preliminary statistics

As shown in Table 1, the mask wearing behavior was positively correlated with the intention to maintain mask wearing ($r = .65, p < .001$) and negatively correlated with the willingness to stop mask wearing ($r = -.30, p < .001$). For the reasoned path, the intention to maintain mask wearing was positively associated with self-efficacy, subjective norm, perceived severity, and response efficacy ($r = .36$ to $.59, p < .001$) and negatively associated with response cost ($r = -.50, p < .001$). For the social reaction path, the willingness to stop mask wearing was positively associated with favorability of risk image ($r = .30, p < .001$) and negatively associated with subjective norm ($r = -.33, p < .001$).

Similar associative patterns among social-cognitive factors, behavioral tendencies, and preventive behavior were found for social distancing (see Table 2). The social distancing behavior was positively associated with the intention to maintain social distancing ($r = .38, p < .001$) and negatively associated with the willingness to stop social distancing ($r = -.27, p < .001$). For the reasoned path, the intention to maintain social distancing was positively correlated with self-efficacy, subjective norm, perceived vulnerability, perceived severity, and response efficacy ($r = .11$ to $.53, p < .05$), and negatively associated with response cost and maladaptive response reward ($r = -.26$ and $-.14$, respectively, $p < .01$). For the social reaction path, the willingness to stop social distancing was positively associated with favorability of risk image ($r = .23, p < .001$) and negatively associated with subjective norm ($r = -.28, p < .001$).

The relationship between social-cognitive factors and behavioral tendencies

We conducted a path analysis to test the relationship between social-cognitive factors and two behavioral tendencies for each preventive behavior, and controlled the demographic influence of gender, age, and educational attainment in the model. Furthermore, we allowed the correlations among social-cognitive factors and between the residuals of intention and willingness to be freely estimated according to the suggestion of Gerrard et al. (2008). For mask wearing (see Figure 2), the hypothesized path model showed a satisfactory model fit, with $\chi^2(34) = 100.95, p < .001, \chi^2/df = 2.97, CFI = .953, RMSEA = .065, SRMR = .065$. All hypothesized paths were significant, except for the three paths from perceived vulnerability, response efficacy, and subjective norm to intention. The correlation between the residual of intention and willingness was not significant ($p = .09$). Altogether, the social-cognitive factors explained 47 per cent variance of the intention to maintain mask wearing and 17 per cent variance of the willingness to stop mask wearing, supporting Hypotheses 1 and 2 for mask wearing.

For social distancing (see Figure 3), the hypothesized path model showed a satisfactory fit, with $\chi^2(34) = 88.44, p < .001, \chi^2/df = 2.60, CFI = .951, RMSEA = .058, SRMR = .056$. All, except four (i.e. from perceived vulnerability, perceived severity, response efficacy, and

TABLE 1 Descriptive statistics and correlations of mask wearing related variables (N = 472)

	Mean	SD	1	2	3	4	5
1. Mask wearing behavior	4.53	0.64	1				
2. Intention to maintain mask wearing	4.48	0.66	.65***	1			
3. Self-efficacy of mask wearing	4.45	0.57	.60***	.59***	1		
4. Subjective norm of mask wearing	4.22	0.69	.37***	.36***	.42***	1	
5. Perceived vulnerability	2.53	0.84	.01	.04	.03	.07	1
6. Perceived severity	4.09	0.63	.40***	.46***	.54***	.35***	.08
7. Response efficacy of mask wearing	4.31	0.65	.43***	.45***	.59***	.35***	-.03
8. Response cost of mask wearing	2.56	1.04	-.42***	-.50***	-.44***	-.32***	.08
9. Maladaptive response reward of stop mask wearing	3.61	0.87	.01	.00	-.07	.00	.03
10. Willingness to stop mask wearing	2.34	1.15	-.30***	-.24***	-.32***	-.33***	-.06
11. Favorability of risk image of stop mask wearing	2.39	0.87	-.27***	-.31***	-.22***	-.22***	-.06
12. Gender	N/A	N/A	-.17***	-.28***	-.16**	-.02	.01
13. Age	40.28	13.67	.21***	.24***	.23***	.24***	.21***
14. Educational attainment	4.85	1.27	-.14**	-.13**	-.13**	-.09	-.17***

Note: Demographic variable coding: Gender (0 = female, 1 = male); educational attainment (1 = no formal education or kindergarten; 2 = primary education; 3 = junior high school education; 4 = senior high school education; 5 = college education without a bachelor's degree; 6 = college education with a bachelor's degree or above); N/A = not applicable.

*p < .05.

**p < .01.

***p < .001.

TABLE 1 (Continued)

	6	7	8	9	10	11	12	13	14
1. Mask wearing behavior									
2. Intention to maintain mask wearing									
3. Self-efficacy of mask wearing									
4. Subjective norm of mask wearing									
5. Perceived vulnerability									
6. Perceived severity	1								
7. Response efficacy of mask wearing	.46***	1							
8. Response cost of mask wearing	-.31***	-.40***	1						
9. Maladaptive response reward of stop mask wearing	.03	-.08	.19***	1					
10. Willingness to stop mask wearing	-.33***	-.36***	.32***	.09	1				
11. Favorability of risk image of stop mask wearing	-.26***	-.15**	.28***	.10*	.30***	1			
12. Gender	-.15**	-.12**	.17***	.05	-.02	.11*	1		
13. Age	.17***	.20***	-.19***	.00	-.22***	-.29***	.08	1	
14. Educational attainment	-.08	-.09	.04	-.03	.09	.21***	-.10*	-.56***	1

Note: Demographic variable coding: Gender (0 = female, 1 = male); educational attainment (1 = no formal education or kindergarten; 2 = primary education; 3 = junior high school education; 4 = senior high school education; 5 = college education without a bachelor's degree; 6 = college education with a bachelor's degree or above); N/A = not applicable. * $p < .05$. ** $p < .01$. *** $p < .001$.

TABLE 2 Descriptive statistics and correlations of social distancing related variables (N = 472)

	Mean	SD	1	2	3	4	5	6
1. Social distancing behavior	3.69	0.98	1					
2. Intention to maintain social distancing	3.95	0.91	.38***	1				
3. Self-efficacy of social distancing	4.01	0.81	.45***	.50***	1			
4. Subjective norm of social distancing	3.91	0.88	.38***	.53***	.47***	1		
5. Perceived vulnerability	2.53	0.84	.12*	.11*	.02	.14**	1	
6. Perceived severity	4.09	0.63	.04	.16***	.18***	.19***	.08	1
7. Response efficacy of social distancing	4.13	0.72	.23***	.33***	.46***	.31***	-.01	.36***
8. Response cost of social distancing	2.58	1.03	-.04	-.26***	-.25***	-.19***	.14**	-.30***
9. Maladaptive response reward of stop social distancing	3.62	0.92	-.07	-.14**	-.07	-.07	-.01	-.02
10. Willingness to stop social distancing	2.79	1.14	-.27***	-.20***	-.23***	-.28***	-.12**	-.03
11. Favorability of risk image of stop social distancing	2.57	0.95	-.18***	-.27***	-.29***	-.30***	-.08	-.19***
12. Gender	N/A	N/A	-.01	.07	.04	-.04	-.01	.15**
13. Age	40.28	13.67	.11*	.17***	.11*	.24***	.21***	.17***
14. Educational attainment	4.85	1.27	-.13**	-.17***	-.17***	-.16***	-.17***	-.08

Note: Demographic variable coding: Gender (0 = female, 1 = male); educational attainment (1 = no formal education or kindergarten; 2 = primary education; 3 = junior high school education; 4 = senior high school education; 5 = college education without a bachelor's degree; 6 = college education with a bachelor's degree or above); N/A = not applicable.

*p < .05.

**p < .01.

***p < .001.

TABLE 2 (Continued)

	7	8	9	10	11	12	13	14
1. Social distancing behavior								
2. Intention to maintain social distancing								
3. Self-efficacy of social distancing								
4. Subjective norm of social distancing								
5. Perceived vulnerability								
6. Perceived severity								
7. Response efficacy of social distancing	1							
8. Response cost of social distancing	-.35***	1						
9. Maladaptive response reward of stop social distancing	-.06	.28***	1					
10. Willingness to stop social distancing	-.24***	.02	.15**	1				
11. Favorability of risk image of stop social distancing	-.18***	.23***	.11*	.23***	1			
12. Gender	.16***	-.19***	-.07	.10*	-.10*	1		
13. Age	.15***	-.19***	.02	-.17***	-.24***	.10*	1	
14. Educational attainment	-.14**	.08	-.03	.09*	.19***	-.10*	-.55***	1

Note: Demographic variable coding: Gender (0 = female, 1 = male); educational attainment (1 = no formal education or kindergarten; 2 = primary education; 3 = junior high school education; 4 = senior high school education; 5 = college education without a bachelor's degree; 6 = college education with a bachelor's degree or above); N/A = not applicable. * $p < .05$. ** $p < .01$. *** $p < .001$.

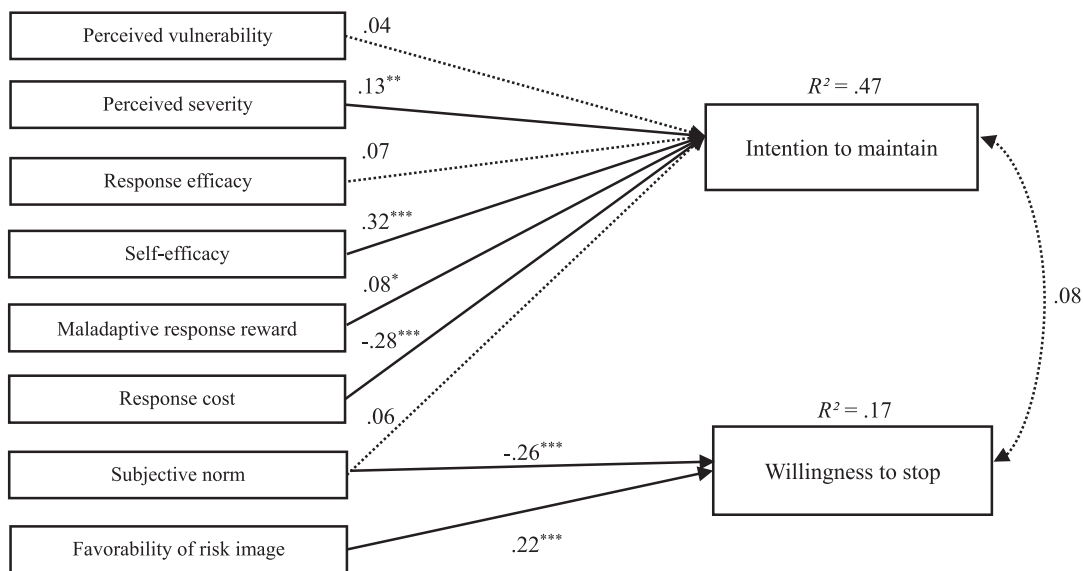


FIGURE 2 The path model of mask wearing. *Note:* Free estimations were allowed for the correlations among endogenous variables. Solid lines denote significant pathways, whereas dotted lines denote nonsignificant pathways. Standardised coefficients were reported. * $p < .05$, ** $p < .01$, *** $p < .001$

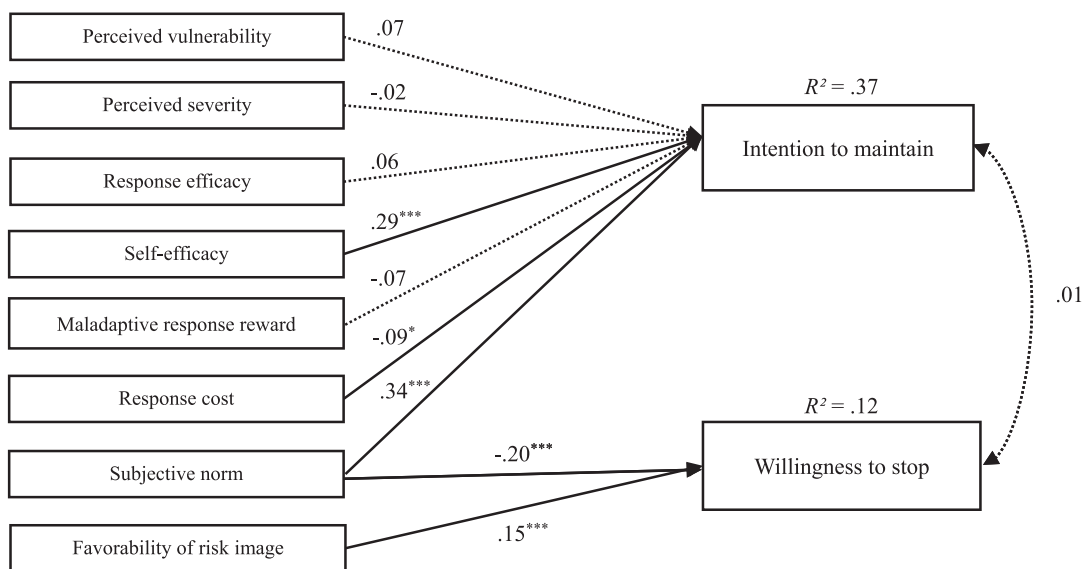


FIGURE 3 The path model of social distancing. *Note:* Free estimations were allowed for the correlations among endogenous variables. Solid lines denote significant pathways, whereas dotted lines denote nonsignificant pathways. Standardised coefficients were reported. * $p < .05$, ** $p < .01$, *** $p < .001$

maladaptive response reward to intention), hypothesized paths were significant. The correlation between the residual of intention and willingness was not significant ($p = .85$). The social-cognitive factors explained 37 per cent variance of the intention to maintain social distancing

and 12 per cent variance of the willingness to stop social distancing, supporting Hypotheses 1 and 2 for social distancing.

The relationship between behavioral tendencies and behaviors

We conducted partial correlation analysis to test the association between the two behavioral tendencies and preventive behaviors (Hypotheses 3a and 3b). When the willingness to stop was being controlled for, the intention to maintain still displayed a significant, positive association with the preventive behavior of mask wearing and social distancing ($r = .63$ and $.34$, respectively, $p < .001$), indicating the unique influence of intention to maintain on both preventive behaviors in addition to the influence of willingness to stop. Similarly, after controlling for the intention to maintain, willingness to stop still manifested a negative correlation with the preventive behavior of mask wearing and social distancing at a statistically significant level ($r = -.19$ and $-.22$, respectively, $p < .001$), indicating the unique influence of willingness to stop on both preventive behaviors in addition to the influence of intention to maintain. Taken together, these two sets of findings substantiated the significant associations of intention to maintain and willingness to stop with preventive behaviors at expected directions and the unique contributions of these two behavioral tendencies to the preventive behaviors, supporting Hypotheses 3a and 3b.

DISCUSSION

The present study evaluated the applicability of an extended PWM, dual-process model to understanding the maintenance of COVID-19 preventive behaviors with a probability community sample. We discovered that social-cognitive factors in our conceptualized dual-process model associated to preventive behaviors via not only the reason path (i.e. intention to maintain) but also the social reaction path (i.e. willingness to stop). Our findings may provide insights for developing better promotion strategies to encourage the maintenance of preventive behaviors of COVID-19 or other epidemics in the future. We detailed the related implications and suggestions in the following sections.

The reasoned paths

Consistent with past findings that self-efficacy (Bashirian et al., 2020; Mortada et al., 2021) and response cost (Delfiyan et al., 2021; Pakmehr et al., 2020) were related to preventive behaviors, these variables of the reasoned path also explained people's intention to maintain COVID-19 prevention in the present study specifically, we found that self-efficacy showed the largest positive effect on the intention to maintain preventive behaviors, in line with previous studies (e.g. Mortada et al., 2021). This finding indicates that the more capable individuals perceive themselves to maintain mask wearing and social distancing, the more likely they continue doing them; therefore, from a practical perspective, strategies should be developed to enhance people's perceived efficacy in order to strengthen the maintenance of preventive behaviors. For instance, convenient access to masks may affect individuals' perceived efficacy over the habitual use of masks in public (Howard, 2020). Accordingly, the government may place vending

machines in public areas and gathering venues (e.g. airports, train stations, and plazas) to sell masks at a reasonable price. Manufacturers may improve the fit and comfort of masks and provide masks with better air permeability in hot weather, to help wearers breathe more smoothly and experience fewer skin irritations with masks on (Clapp et al., 2021). As for obstacles to maintaining social distancing, Coroiu et al. (2020) identified the inability to work and study remotely as a primary barrier. Companies and colleges may provide more user-friendly network office platforms and e-learning systems for employees and students to work and study online conveniently (Favale et al., 2020).

Response cost was negatively and consistently related to the intention to maintain two preventive behaviors in the path models, suggesting that reducing the perceived cost or burden is essential to maintaining preventive behaviors against COVID-19. For example, keeping social distancing and decreasing interpersonal contacts may change people's lifestyle, impair interpersonal relationships, and cause anxiety, depression, and loneliness (Chen et al., 2021; Stickley et al., 2021). Promoting more extensive use of multichannel social support systems in terms of online interactive activities and programs for entertainment or education purposes (e.g. interactive concert, cookery training, and exercise class) may help alleviate psychological distress associated with maintaining social distancing (Saltzman et al., 2020). In addition, medical institutions, universities and academic societies may establish online mental health services, such as psychological assistance hotlines and online psychological counseling, as compensation for the lack of traditional face-to-face psychological interventions (Liu et al., 2020).

Different from previous studies (e.g. Bashirian et al., 2020; Mortada et al., 2021), perceived vulnerability did not display a significant effect on the intention to maintain preventive behaviors in our study. We speculated that perceived vulnerability, as a part of threat appraisal, may play a more significant role in the early stage of the pandemic when the infected rate was rising (Bashirian et al., 2020) and in regions where the COVID-19 threat is more imminent (Stangier et al., 2021). In contrast, our study was conducted in a region with relatively stable and low prevalence/incidence of the COVID-19. By May 2022, Macao records 82 cases (i.e. 12 cases per 100,000 people), and there is no causality linked to COVID-19 (Macao SAR Centre for Disease Control and Prevention, 2022). Considering the low-risk situation, it is not surprising for us to observe the nonsignificant role of perceived vulnerability in intention to maintain preventive behaviors in Macao. On the other hand, we speculate that it may be more critical for such regions to promote the maintenance of preventive behaviors from the social reaction path.

The social reaction path

Current models for explaining COVID-19 preventive behaviors have primarily focused on the planned process (e.g. Ahmad et al., 2020; Duong et al., 2021; Lin et al., 2020). Our findings support the dual-process model that people's maintaining preventive behaviors were not only affected by their planned intention via the reasoned path but also their unplanned willingness via the social reaction path. Specifically, we found a positive association between the favorability of risk image and the willingness to stop preventive behaviors and a negative association between subjective norm and the willingness to stop preventive behaviors.

Our findings highlighted the importance of the previously ignored social reaction path and provided theoretical supports and new insights to develop strategies to maintain preventive behaviors when perceived threat became lower (e.g. due to an increasing vaccination rate and/or successful virus containment strategies). For instance, we may apply such findings to

underscore why it is necessary to design specific preventive policies concerning bars, night-clubs, and restaurants (e.g. limits on the number of customers indoors; Fitzgerald et al., 2021) or other social gathering venues where one's social reaction path is more likely to be activated and hence stop preventive behaviors unintentionally. Posters and signs can be put up in public places to remind people to maintain preventive behaviors of COVID-19 (Lunn et al., 2020). In the community, working up an active atmosphere of maintaining preventive behaviors and enhancing the subjective norm (i.e. increase individuals' perception of their neighbors' and friends' expectation for them to maintain preventive behaviors) may help counter defiance of preventive behaviors.

In addition to identifying conditions at which people are more likely to stop preventive behaviors, pinpointing groups of people who have a stronger tendency to stop preventive behaviors is another key to control the pandemic. In our study, for both preventive behaviors, age was negatively correlated with the willingness to stop ($r = -.17$ and $-.22$, $p < .001$), negatively correlated with the favorability of risk image ($r = -.24$ and $-.29$, $p < .001$), and positively correlated with subjective norm ($r = .24$, $p < .001$). In other words, younger adults tended to underestimate the expectations of their family or friends for them to maintain preventive behaviors, perceive those who stop preventive behaviors more favorably, and hence display a higher level of willingness to stop preventive behaviors. Extant studies have also identified that young people had low compliance with COVID-19 preventive behaviors (Nivette et al., 2021) and were more prone to underestimate the extent to which their peers adhere to preventive behaviors of COVID-19 (Graupensperger et al., 2021). Considering these idiosyncrasies of the young, in addition to enhancing subjective norm, we recommend redirecting the effort to alter their image of those who maintain/stop preventive behaviors. Specific strategies may involve presenting negative personality information of health-risk image and positive personality information of health-protective image on social media, which is popular with young people (Blanton et al., 2001), and conducting systematic contemplations of typical health-protective image or health-risk image among school and college students (Ouellette et al., 2005). We expect intervention programs targeting one's prototype perceptions may be particularly effective among the young because they are under a more significant influence of social orientation (Gerrard et al., 2008).

Although both the reasoned path (i.e. intention to maintain) and the social reaction path (i.e. willingness to stop) were related to COVID-19 preventive behaviors, the reasoned path had a stronger unique influence on preventive behaviors. Nevertheless, the social reaction path significantly contributed to gaining our understanding of individual differences in practicing preventive behaviors. We suggest the application of a dual-process approach in future research on health-related behaviors, which may achieve a better predictive and interpretive value of health behavior theories (Gerrard et al., 2008).

Limitations and future directions

There are some limitations of our study that deserve attention. First, we selected mask wearing and social distancing as the two preventive behaviors under study because they are core preventive measures against the pandemic of COVID-19 (Breakwell et al., 2021; WHO, 2021). Nevertheless, as indicated in our path models, the significance and the magnitude of the effects of the predictors in the models would vary across preventive behaviors. Such observation is consistent with previous research (Todd et al., 2016), which found a variation in the relative

strength of the social reaction path for different behaviors. Therefore, we recommend subsequent applications of this dual-process model to other preventive behaviors of COVID-19, such as cleaning hands and avoiding face touching (WHO, 2021), for comparison. Second, although the favorability of risk image and subjective norm exerted a significant impact on willingness in our study, there was still a large proportion of unexplained variance of willingness. Future research may take into account other potential predictors of willingness, such as favorability of protective image (Gerrard et al., 2008) and similarity of risk/protective image (van Lettow et al., 2016), to explore the effect of the social reaction path more comprehensively. Third, due to the restriction of a cross-sectional design, this study only focused on the existing experience of maintaining preventive behaviors and could not trace the behavioral maintenance over time. Forthcoming studies may consider a longitudinal research design to test the chronological effects of cognitive and social factors on intention, willingness, and the maintenance of COVID-19 preventive behaviors. Fourth, the present study assumed that the participants considered the stopping of preventive behaviors were risky behaviors. It may be true that many people considered such a stopping to be risky (Shiina et al., 2021) at the early stage of the COVID-19 pandemic or in places where COVID-19 is still considered a severe threat; however, it is also possible that some people may not consider the stopping of preventive behaviors, such as not wearing a mask, risky at a later stage of the pandemic, especially in places where preventive policies have been relaxed. We believe that future studies should take into account how individuals conceptualize preventive behaviors.

CONCLUSION

The present study applied a dual-process model to explain the individual differences in maintaining two primary COVID-19 preventive behaviors, mask wearing and social distancing. Based on the data of a probability community sample, it provides empirical evidence that we could understand individuals' maintenance of preventive behaviors from both the intended reasoned path and the unintended social reaction path, shedding light on the less-studied unplanned willingness to stop preventive behaviors. These findings enlighten new directions to develop strategies for promoting people to maintain preventive behaviors in the current COVID-19 pandemic and future epidemic control.

CONFLICT OF INTEREST

On behalf of all authors, the corresponding author states that there is no conflict of interest.

ETHICS STATEMENT

This research was approved by Research Ethics Committee of the affiliated department of the corresponding author.

AUTHOR CONTRIBUTIONS

Mr. Mu He was responsible for literature review, data analysis, finding interpretation, and manuscript writing. Dr. Juliet Honglei Chen was involved in data analysis, finding interpretation, and manuscript writing. Prof. Anise M. S. Wu was involved in research conception, finding interpretation, and manuscript writing. Prof. Kwok Kit Tong was responsible for research conception and design, data collection, coordination, funding acquisition, and manuscript writing. All authors approved the final manuscript.

DATA AVAILABILITY STATEMENT

The dataset generated during and/or analyzed during the current study is available from the corresponding author on reasonable request.

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