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Protecting children from COVID-19: examining U.S. parents motivation and behaviour using an integrated model of self-determination theory and the theory of planned behaviour

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ABSTRACT

Objectives: This longitudinal study applied the integrated model of self-determination theory (SDT) and the theory of planned behaviour (TPB) to explain COVID-19 preventive behaviours among parents of young children in the United States.

Design: The study adopted a two-wave longitudinal study design. Parents ($N = 681$) completed self-report questionnaires related to measures of SDT and the TPB constructs and behavioural adherence at baseline and after one month. We used standardised residual change scores to test the structural relationships of the integrated model.

Results: The parameter estimates of the model (CFI > .96, TLI > .86, RMSEA = .05, SRMR = .03) fit acceptably well to the data. Psychological need support was positively and significantly linked to autonomous and controlled motivation and amotivation. Autonomous motivation was positively and significantly correlated with TPB factors, and intention. Intention was a significant and positive predictor of behavioural adherence.

Conclusion: The integrated model of SDT and the TPB appeared to be applicable to the explanation of COVID-19 prevention among the U.S. parents. Longitudinal data showed that a psychological need supportive social environment was related to favourable motivation, social cognition beliefs, intention and behavioural adherence to the preventive behaviours of parents protecting their young children from COVID-19.

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The number of confirmed novel coronavirus disease 2019 (COVID-19) cases has been increasing globally. So far, the United States (U.S.) has had the highest number of confirmed cases and deaths of COVID-19 in the world (World Health Organization,

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2022). Different health organisations, such as the World Health Organisation (WHO), the Centres for Disease Control and Prevention (CDC) and the National Health Service (NHS), have provided various guidelines and recommendations on prevention of COVID-19, especially for parents who are expected to keep their children safe from COVID-19 (Centers for Disease Control & Prevention, 2020b).

However, COVID-19 cases detected in the U.S. have increased rapidly since March 2020, and over 7.3 million confirmed cases have been reported, as of 30 September 2020 (Centers for Disease Control & Prevention, 2021c). Similarly, the incidence of COVID-19 steadily increased among the children aged below 18 from 1 March 2020 to 1 September 2020 in the U.S. (Centers for Disease Control & Prevention, 2021a), and totally more than 500,000 cases of COVID-19 among the children have been recorded in September 2020 and reported from the American Academy of Pediatrics (Sisk et al., 2020). Controlling the spread of COVID-19 has become the top priority in many nations. Apart from taking vaccination, there are a number of behavioural strategies that are suggested to be effective for the prevention of COVID-19, namely maintaining proper hand hygiene, wearing appropriate personal protective equipment and increasing social distancing (Gupta & Lipner, 2020; Pradhan et al., 2020; Sun & Zhai, 2020).

Commitment to the behavioural strategies is critically important for both adults and children, so it is crucial for parents to comply with these guidelines to protect themselves and their children against COVID-19, and to minimise the risk of exposure of their children to coronavirus. Indeed, adherence to COVID-19 prevention is a self-regulatory behaviour that may be explained by one's motivation and social cognition beliefs. Health psychology theories and frameworks have provided useful insights on the understanding of how health behaviours could be governed by the individuals' self-regulatory processes (Gillison et al., 2019; Kwasnicka et al., 2016), and there are growing research interests in their potential applications into the explanation of the individuals' preventive behaviours against COVID-19 (Chan et al., 2021; Hagger et al., 2020; Lin et al., 2020; Michie et al., 2020). However, only few empirical studies have formally tested the application of health psychology theories or models on the prediction of COVID-19 related to behavioural patterns (Hagger et al., 2021; Lin et al., 2020). In this study, we aimed to empirically test the application of the integrated model of self-determination theory (SDT) (Deci & Ryan, 2002) and the theory of planned behaviour (TPB) (Ajzen, 1991) into the prediction of the parents' preventive behaviours against COVID-19 for their children.

The integrated model of SDT and the TPB

The integrated model of SDT (Deci & Ryan, 2000b) and the TPB (Ajzen, 1991) utilises psychological concepts of two different theories to seek a deeper understanding of the self-regulatory processes of human behaviours. It has been extensively applied in the health psychology literature to explain and predict the people's adherence to a wide range of preventive health behaviours, including the prevention of H1N1 influenza (Chan et al., 2015). In the integrated model, constructs of both theories explain the proximal and distal psychological processes of health-related behaviours, thus resulting in the increased effectiveness on predicting and explaining behavioural adherence (Chatzisarantis et al., 2002).

The distal psychological process of the integrated model is outlined in the tenets of SDT, in which supporting the psychological needs of autonomy, competence, and relatedness may foster the individuals' autonomous motivation (Deci & Ryan, 1985, 2000b). Establishing autonomous motivation is believed to be the key for the persistence of volitional behaviour as the reasons behind the action is perceived to be consistent with personal interests, values, and sense of self (Deci & Ryan, 1985, 2000b). Autonomous motivation is, therefore, more likely to lead to more favourable behavioural outcomes (e.g. commitment and well-being) than other forms of motivation, such as controlled motivation (i.e. complying with behaviours because of external contingencies, satisfaction of ego, or the avoidance of feeling shameful or guilty) and amotivation (i.e. the absence of clear motives or purposes behind the action) (Deci & Ryan, 2000a). In the integrated model, it is speculated that perceived psychological need support and autonomous motivation from SDT may serve as the distal antecedents of social cognition processes outlined in the TPB. The proximal psychological process of the integrated model is explained by the decision-making processes outlined in the TPB, in which the social cognition beliefs of attitude, subjective norms, and perceived behavioural control (PBC) may serve to predict future engagement of behaviour via the mediation of intention (Ajzen, 1985, 1991). Apart from use of behavioural intention to predict the behaviours directly, PBC also gains predictive power on the future behaviours (Ajzen, 1991).

Evidence about the integrated model

The integrated model was originally applied to explain the individuals' intention and behaviour of leisure-time physical activity (Arnautovska et al., 2017; Hagger & Chatzisarantis, 2009; Hagger et al., 2002; Hagger et al., 2014). However, the growing amount of research has extended the application of the model into other health contexts, such as binge drinking (Caudwell & Hagger, 2015; Hagger et al., 2012), sun safety (Hamilton et al., 2017), myopia prevention (Chan et al., 2014), injury prevention (Chan & Hagger, 2012c; Chan et al., 2020), and rehabilitation (Chan & Hagger, 2012a, 2012b; Chan et al., 2009). In addition to the positive findings of these studies applied in various health contexts, cross-cultural studies (Chan et al., 2015; Hagger & Chatzisarantis, 2009; Hagger et al., 2005) and meta-analyses (Hagger & Chatzisarantis, 2009, 2016) have also supported the psychological pathways illustrated in the integrated model.

With regard to the prevention of infectious disease, a previous study has also tested the components of the integrated model in the prevention of H1N1, which was an infectious disease that spread over 200 countries globally in 2009 and was considered to be a pandemic. In the studies of Chan et al. (2014, 2015), participants were 705 university students who were asked to put themselves into a hypothetical scenario of attending a lecture during the H1N1 pandemic. The hypothetical scenario manipulated psychological need support of the student participants by having a professor who asked the students to put on facemasks during the lecture, using either a psychological need supportive style or a controlling style of communication. The results showed that participants who were asked to put on facemasks by a psychological need supportive style of communication, in comparison to those being asked by a controlling

style, perceived more professors' psychological need support. Perceived psychological need support from the professor was directly and indirectly linked to heightened autonomous motivation, social cognition beliefs and intention of wearing facemasks for the prevention of H1N1 during the pandemic (Chan et al., 2014; Chan et al., 2015). The findings of this study were in line with the pathways of the integrated model. It was apparent that the manipulation of individuals' psychological need support by need supportive communication styles was related to higher autonomous motivation, social cognition beliefs and intention of complying with preventive behaviours against the spread of H1N1 during a pandemic (Chan et al., 2014; Chan et al., 2015).

Although there are subtle differences between the pandemic of H1N1 and COVID-19 regarding the nature of the viruses, the preventive strategies against the transmission of these respiratory diseases, such as hand hygiene and respiratory hygiene, have shared some degree of similarity (World Health Organization, 2009, 2014, 2020). A recent paper has suggested that it might be useful for using the integrated model to provide explanations and practical recommendations for promoting the individuals' preventive behaviours for the current COVID-19 pandemic (Chan et al., 2021). However, there has not been a formal test of the integrated model in the prediction of preventive behaviours against COVID-19. It is therefore important to fill the research gap in the existing literature.

Present study

This study is an empirical investigation focusing on the application of the integrated model of SDT and the TPB into the explanation of the parents' behaviours of COVID-19 prevention to safeguard their children from COVID-19. By using a two-wave longitudinal design, our study examined how motivational and social cognition constructs would be correlated with intention and behavioural adherence to COVID-19 prevention. This design may advance the level-of-evidence of existing research that primarily looked at the cross-sectional or prospective relationships within the integrated model (Chan et al., 2020; Lee et al., 2020). In addition, our findings may reveal the temporal relationships among psychological need support, motivations, social cognition beliefs, intention, and behaviour in a novel health context of COVID-19 prevention. Based on the tenets and research findings of the integrated model (Chan et al., 2014; Chan et al., 2017; Chan et al., 2020; Lee et al., 2020) and the propositions about the application of the model in COVID-19 prevention (Chan et al., 2021), we draw the following hypotheses about the pathways of the integrated model at change-score level: (H1) psychological need support would be positively and significantly associated with autonomous motivation (H1a), but not with controlled motivation (H1b) and amotivation (H1c); (H2) autonomous motivation (H2a) would be positively and significantly related to the three social cognition beliefs (i.e., attitudes, subjective norms and PBC), but not amotivation (H2c), and controlled motivation (H2b) would be positively and significantly associated with subjective norms, but not with attitudes and PBC; (H3) attitudes, subjective norms and PBC would be positively and significantly associated with intention; (H4) behavioural adherence to COVID-19 prevention would be positively and significantly associated with intention and PBC; (H5) motivations (H5a), social cognition variables (H5b), and intention (H5c) would serve as the mediators of the

pathways between psychological need support and behavioural adherence. Both hypothesised direct and indirect effects of the proposed integrated model are displayed in Figure 1 and Appendix A (online supplementary material).

Method

COVID-19 situation and recruitment of participants

Data collection was conducted between July and August of 2020, when the U.S. suffered heavily from COVID-19 with the notable number of new cases and deaths of the disease daily (see the corresponding statistics below), and yet the vaccination programmes for COVID-19 were not available to the public at that time. We used Prolific, which is a participant recruitment platform, to recruit adult parents with at least one child aged 3–8 in the U.S. from July 9, 2020 to July 16, 2020. A total of 704 parents participated in this study. Based on the information provided by the eligible participants, we further identified 681 parents (mean age = 33.15, *SD* = 5.58, 46.88% male) who satisfied the following eligibility criteria: (i) participants resided in the U.S.; (ii) participants had at least one child; (iii) the ages of the participants' oldest child ranged from 3 to 8 years old; (iv) participants and their child have not been diagnosed with COVID-19.

Participants had an average of 1.69 (*SD* = .72) children, and their children's mean age was 5.14 (*SD* = 1.54) years old. There were 75.77% of the participants having an educational level of university or above. Owing to the state government's stay-at-home orders, 39.35% of the participants have been locked down in June 2020, and

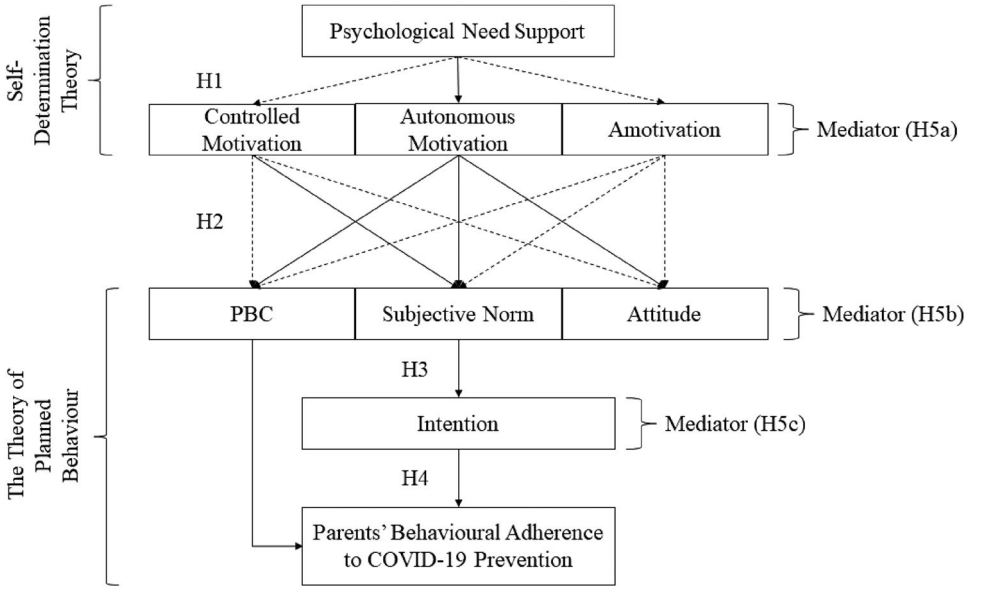

Figure 1. Summary of hypothesised direct and indirect effects in the proposed integrated model. Note: H1 to H5 represent the direct or indirect pathways of Hypotheses 1–5. The solid lines are hypothesised to be positive and significant. The dotted lines are hypothesised to be negative and non-significant.

only 14.46% of the participants needed to abide by stay-at-home orders in July 2020. Apart from the stay-at-home orders in some states, some preventative measures, such as wearing a face mask, maintaining social distancing and self-quarantine, were recommended by the CDC at the data collection period (Centers for Disease Control & Prevention, 2020a). The COVID-19 preventive behaviours are summarised in Appendix B (online supplementary material). The states (except for Alaska, Delaware and Hawaii), in which the participants reside currently have recorded a total of 838,346 and 1,903,513 COVID-19 confirmed cases in June and July of 2020, respectively, and 23,196 and 28,056 of death cases from COVID-19 in June and July of 2020 have been reported respectively (Centers for Disease Control & Prevention, 2021c).

Procedures

The research protocol was approved by the Human Research Ethics Committee of the first author's institution (Ref. no. 2019-2020-0306). This is a two-wave longitudinal study to examine the association between the variables in the integrated model and behavioural adherence over two periods of time at change-score level. After signing the consent form, the participants were asked to complete an online self-report questionnaire twice at T0 (baseline) and T1 (one month after baseline). The questionnaire comprised different questions to measure the participants' psychological need support by the social environment, SDT constructs, TPB constructs and behavioural adherence to COVID-19 prevention. Participants who took part in the survey at each time point received an inconvenience allowance of approximately 2.41 USD. Of the participants, 13.66% ($N = 93$) dropped out of the study after completing the baseline survey at T0.

Measures

Psychological need support

We adopted a short-form Health Care Climate Questionnaire (HCCQ) to measure the degree of autonomy support within the social environment in preventing participants' children from COVID-19 (Williams et al., 2006). Participants responded to six items with a 7-point Likert scale from 1 ('strongly disagree') to 7 ('strongly agree'). We revised the scale of the previous research studies in different health contexts (e.g. prevention of H1N1) (Chan et al., 2015; Lee et al., 2020) so that the items of the scale were relevant to our study. Each item followed a stem of 'For prevent my child from getting COVID-19, …', and the social agent changed to 'the social environment'. One example item was 'social environment encourages me to ask questions'. The Cronbach's alphas of the responses of HCCQ at two time points were satisfactory (α=.93-.94). All items and scales in the study are shown in Appendix C (online supplementary material).

Autonomous motivation, controlled motivation and amotivation

We adopted the 15-item Treatment Self-Regulation Questionnaire (TSRQ) (Levesque et al., 2007) to measure the parents' motivation for preventing their child from COVID-19. Six items assessed autonomous motivation, six items assessed controlled

motivation, and three items assessed amotivation. The 7-point Likert scale was also used and ranged from 1 ('not at all true') to 7 ('very true'). The stem 'I want to prevent my child from getting COVID-19, because …' was followed by each item. Example items were 'I feel that I want to take the responsibility for my child's health', 'I would feel guilty or ashamed of myself if I did not' and 'I really don't think about it'. The Cronbach's alphas of autonomous motivation (α = .94), controlled motivation (α = .81–.83) and amotivation (α = .69–.75) at T0 and T1 were acceptable.

Social cognition variables

We adopted the TPB Questionnaire (Ajzen, n.d.) to assess the parent's attitudes towards adherence to COVID-19 prevention. The questionnaire consisted of five items for assessing attitudes, three items for assessing subjective norms, five items for assessing PBC and three items for assessing intention. They ranged from 1 (e.g. 'strongly disagree') to 7 (e.g. 'strongly agree'). The stem 'For me, to prevent my child from getting COVID-19 during next month would be…' was followed by each item. The Cronbach's alphas of attitudes (α=.80–.86), subjective norms (α = .90-.91), PBC (α=.81–.83) and intention (α=.92–.95) were satisfactory at two time points.

Behavioural adherence

We adopted an adapted version of Self-Reported Treatment Adherence Scale (SRTAS) to examine the participants' behavioural adherence to COVID-19 prevention (Chan & Hagger, 2012d; Chan et al., 2009). The participants responded to two items, including how frequent (from 1 ('never') to 7 ('very often')) and how much effort (from 1 ('minimum effort') to 7 ('maximum effort')) spent on preventing their child from getting COVID-19, on a 7-point scales. Apart from these two indicators, twenty items of preventive strategies applied for parents to prevent COVID-19 could assess behavioural adherence. These strategies, including the use of face masks, the maintenance of personal and environmental hygiene and compliance with social distancing measures, were recommended by the CDC (Centers for Disease Control & Prevention, 2020a), the NHS (National Health Service, 2020), and the WHO (World Health Organization, 2020). Respondents answered either 'yes' or 'no' to the items depending on whether they applied these preventive strategies, for example, 'Children wear masks when they go out', 'Using soap to wash hands' and 'I reduce taking children to go out'. In addition, they could state what COVID-19 preventive strategies they have used in an open-ended question. Based on these responses, an additional strategy of parent's provision of education or training for increasing a child's knowledge and awareness of the prevention of COVID-19 was coded using the same dichotomous scale. Therefore, there were a total of twenty-one items of preventive strategies, and we calculated the total scores serving as one of the indicators of behavioural adherence. The Cronbach's alphas of SRTAS (α=.83–.85) and the responses of the COVID-19 preventive strategies (α=.90) were satisfactory at T0 and T1.

Perceived vulnerability and perceived severity

We adopted the previous study of H1N1 prevention (Chan et al., 2015) to assess the confounding effect that may affect the results of the study. The 7-point Likert scale

was also used to assess participants' perceived vulnerability (three items; e.g. 'My children are vulnerable to contracting COVID-19') and perceived severity (three items; e.g. 'COVID-19 infection may lead to serious health problems for my children') providing a range of 1 ('strongly agree') to 7 ('strongly disagree'). In support of the internal consistency of the item responses at two time points, Cronbach's alphas of perceived vulnerability and perceived severity ranged from .84–.88 to .85–.86, respectively.

Demographic variables

Participants responded to self-report measures of the demographic details, such as the parents' age, gender and the highest educational level, the number of children they have, and the state they currently live in. In addition, we considered the preventive measures against the spread of COVID-19 and the number of COVID-19 cases may have the confounding effect on the variables in the integrated model. The new variables of the number of COVID-19 confirmed cases and death cases were added according to the state in which the participants lived in the period from June 2020 to July 2020. Moreover, some state governments issued a stay-at-home order effective from June 2020 (Schuchat & CDC COVID-19 Response Team, 2020), so we also added an additional variable to record whether the participants experienced the stay-at-home order either in June 2020 or July 2020 according to the state they reported, and 'yes' and 'no' are represented by '1' and '0', respectively.

Statistical analysis

Descriptive statistics, zero-order correlations among the model constructs and Cronbach's alpha reliability coefficient for each scale were analysed by using the IMB SPSS Statistics 26. We perform path analysis to examine the fit of the integrated model and parameter estimates (i.e., direct and indirect effects) of the associations among the variables and related mediation effects. H1- H5 were tested by the integrated model for psychological need support → SDT constructs (autonomous motivation, controlled motivation and amotivation) → TPB constructs (attitude, subjective norms and PBC) → intention → behavioural adherence to COVID-19 prevention. These hypothesised paths would be supported by significant standardised parameter estimates. Mediation analysis was also performed to examine the indirect effects of the proposed model. The analyses were conducted by Mplus (Version 8.3) with a maximum likelihood estimation method. The missing data was handled by using the full-information maximum likelihood method (Shin et al., 2017). Missing values ranged from 13.50% to 14.51% for the items due to the participants' drop-out and item nonresponse.

In order to measure integrated constructs and behavioural adherence between T0 and T1 at change-score level, the standardised residual changes scores of all variables were generated by the regression of the post-test scores on the baseline scores (Castro-Schilo & Grimm, 2018; Jacobs et al., 2011). Confounding factors and demographic characteristics, including perceived severity, the number of kids and the parents' highest educational level, had the significant zero-order correlation with some variables of the integrated model, so they served as additional predictors for these correlated variables in the model. We used the multiple goodness-of-fit indices to

assess model fit, including the root-mean-square error of Approximation (RMSEA), the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI) and the standardised root-mean-square Residual (SRMR). The traditional cut-off values for RMSEA and SRMR (< .08) and for CFI and TLI (> .90) were used to consider whether the model is an acceptable fit (Hu & Bentler, 1999).

Results

Descriptive analysis

Descriptive statistics, zero-order correlations and Cronbach's alphas of the variables in the integrated model are demonstrated in Table 1. Perceived severity and descriptive statistics (i.e., the parents' highest level of education, the number of kids and the number of confirmed cases of COVID-19 during June and July of 2020) had significant correlations with the model variables, so they were acted as the additional predictors in the model to reduce their potential confounding effects.

Hypothesis tests

The proposed model for psychological need support → SDT constructs →TPB constructs → behavioural adherence provided an acceptable fit to the data, ($\chi 2 = 35.12$ ($df = 15$), CFI = .96, TLI = .86, RMSEA = .05 [90% CI = .03 to .07], and SRMR = .03). Standardised parameter estimates (β) for the direct effects are shown in Figure 2.

In support of H1a, psychological need support had the positive and significant association on autonomous motivation (β=.09, p=.04). In terms of H1b and H1c, psychological need support established positive and significant associations with controlled motivation (β=.11, p=.02) and amotivation (β=.10, p=.02). Therefore, the findings did not support H1b and H1c. In support of H2a, autonomous motivation had the positive and significant association on attitude (β = .32, p < .001), subjective norms (β=.26, p<.001) and PBC (β=.19, p<.001). In support of H2b, controlled motivation had the positive and significant association on subjective norms (β=.16, p<.001) and its links towards attitude (β=.01, p=.70) and PBC (β=.04, p=.43) was found to be insignificant. In support of H2c, amotivation had the negative and significant association on attitude (β=−.07, p=.02) and subjective norms (β=−.11, p=.006), but it was insignificantly linked with PBC (β=.06, p=.13). In support of H3, attitude (β = .72, p=.008), subjective norms (β=.27, p = .01) and PBC (β=.27, p<.001) had the positive and significant association on intention. In partial support of H4, intention (β=.28, p=.001) had the positive and significant association on behavioural adherence to COVID-19 prevention but PBC (β=.05, p=.30) was insignificantly associated with behavioural adherence.

In terms of H5, mediation analyses revealed mixed findings. Three forms of motivations mediated the positive effect of psychological need support on PBC (indirect effect = .03, p=.02), which partially supported H5a. In support of H5b, the three social cognition variables mediated the effect of autonomous motivation on intention (indirect effect = .35, p<.001), but not the effects of controlled motivation (p=.09) and amotivation (p=.05) on intention. In the partial support of H5c, intention mediated the positive effects of subjective norms (indirect effect = .07, p < .001) and PBC

Table 1. Descriptive statistics, zero-order correlations and reliability indices of the standardised residual changes scores between variables ($N = 681$).

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Psychological Need Support	–																	
2. Autonomous Motivation	.09*	–																
3. Controlled Motivation	.12**	.26**	–															
4. Amotivation	.11**	−.08*	.31**	–														
5. Attitude	.04	.34**	.13**	−.09*	–													
6. Subjective Norms	.07	.32**	.19**	−.09*	.29**	–												
7.PBC	.15**	.23**	.11*	.06	.15**	.25**	–											
8. Intention	.09*	.40**	.10*	−.09*	.28**	.54**	.40**	–										
9. Behavioural Adherence	.11*	.29**	.17**	.00	.22**	.21**	.19**	.35**	–									
Control variables																		
10. Perceived Vulnerability		.02	.02	.00	−.02	.04	−.02	−.01	−.05	.07	–							
11. Perceived Severity		.01	−.13**	.01	.07	−.10*	−.10*	−.09*	−.12**	.02	.41**	–						
Demographic variables																		
12. Parents' gender	−.04	.02	−.02	−.06	−.02	.04	.03	.02	.01	−.01	−.02	–						
13. Parents' age	.00	.01	−.01	−.05	.03	.07	.05	−.04	.02	.04	−.03	−.17**	–					
14. Parents' highest education level	.01	−.08	.07	.11**	−.06	−.02	.02	−.06	−.02	−.03	.00	−.17**	.22**	–				
15. Number of kid	−.06	−.08	−.03	−.04	.06	−.10*	−.11*	−.12**	−.02	.06	.06	−.01	−.03	.00	–			
16. Number of confirmed cases in June and July	−.07	.00	−.12**	−.07	−.02	.01	.01	−.02	−.02	.02	.07	−.04	.05	−.09*	.07	–		
17. Number of death cases in June and July	−.07	−.04	−.03	−.02	.00	−.05	−.03	−.05	−.06	.01	.03	.00	.00	−.12**	−.01	.30**	–	
18. Stay-at-home order in June and July	−.04	−.01	−.06	−.03	.06	.03	−.04	−.04	.02	.00	.04	.00	.04	.08	.02	.04	−.42**	–
Mean	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.53	33.16	2.99	1.69	1370929.50	25626	.41
SD	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.50	5.53	.97	.72	532583.50	2430	.49
Cronbach's Alpha	.93–.94	.94	.81–.83	.69–.75	.80–.86	.90–.91	.81–.83	.92–.95	.83––.90	.84–.88	.85–.86	–	–	–	–	–	–	–

Note: PBC, perceived behavioural control.
*$p < .05$.
**$p < .01$.

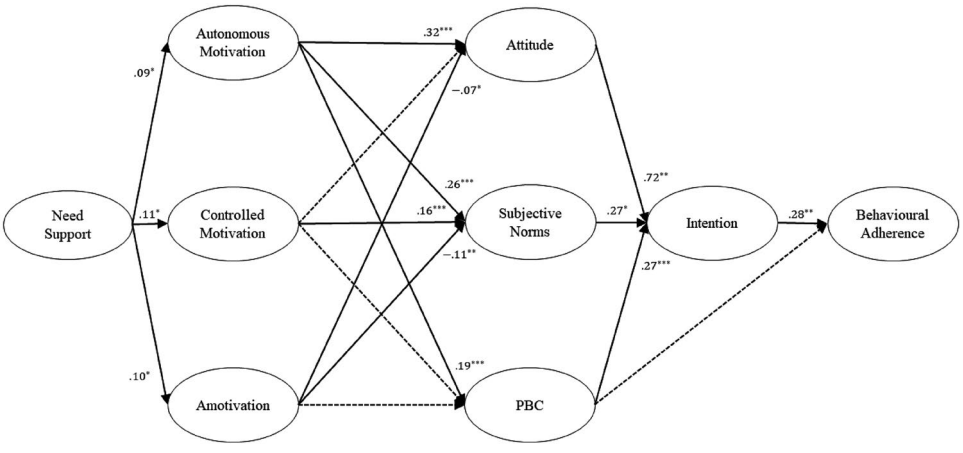

Figure 2. Path Estimates in the integrated model of SDT and the TPB. Note: The statistically significant paths ($p < .05$) were represented by solid lines whereas the dotted lines indicate the non-significant paths ($p > .05$). For reasons of clarity, only significant standardised parameter estimates are displayed in the figure. *$p < .05$ (two-tailed), **$p < .01$ (two-tailed) and *** $p < .001$ (two-tailed).

(indirect effect=.07, $p<.001$) on behavioural adherence, but the indirect effect of attitude on adherence was not significant ($p = .07$). The detailed results of mediation analysis are summarised in Table 2.

Discussion

The current study aimed to test the proposed integrated model of two theories, SDT and the TPB, in a pandemic situation related to the parents' preventive behaviours against COVID-19 for their children, and examine the association between constructs from SDT and the TPB, as well as the parents' behavioural adherence to COVID-19 prevention. We proposed the sequence of the integrated model to explain the parents' behavioural adherence to COVID-19 prevention was psychological need support → SDT constructs (autonomous motivation, controlled motivation and amotivation) → TPB constructs (attitude, subjective norms and PBC) → intention → behavioural adherence to COVID-19 prevention. Consistent with our hypotheses, we found statistically significant and positive effects of (1) psychological need support on autonomous motivation, (2) autonomous motivation on attitude, subjective norms and PBC, (3) controlled motivation on subjective norms (4) attitude, subjective norms and PBC on intention and (5) intention on behavioural adherence to COVID-19 prevention. However, the findings in this study demonstrated that there were positive and significant effects of psychological need support on controlled motivation and amotivation. In regard to the mediation analysis, it revealed that motivations, the social cognition variables and intentions could serve as the mediators in the effect of psychological need support on behavioural adherence. Overall, our findings offered additional supporting evidence in applying the integrated model on the prediction of COVID-19 preventive behaviours.

First of all, the findings of the current study on the sequence of psychological need support to autonomous motivation is consistent with the hypothesis (H1a). That is, psychological need support was positively and significantly associated with

Table 2. Results from the mediation analyses for the integrated model of COVID-19 prevention.

Path	Mediator (s)	Indirect effects [95% CI]
Need Support → Attitude	Autonomous motivation, controlled motivation and Amotivaton	.02 [−.01 to .05]
Need Support → Subjective Norms	Autonomous motivation, controlled motivation and Amotivaton	.03 [.00−.05]
Need Support → PBC	Autonomous motivation, controlled motivation and Amotivaton	.03* [.01−.05]
Autonomous Motivation →Intention	Attitude, subjective norms and PBC	.35*** [.24−.46]
Controlled Motivation →Intention	Attitude, subjective norms and PBC	.06 [.00−.12]
Amotivation →Intention	Attitude, subjective norms and PBC	−.07 [−.12 to −.01]
Attitude→ Behavioural Adherence	Intention	.20 [.02−.38]
Subjective Norms→ Behavioural Adherence	Intention	.07** [.03−.12]
PBC→ Behavioural Adherence	Intention	.07** [.04−.11]

Note: Need support, psychological need support; PBC, perceived behavioural control.
*p<.05 (two-tailed).
**p<.01 (two-tailed).
***p<.001 (two-tailed).

autonomous motivation. Compatible with the previous H1N1 influenza prevention study, university students perceiving need support from autonomous supportive messages engendered a high level of autonomous motivation towards behaviour of facemask wearing (Chan et al., 2015). Parents with higher psychological need satisfaction supported by the social environment, such as acknowledging the parents' feelings and providing them with options and choices, are therefore more likely to endorse autonomous motivation for adherence to COVID-19 prevention (Ryan & Deci, 2014).

Contrary to our hypotheses (H1b and H1c), findings of the current study demonstrated that psychosocial need support positively and significantly predicted the parents' controlled motivation. These unusual effects are possibly attributed to parent's high level of moral obligation to comply with COVID-19 prevention and protect their children's health from COVID-19 triggering introjected regulation (controlled motivation) even if the social environment could provide the parents with sufficient psychological need support (Deci & Ryan, 2000b; Ng et al., 2012). Furthermore, different measures and regulations varying by state (e.g. lockdown rules, stay-at-home restrictions and compulsory face-mask rules) to stem the spread of COVID-19 in the community have been implemented. These are the external factors to urge people to strictly follow the prevention, thereby fostering the development of controlled motivation (Centers for Disease Control & Prevention, 2021b; Hagger & Chatzisarantis, 2009). Some relevant studies (Chan et al., 2015; Chan & Hagger, 2012b) have even argued that controlled motivation could act as one of the predictors for short-term behavioural adherence in health-related aspects. However, using controlled motivation in the prediction of long-term adherence to health-related behaviours is likely to be less effective since the behaviour may be undermined or vanished when the external reinforcement is weakened or absent (Chan et al., 2009; Chan et al., 2015; Deci & Ryan, 2000b). Regarding the positive relationship between psychological need support and amotivation, the reason behind this is that parents engaging in preventive actions were stimulated by unconscious motives that they did not fully understand the reasons for their preventive

action. As such, people endorsing amotivation are linked to a lack of motivation and intention to perform the behaviour (Deci & Ryan, 2000b). Moreover, both controlled motivation and amotivation were not predictive in the three social cognition variables in the integrated model. Therefore, it is in line with SDT in terms of the importance of autonomous motivation in facilitating behavioural adherence.

Parents' autonomous motivation was significantly and positively related to the three belief-based factors (i.e., attitude, subjective norms and PBC) from the TPB which is consistent with our hypothesis (H2a). Parents endorsing higher autonomous motivation are likely to have more favourable feelings of carrying out COVID-19 prevention, gain support from important others and perceive the ease of performing COVID-19 prevention (Ajzen, 1985, 1991; Chan & Hagger, 2012b). In line with the previous research (Chung et al., 2018; Hagger & Chatzisarantis, 2009; Hamilton et al., 2017), endorsing largely autonomous motivation was associated with more positive cognition beliefs factors, such as positive attitude and perception of control over certain behaviours. In addition, our result also found that autonomous motivation was positively related to the parents' intentions to COVID-19 prevention via the mediation of these belief-based factors. This implied that attitude, subjective norms and PBC are strongly associated with the intention and act as the most proximal predictor of intention towards behavioural adherence, rather than autonomous motivation alone (Ajzen, 1985, 1991).

Parents' controlled motivation to attitude and PBC were not statistically significant but had the positive and significant association with subjective norms. In addition, there was also no indirect effect of controlled motivation on intention towards adherence to COVID-19 preventive behaviours. It showed that controlled motivation might ineffectively predict the behavioural adherence to COVID-19 prevention (Deci & Ryan, 2000b; Hagger et al., 2014). These findings fully supported our hypothesis (H2b). Parents with controlled motivation are likely to perceive social pressure from others to perform the prevention (subjective norms), instead of having affective evaluations of performing prevention (attitude) and perceiving the ease of performing prevention (PBC). They engaged in the behaviours for the external forces and a sense of obligation, so they lacked intention towards adherence to the COVID-19 prevention for their children (Chan et al., 2015; Chan et al., 2015). Regarding the path from amotivation to three cognition constructs, the findings revealed amotivation formed the negative and significant associations with attitude and subjective norms but was insignificant with PBC which concurs well with our hypothesis (H2c). Parents with high amotivation showing a lack of motivation to engage in the behaviours could result in unfavourable attitude towards prevention and a lower level of PBC (Chan et al., 2015; Ryan & Deci, 2017). Amotivation is characterised by performing behaviours without intention, so it is not beneficial for intention to behavioural adherence (Chan et al., 2014; Chatzisarantis et al., 1997).

The three belief-based social cognition factors were found to be positively associated with intentions, and intentions predicted behavioural adherence to COVID-19 prevention positively and significantly, which matches our hypotheses (H3 and H4). The TPB postulates that intention to engage in particular behaviours could be highly determined by the combination of social cognition factors, including individuals with positive attitudes towards engaging the behaviour, highly perceived social support for the behaviours

from significant others and the belief that he/she has the capacity to perform the behaviour successfully (Ajzen, 1991; Kan & Fabrigar, 2017). Moreover, the findings demonstrated the effects of subjective norms and PBC on behavioural adherence to COVID-19 prevention were positively mediated by intentions, which are consistent with the tenet of the TPB that intention is assumed to form the most proximal determinant of behavioural performance (Ajzen, 1985, 1991). Consequently, parents with high-level of social cognition factors were associated with high intention to engage in preventive action, thus resulting in high behavioural adherence to COVID-19 preventive measures.

Ajzen (1991) showed that PBC can be used to predict behavioural adherence directly when the behaviour is not under full volitional control. More necessary resources and opportunities available could prompt people to have a greater degree of PBC over the behaviours, and to carry out the particular behaviours (Madden et al., 1992). However, our findings did not support PBC serving as a predictor of behavioural adherence. The reason behind is that parents might be under complete volitional control to protect their children against COVID-19, so the relationship between intention and behaviour becomes stronger or could even be optimal (Ajzen, 1991; Armitage & Conner, 2001). Moreover, in our findings, intention acted as a mediator in the relationship between PBC and behavioural adherence to COVID-19 prevention. It implied that parents who complied with COVID-19 prevention for their children not only have a high level of belief that they could control over the behaviour, but they also have high intention to engage in this behaviour (Armitage & Conner, 2001). Therefore, the parents' PBC is not likely to serve as a significant and direct predictor of behavioural adherence to COVID-19 prevention.

Strengths and limitations

There are some strengths in our current study. Firstly, we used the well-established theoretical framework of the integrated model of SDT and the TPB to investigate how the parents' motivational and social cognition constructs are associated with their intention and adherence to the COVID-19 preventive measures at the change-score level. This integrated model has been well tested and widely applied in health contexts, and statistically showed there were significant associations among perceived autonomy support, motivation constructs, social cognition constructs and the behavioural adherence to particular health-related behaviours (Hagger & Chatzisarantis, 2009). Moreover, COVID-19 has been spreading across the world, and some governments have, indeed, carried out different coercive measures leading individuals to endorse controlled motivation and lack adherence to the preventive measures in the long term (Hagger & Chatzisarantis, 2009). Therefore, our findings could raise the awareness of different health policy makers to consider the autonomy-supportive measures, which probably strengthen individuals' autonomous motivation, social cognition beliefs and behavioural adherence, in order to prevent the spread of communicable disease in the community (Chan et al., 2015; Chan et al., 2021). Moreover, we measured all motivational and social cognition constructs using accurate and validated measures. These measurements are fully used in the previous studies regarding testing the integrated model of SDT or the TPB for ensuring more reliable measurement provided and valid results (Chan et al., 2014; Chan et al., 2020).

Despite the strengths of our study, we have to note a number of limitations. First, the longitudinal design only enabled formal tests to examine how psychological need supports, motivational constructs, and social cognition constructs were correlated to behavioural adherence to COVID-19 prevention at the change-score level. However, it has been argued that having only two waves of assessments could not effectively evaluate the true changes (when taking measurement error into account) and the variation of changes over time (Ployhart & Vandenberg, 2010; Singer & Willett, 2003). It is therefore important that the future studies implement multiple waves of assessment over a long period of time, yet it was challenging to achieve during the pandemic period. Similarly, with our given study design, the absolute causal relationships between psychological and behavioural variables could not be shown in our study, so it is important that future interventions adopt factorial designs (e.g. randomised control trial) to test if manipulating the psychological variables of the integrated model may lead to changes in behavioural adherence. Second, the primary measures of our study were self-report surveys, so the responses of participants could be subjected to social desirability, response bias, and general response tendency (Chan et al., 2015; Chan et al., 2020). Although objective measures of COVID-19 preventive behaviours (e.g., other report measures) could lead to major challenges in execution and methodological issues (e.g., privacy, mere measurement effects, and labour cost), future studies may implement implicit association tests for evaluating the belief-based or motivational variables in the integrated model (Keatley et al., 2015).

Third, our study only examined the content to which the social environment provided parents with psychological need support. It is worthy to note that the nature of the perceived social environment could be different between individuals, but our study only focused on the overall level of psychological need support without specifying the key social agents, organisations, social support, and the sources of health-related information in the social environment. Therefore, our findings were unable to reveal which sources of psychological need support (e.g., family, schools, governments, media) was the most important to the parents' COVID-19 preventive behaviours (Chan et al., 2019). On a related note, psychological need support from the social environment may facilitate individuals' satisfaction of the three basic psychological needs (Deci & Ryan, 2000b), which would be elementary for the motivational and behavioural patterns of health behaviour (Ng et al., 2012). Therefore, the future studies should measure basic psychological need satisfaction of COVID-19 prevention, and reveal its potential mediation role on the integrated model (Ng et al., 2012). Forth, we used the TSRQ to measure the three general forms of motivation. Although this measure is widely applied to assess the individuals' motivation in diverse health contexts (Levesque et al., 2007), it only provides an evaluation of the three general forms of motivations without specifying the subtypes of autonomous (i.e., intrinsic motivation, integration, identification) and controlled motivations (i.e., introjection, and external motivation). In the future studies, new improved measures of motivation should be implemented to address this limitation and unveil the predictive values of these subtypes of motivation (Ryan & Deci, 2000).

Finally, adherence to COVID-19 prevention is a complex behaviour, and it could be affected by many personal and external factors. Although we measured and considered a wide range of potential confounding variables in our study (e.g., the parents' age, geographical region, the number of COVID-19 cases/deaths in the region,

experience of stay-at-home order, perceived severity and vulnerability of COVID-19), some other personal (e.g., family history of health condition/COVID-19 infection, working environment of parents) or external factors (e.g., accessibility of medical resources, COVID-19 cases in the nursery home of the young children) could affect COVID-19 preventive behaviours, and they should be considered in future studies for examining the behavioural adherence to COVID-19 prevention.

Conclusion

COVID-19 continues to spread around the world so following preventive measures against COVID-19 is the effective method to reduce the spread and protect people's health. This study applied the integrated model of SDT and the TPB to explain how parents in the U.S. adhered to COVID-19 prevention to protect their children from COVID-19, and we tested the sequence and relationships among motivational constructs, social cognition constructs and behavioural adherence to COVID-19 prevention at the change-score level. The current results were partially in line with our proposed integrated model, and confirmed the proposed sequence of psychological need support → autonomous motivation → three social cognition beliefs → intention → behavioural adherence to COVID-19 prevention. Although psychological need support was correlated with controlled motivation and amotivation (as shown in our findings), it seems they are less likely to link to the TPB constructs and behavioural adherence to COVID-19 prevention. We hope this study may help health policy-makers and planners when implementing preventive actions. Creating autonomy-supportive environments to facilitate the development of autonomous motivation for a high intention to engage in prevention and behavioural adherence is of utmost importance.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

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