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Preventing the spread of H1N1 influenza infection during a pandemic: autonomy-supportive advice versus controlling instruction

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Abstract Wearing facemask is an effective strategy for preventing the spread of the H1N1 in enclosed public spaces. This quasi-experiment examined the effects of University professor 'autonomy support on students' motivation, social cognitive factors, and intention to wear facemasks in the lecture hall during a hypothetical H1N1 pandemic. University students (N = 705) completed self-report measures of motivation, social cognitive factors, and intention according to a hypothetical H1N1 pandemic scenario in which their professors asked them to wear facemasks in the lecture hall, using either an 'autonomy-supportive' interpersonal style or a 'controlling' style. The results showed that the manipulation of professors' autonomy support exerted a positive effect on students' perception of autonomy support, which positively predicted their self-determined motivation, social cognitive factors, and intentions to wear facemasks. In conclusion, promoting self-determined motivation using autonomy-supportive communication styles might be an effective means of fostering individuals' adaptive beliefs and motivation of H1N1 prevention.

Keywords Pandemic · Self-determination theory · Theory of planned behavior · Infectious disease control · Hygiene

Introduction

Influenza type A/H1N1 is one of the most widespread infectious diseases in recent history. According to a recent report from the World Health Organization (2010), an H1N1 pandemic was reported in 209 countries across the globe and caused at least 147,000 deaths in 2009. Wearing facemasks in public areas, especially in enclosed spaces (e.g., lecture halls), is one of the most effective preventive strategies for reducing the risk of transmission of H1N1 within the community (World Health Organization, 2009), but the majority of people do not follow this health guideline even when expressing influenza-like symptoms (Lau et al., 2010). There is increasing evidence that psychological factors (e.g., anxiety, attitude, self-efficacy, susceptibility, perceived severity) are associated with behavioral compliance with preventive strategies for influenza (Bish & Michie, 2010; Cowling et al., 2010; Lau et al., 2010; Tang & Wong, 2003, 2004). In the present study, self-determination theory (Deci & Ryan, 1985) and the theory of planned behavior (Ajzen, 1985) were applied to explain and manipulate the psychological variables related to students' intention to wear facemasks in lecture halls.

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Self-determination theory is a humanistic theory positing that initiation and persistence in human action are governed by different qualities or styles of motivation (Deci & Ryan, 1985, 2000). According to the theory, motivation differs to the extent that it is experienced as autonomous or self-determined (Deci & Ryan, 1985; Ryan & Connell, 1989). The most self-determined form of motivation, autonomous motivation, is experienced when individuals perform an action for intrinsic reasons (e.g., fun, pleasure, excitement) or for personally-valued goals that are consistent with their sense of self. Autonomous motivation is contrasted with a less self-determined form of motivation, controlled motivation, which is experienced when individuals perform a behavior for reasons external to the individual (e.g., external demands or contingencies), ego-protection, or avoiding the feeling of guilt and shame. The least self-determined form of motivation, amotivation, is experienced when individuals are uncertain about why they are doing a behavior, and it is often linked to lack of self-efficacy and intention to perform a behavior (Deci & Ryan, 2000). A burgeoning literature on the application of self-determination theory to explain health behavior (e.g., physical activity, smoking cessation, rehabilitation, and safety) has provided strong evidence that experiencing a behavior as autonomously motivated is more adaptive than experiencing it as controlled motivated or amotivated (e.g., Chan et al., 2014; Chan & Hagger, 2012a; Halvari & Halvari, 2006; Ng et al., 2012; Williams et al., 2006).

Due to the favorable motivational outcomes associated with autonomous motivation, a social environment in which social agents place strong emphasis on autonomy-support (e.g., providing choice and positive, informational feedback, acknowledging feelings, values, and conflicts, providing rationale for the behavior and allowing exploratory, questioning approaches) has been shown to be effective in fostering autonomous motivation (Chan et al., 2009; Halvari et al., 2012; Reeve & Jang, 2006; Williams et al., 2006). In contrast, a controlling social environment in which social agents use pressure, punishment, external contingencies, and commands to influence others' behavior fosters controlled forms of motivation (Bartholomew et al., 2010; Deci & Ryan, 1985, 2000). According to self-determination theory (Deci & Ryan, 1985, 2000), messages (e.g., health advice) delivered in an autonomy-supportive manner, in comparison to messages presented in a controlling style, are more likely to promote intention and behavioral engagement mediated by autonomous motivation.

Building on self-determination theory, recent research has attempted to integrate the concepts of the theory of planned behavior (Ajzen, 1985, 1991) and self-determination theory into a single model to provide a comprehensive explanation of the effects of perceived autonomy support and motivation on intention and behavior in health contexts (Chan et al., 2014; Chan et al., 2014; Chan & Hagger, 2012a, 2012b; Hagger & Chatzisarantis, 2009). The integrated model proposes that the three social-cognitive variables from the theory of planned behavior, including attitude, subjective norm, and perceived behavioral control are positive predictors of behavioral intention (i.e., the most proximal predictor of human behavior according to the theory of planned behavior) that mediate the relationships between motivation from self-determination theory and intention. This integrated model has been applied to health behaviors, such as physical activity and dieting (Chatzisarantis et al., 2007; Hagger et al., 2006), myopia prevention (Chan et al., 2014), and injury prevention and rehabilitation (Chan & Hagger, 2012a, 2012b, 2012c; Chan et al., 2011; Chan et al., 2009). Findings from meta-analyses also support the motivational sequence proposed in the model (Hagger & Chatzisarantis, 2009). However, no study has, to date, examined the model in the context of infectious disease prevention control. More importantly, no research has been employed to experimentally test the effects of autonomy support on the mechanisms of this integrated model.

In this study, a quasi-experimental design was adopted. Students' autonomous motivation was promoted using a hypothetical scenario in which their professor displayed autonomy-supportive behaviors when instructing students to wear facemasks in the lecture hall for the prevention of H1N1. The treatment effect of autonomy-supportive behaviors (i.e., the manipulation of autonomy-support and controlling style of the professor in the hypothetical scenario) on variables from the integrated theoretical model adopting self-determination theory and the theory of planned behavior was tested. It was hypothesized that the treatment effect of autonomy support would exert direct effects on each psychological variable in the nomological network of relations among the model variables (i.e., perceived autonomy support → autonomous motivation, controlled motivation, amotivation → attitude, subjective norm, perceived behavioral control → intention).

Specifically, it was expected that when health advice is delivered in an autonomy-supportive manner, students are more likely to have higher perceived autonomy support, autonomous motivation, the social cognitive variables (i.e., attitude, subjective norm, perceived behavioral control), and intention, and lower controlled motivation and amotivation for the health behavior. The hypothesized model is depicted in Fig. 1.

Methods

Participants

Participants were 705 undergraduate students from China [mean age = 20.30, SD = 1.31; 269 male (38.16 %)]

recruited across 17 different Schools (e.g., Education, Biology, Physics, History, Law, English) from the University of [name omitted for masked review] (response rate = 96.31 %). The majority of the participants had prior experience with, or knowledge of, the H1N1, influenza, and wearing facemasks. For example, 72.62 % had suffered from influenza before, 92.90 % had heard of H1N1, 70.78 % knew that wearing a facemask could prevent the transmission of influenza, and 69.93 % had worn facemasks for infection prevention before. Participants on average had experienced influenza .88 times (SD = 1.07) in the past 6 months.

Procedure

Ethical approval from the Hebei University was obtained. Participants signed the consent form to confirm they understood the voluntary nature of their participation and their right to withdraw without prejudice. Participants were randomly assigned into either the autonomy-supportive group (group 1; n = 362) or the control group (group 2; n = 343) before being asked to respond to the study items according to a hypothetical scenario about an H1N1 pandemic. The hypothetical scenario depicted a scene in which participants were asked by their professors to wear facemasks in their lecture hall to prevent the spread of H1N1 influenza infection. In group 1, the professor delivered the health advice in an autonomy-supportive manner. Based on self-determination theory (Ryan & Connell, 1989), this autonomy-supportive style included explaining the rationale for the behavior, highlighting personal values and self-initiation of behavior, showing care and understanding about potential difficulties or inconvenience associated with the health action. In group 2, the professor adopted a controlling style (Bartholomew et al., 2010) in which wearing facemasks was described as obligatory and something they "must-do", and that punishment would be given for non-compliance (Appendix A displays the full scenario). Participants in both groups were asked to complete a questionnaire, including measures of perceived autonomy support of the professor, motivation, social-cognitive variables, and intention to wear facemasks in the lecture hall (see the following section for details of the measures). At the end of the questionnaire, participants were given the hypothetical scenario of the opposite group (i.e., control scenario for group 1 and autonomy-supportive scenario for group 2) and asked to rate the perceived autonomy support from the professor again, which served as a within-participants manipulation check. To standardize and enhance the integrity of the experimental manipulation, a trained experimenter delivered and collected the consent forms, questionnaires, and hypothetical scenarios to and from participants in both groups in the lecture halls at the end of the lecture. The professors were not present during the study, and participants were reassured that their responses would be anonymous, and would not be disclosed to their professors or anyone apart from the research team.

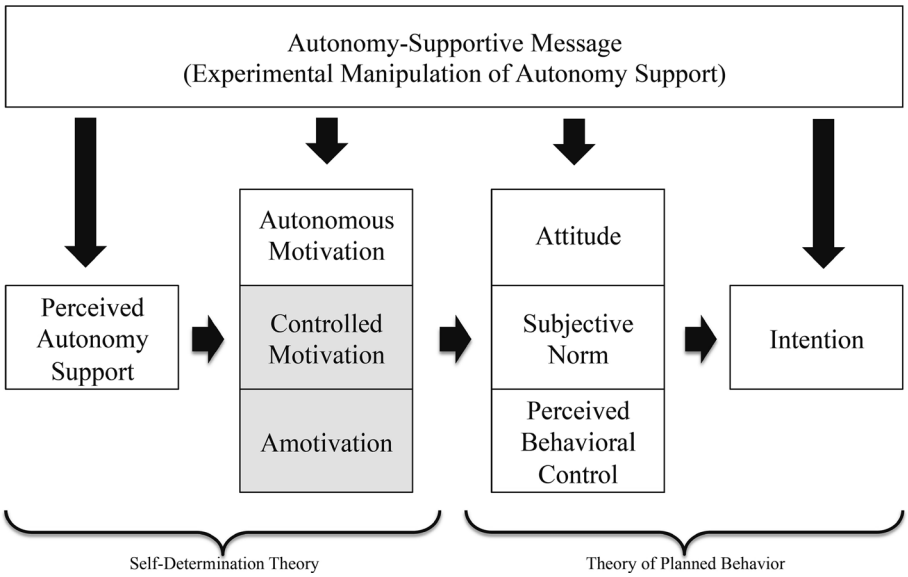

Fig. 1 The hypothesized model illustrating the theoretical integration between self-determination theory and TPB, and the treatment effect. The treatment group factor has 2 levels (0 = controlling group; 1 = autonomy-supportive group). All factors were proposed to be positive predictors or factors predicted positively by other factors apart from controlled motivation and amotivation (*shaded grey*). These two factors were proposed to form negative or statistically non-significant associations with other factors in the model

Measures

The six-item Health Care Climate Questionnaire (HCCQ) (Williams et al., 1996) was used to measure perceived autonomy support. The HCCQ has been previously translated into Chinese and validated (Chan et al., 2014; Chan & Hagger, 2012a). Participants were presented with an initial common stem ("When my professor asks me to wear a facemask in the lecture hall…") followed by a number of behaviors displayed by the professor (e.g., "I feel that he/she has provided me with choices and options"). Participants' responses were recorded on 7-point scales anchored by 1 ("not at all true") and 7 ("very true").

The Treatment Self-Regulation questionnaire (TSRQ) (Levesque et al., 2007) is a 15-item scale designed to assess the motivational styles from self-determination theory. It has been adapted for measuring motivational styles in various health contexts, such as dieting, physical activity, smoking cessation, injury prevention and rehabilitation (Chan & Hagger, 2012b; Chan et al., 2009; Levesque et al., 2007). In this study, the stem of the TSRQ items were modified to refer the specific behavior of interest ("I want to wear a facemask in the lecture hall because …") with items measuring autonomous motivation (5 items) and controlled motivation (6 items) adopted directly from the original TSRQ. The three amotivation items were adapted to the behavioral context (e.g., "I really don't think about why I want to wear facemask in the lecture hall."). Participants responded using a 7-point Likert-scale with anchors of 1 as "not at all true" to 7 as "very true". The items were translated into Chinese using a back-translation procedure (Hambleton, 2005).

Items measuring attitude, subjective norm, perceived behavioral control, and intention to wear a facemask in the prevention of H1N1 were constructed based on Ajzen's guidelines (Ajzen, 2002). Items measuring subjective norm (3 items; e.g., "It is expected of me that I wear a facemask in the lecture hall in the forthcoming month"), perceived behavioral control (5 items; e.g., "It is possible for me to wear a facemask in the lecture hall in the forthcoming month"), and intention (3 items; e.g., "I intend to wear a facemask in the lecture hall in the forthcoming month") were rated on a 7-point Likert-scale with 1 ("strongly disagree") and 7 ("strongly agree") anchors. Attitude was measured on six items preceded by a common stem ("For me wearing a facemask in the lecture hall in the forthcoming month would be …") on 7-point semantic differential scales (extremely harmful-extremely beneficial, extremely unpleasant-extremely pleasant, extremely worthless-extremely valuable, extremely bad-extremely good, and extremely unenjoyable-extremely enjoyable).

Measures of a number of relevant control variables likely to affect results were also included. These included perceived vulnerability (3 items) and severity of influenza (3 items; Nexoe et al., 1999), medical history of influenza ("have you ever had influenza?"), knowledge of utility of facemasks as a preventive measure for the spread of H1N1 virus ("before this survey, did you know that wearing a facemask may reduce the risk of falling ill with influenza-type A (H1N1) virus?"), prior use of a facemask ("have you ever used a facemask?"). Responses were either a "no" (0) or "yes" (1) answer. Participants also reported the frequency of influenza they had in the past 6 months ("In the past 6 months, how many times did you suffer from influenza?").

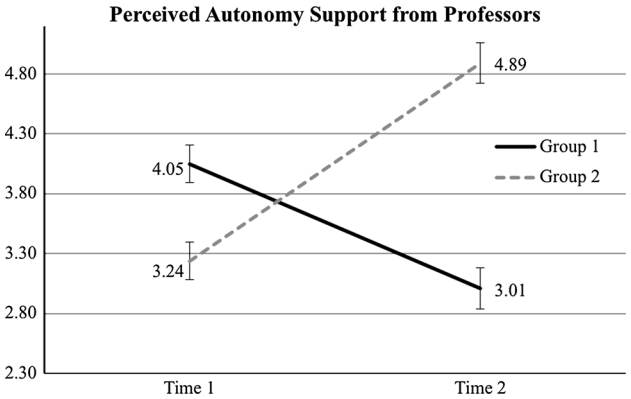

Fig. 2 In the hypothetical scenario of H1N1 pandemic, Group 1 (n = 362) responded to an autonomy-supportive professor in Time 1, and to a controlling professor in Time 2. Group 2 (n = 343) evaluated a controlling professor in Time 1, and an autonomy-supportive professor in Time 2. The *mean values* and *error bars* (representing the 95 % confidence intervals) are displayed for each data point. Post-hoc independent-sample *t*-tests revealed that the perceived autonomy support of Group 1 was statistically significantly different from that of Group 2 in Time 1 [Group 1 > Group 2; $t(703) = 7.23$, $p < .001$] and Time 2 [Group 2 > Group 1; $t(703) = 15.19$, $p < .001$]

Analysis

Perceived autonomy support for professors was used as a manipulation check. A 2 × 2 repeated measures ANOVA was conducted to examine whether the perceived autonomy support of the professors was rated higher in the autonomy-supportive scenario than in the controlling scenario. The between-participants factor was the experimental group while the within-participants factor was the time of measurement.

To examine the effects of the experimental manipulation on self-determination theory and the theory of planned behavior outcome variables, variance-based structural equation modeling was employed using the WarpPLS 3.0 computer software (Kock, 2011). This analysis is a distribution-free multivariate modeling technique that is unaffected by non-normality, small sample-size, or complex

model structures. Moreover, it is able to force the measurement error to nil by constructing latent factors. The averaged parameter estimates and latent-factor correlation were estimated using a bootstrapping of 999 replications to reveal the stability of the model across replicated samples. The factor loadings, cross-loadings, average variance extracted (AVE), composite score reliability, and Cronbach's alpha were used to reveal the convergent validity of the hypothesized factors. The global fit of the model (Tenenhaus et al., 2005; Wetzels et al., 2009) was examined by goodness-of-fit index, averaged R-squared, averaged variance inflation factor, and averaged path coefficient. The group variable (autonomy-support professor group = 1; controlling professor group = 0) represented an experimental manipulation of autonomy support as opposed to controlling behavior, and we named this variable as autonomy-supportive message.

The tested model included the essential pathways of the proposed integrated model based on self-determination theory and the theory of planned behavior and the experimental group and the control variables were inserted as a predictor all the factors of the model. Mediation analysis (Zhao et al., 2010) was employed to test mediation effects, indicated by statistically significant direct, indirect effects, and total effects of the independent variables on the dependent variables presented in the proposed model. When statistically significant mediation was found, the type of mediation was determined in a combined effects model testing whether the direct effects of the independent variables on the dependent variables were be reduced but remained statistically significant (partial mediation), or were statistically non-significant when the effects of mediators were controlled (full mediation) (Frazier et al., 2004).

Results

Preliminary analysis

No apparent pattern of missing data was found (missing values constituted <1.00 % of the data), and the missing values were replaced by mean-replacement. The study variables were normally distributed (Shapiro–Wilk test; $p > .05$) with no presence of multivariate outliers ($p < .01$). A two-way ANOVA showed statistically significant main effects of group [$F(1, 684) = 31.86$, $p < .001$, $\eta^2 = .05$] and time [$F(1, 684) = 18.23$, $p < .001$, $\eta^2 = .03$] on perceived autonomy support, and a statistically significant group x time interaction effect [$F(1, 684) = 353.18$, $p < .001$, $\eta^2 = .34$] (see Fig. 2.). Thus, participants' ratings of perceived autonomy support were statistically significantly higher in the autonomy-supportive professor scenario than in the controlling professor scenario, supporting the experimental manipulation of the study. The factor loadings, cross-loadings, average variance extracted, composite score reliability, and Cronbach's alpha met published criteria for the supporting the convergent validity of the latent factors (see Table 1). The goodness-of-fit indicators (Goodness-of-fit index = .41; averaged- R-squared = .22, $p < .01$; averaged variance inflation factor = 1.08; average path coefficient = .11, $p < .01$) also supported the global fit of the hypothesized model (Pauwels et al., 2009).

Structural equation model

As expected, the effects of autonomy-supportive message on perceived autonomy support was statistically significant and positive, and that on controlled motivation was statistically significant and negative. However, the corresponding effects of autonomy-supportive message on autonomous motivation and amotivation, the other social cognitive variables and intention were not statistically significant. Congruent with the tenets of the theoretical integration of self-determination theory and the theory of planned behavior, perceived autonomy support was a statistically significant and positive predictor of autonomous motivation, and autonomous motivation was a statistically significant positive predictor of attitude, subjective norm, and perceived behavioral control. These three social cognitive factors were statistically significant and positive predictors of intention. Controlled motivation was statistically significant and positively associated with subjective norm and perceived behavioral control. Amotivation was not statistically significantly related to other factors within the model (see Table 2).

Mediation

Mediation analyses revealed that perceived autonomy support was not a statistically significant mediator of the relationship between autonomy-supportive message and autonomous motivation (direct effect = −.06, $p > .05$; combined effects = .11, $p < .05$; indirect effect = .10, $p < .01$; total effect = −.02, $p > .05$; full mediation). It was also not a statistically significant mediator of the relationship between autonomy-supportive message and controlled motivation (direct effect = −.11, $p < .01$; combined effects = −.13, $p < .01$; indirect effect = .02, $p > .05$; total effect = −.11, $p < .01$).

The effects of perceived autonomy support on attitude (direct effect = .36, $p < .01$; combined effects = .20, $p < .01$; indirect effect = .16, $p < .01$; total effect = .33, $p < .01$) and perceived behavioral control (direct effect = .21, $p < .01$; combined effects = .08, $p < .05$; indirect effect = .10, $p < .01$; total effect = .17, $p < .01$)

Table 1 Factor correlations, and the descriptive and reliability indices

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Autonomy-supportive message	1													
2	Perceived autonomy support	.26**	1												
3	Autonomous motivation	−.06	.30**	1											
4	Controlled motivation	−.11**	.04	.28**	1										
5	Amotivation	−.02	.04	−.09*	.28**	1									
6	Attitude	−.05	.31**	.48**	.18**	−.07	1								
7	Subjective norm	−.08*	.04	.34**	.39**	−.03	.43**	1							
8	Perceived behavioral control	.04	.18**	.36**	.20**	−.10*	.46**	.51**	1						
9	Intention	−.06	.19**	.44**	.24**	−.09*	.56**	.65**	.55**	1					
10	Susceptibility	.00	.03	.08*	.19**	.18**	.07	.18**	.07	.18**	1				
11	Severity	.05	.03	.08*	.19**	−.05	.11**	.18**	.20**	.09*	.24**	1			
12	Mask use	−.04	.05	.13**	.06	−.08*	.15**	.09*	.11**	.15**	.08*	.11**	1		
13	Mask knowledge	.06	.05	.15**	−.06	−.14**	.10**	.09*	.13**	.14**	.02	.03	−.14*	1	
14	Frequency of flu	−.02	.01	.00	.03	.03	.00	−.06	−.03	.00	.15**	.03	−.07**	−.02	1
	Mean	N/A	3.62	4.68	3.57	2.61	4.27	4.18	4.75	4.05	2.73	4.31	1.29	1.18	.88
	SD	N/A	1.55	1.26	1.34	1.36	1.10	1.47	1.22	1.47	1.38	1.43	.45	.39	1.07
	α	N/A	.93	.86	.87	.81	.86	.89	.83	.89	.83	.72	N/A	N/A	N/A
	Composite score reliability	N/A	.95	.90	.90	.89	.90	.93	.88	.93	.90	.84	N/A	N/A	N/A
	Average variance extracted	N/A	.75	.59	.60	.73	.64	.82	.60	.82	.75	.64	N/A	N/A	N/A
	Mean factor loadings	N/A	.86	.76	.77	.85	.80	.90	.77	.90	.87	.80	N/A	N/A	N/A
	Mean cross-loadings	N/A	.11	.17	.11	.12	.19	.19	.20	.21	.07	.09	N/A	N/A	N/A

** $p < .01$ at 2-tailed, * $p < .05$ at 2-tailed

were partially mediated by autonomous motivation and controlled motivation, but mediation was not shown in the corresponding effect on subjective norm due to the statistically non-significant direct effect of perceived autonomy support on subjective norm (direct effect = .06, $p > .05$; combined effects = .04, $p > .05$; indirect effect = .09, $p < .05$).

The effect of autonomous motivation on intention was positive and partially mediated by attitude, subjective norm, and perceived behavioral control (direct effect = .36, $p < .01$; combined effects = .12, $p < .01$; indirect effect = .27, $p < .01$; total effect = .34, $p < .01$). The effect of controlled motivation on intention was positive and fully mediated by subjective norm and perceived behavioral control (direct effect = .12, $p < .01$; combined effects = .04, $p > .05$; indirect effect = .16, $p < .01$; total effect = .19, $p < .01$) (Fig. 3).

Discussion

The aim of this study was to compare health advice presented in an autonomy-supportive manner to that presented in a controlling manner, on motivational and social-cognitive outcomes associated with the wearing facemasks in lecture halls for the prevention of H1N1 during an influenza pandemic. Results indicated that the autonomy-supportive message was positively related to perceived autonomy support and negatively related to controlled motivation. Findings also supported the theoretical integration of self-determination theory and the theory of planned behavior (Chatzisarantis et al., 2007; Hagger & Chatzisarantis, 2009; Hagger et al., 2006), and demonstrated how perceived autonomy support is linked to the social cognitive antecedents of health behavior through the mediation of individuals' motivational orientations. Contrary to predictions, however, no direct or indirect effects of the autonomy-supportive health message on the direct antecedents of intentions (attitudes, perceived behavioral control, subjective norms) or intentions themselves were found.

Current results are consistent with research that has tested the effects of autonomy support on behavior in other health contexts, such as physical activity (Silva et al., 2010), smoking cessation (Williams et al., 1999; Williams et al., 2006), dental care (Halvari & Halvari, 2006; Halvari et al., 2012), treatment compliance (Chan & Hagger, 2012a; Chan et al., 2009), and safety (Chan & Hagger, 2012a, 2012b, 2012c, 2012d). Our findings demonstrate that the promotion of wearing face masks for H1N1 prevention would be most effective in influencing motivation

Table 2 Path coefficients for the hypothesized model

Predictors	Dependent factors							
	Perceived autonomy support	Autonomous motivation	Controlled motivation	Amotivation	Attitude	Subjective norm	Perceived behavioral control	Intention
Autonomous motivation	.36**							
Controlled motivation	.07							
Amotivation	.07							
Attitude		.44**	.07	−.07				
Subjective norm		.21**	.31**	−.08				
Perceived behavioral control		.30**	.10**	−.13				
Intention					.27**	.39**	.21**	
Main effects								
Autonomy-supportive message *(Manipulation of autonomy support)*	.26**	.11**[a]	−.13*	−.03	.01	.04	.07*	.03
Control variables								
Susceptibility	.10	.10*	.16**	.19**	.02	.10**	.01	.09**
Severity	.04	.12	.17**	−.10*	.07	.09*	.14**	.02
Mask use	−.05	−.08**	−.03	.09**	−.07*	−.01	−.03	−.04
Mask knowledge	−.03	−.12**	.07*	.13**	−.03	−.08**	−.06*	−.04
Frequency of flu	.05	−.02	−.03	.08	−.05	−.12**	−.03	.07
Effect size (R^2)	.09	.19	.09	.08	.27	.26	.20	.56

This statistically significant positive link was likely to be inflated by a suppressor effect because the correlation between autonomy-supportive message and autonomous motivation was negative and statistically non-significant. Therefore, this path coefficient should be considered non-significant

** $p < .01$ at 2-tailed, * $p < .05$ at 2-tailed

if the health message was delivered in an autonomy-supportive manner (Deci & Ryan, 1985, 2000; Ryan & Connell, 1989). Although there were no statistically significant treatment effects of autonomy-supportive messages on autonomous motivation, attitude, subjective norm, and intention, the manipulation of autonomy support exerted statistically significant effects on perceived autonomy support, controlled motivation, and perceived behavioral control. The students who were presented with the health advice in an autonomy-supportive manner reported higher perceived autonomy support. According to self-determination theory (Deci & Ryan, 1985, 2000) this would be more likely to link to higher autonomous motivation, behavioral persistence, and better well-being in health contexts (Deci & Ryan, 1985, 2000; Ryan & Connell, 1989). Although the positive effects of autonomous motivation on the theory of planned behavior variables may support these arguments, we did not observe a statistically significant effect of autonomy-supportive messages on autonomous motivation. According to self-determination theory (Deci & Ryan, 1985, 2000; Ryan & Connell, 1989), a controlled-motivated individual needs to internalize and integrate the regulations of the action before it can be endorsed as autonomous. Plausibly, more time is required for the development of autonomous motivation for behaviors that are controlled motivated (Chan & Hagger, 2012a; Chan et al., 2011), perhaps this is the case for a behavior like H1N1 prevention facemask use. In contrast, the effect of autonomy-supportive message on controlled motivation was statistically significant. This interesting pattern of result might indicate that controlled motivation for the health action is more malleable and open to change as a result of the health message than autonomous motivation. Indeed, the magnitude of the parameter estimate was still small, so it might reflect a generally weak intervention effect on all motivational constructs in the study. The use of hypothetical scenario and the brief-intervention period in this study were possible reasons of why the health message only altered individuals' perception of autonomy support, but did not exert a statistically significant or strong effect on other variables in the study.

Another findings contrary to the propositions of self-determination theory was that individuals endorsing high controlled motivation were supposed to be less likely to

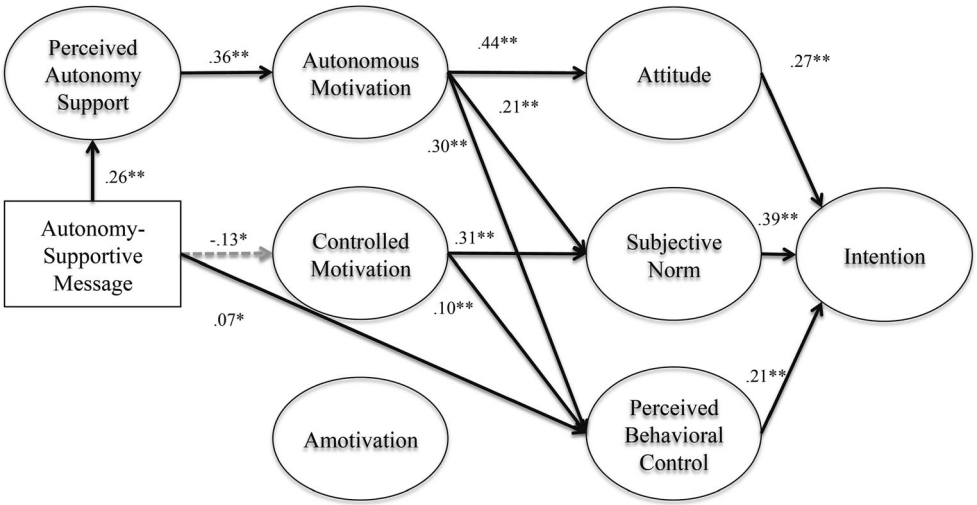

Fig. 3 Path estimates of the model. The *black vectors* indicate statistically significant positive paths. The *broken vectors* indicate statistically significant and negative paths. For clarity reasons, the *paths* associated with the control variables, and the statistically non-significant *paths* are not displayed

develop personal agency over action, might have problems in complying with the behavior, and were more likely to desist with the behavior (Deci & Ryan, 1985, 2000; Ryan & Connell, 1989). The current findings did not support these arguments, as controlled motivation was also a positive predictor of subjective norm, perceived behavioral control, and intention, even though the effect sizes were generally smaller than the effects of autonomous motivation on the same outcomes. Such a finding illustrates that controlled motivation might be as adaptive as autonomous motivation in behavioral compliance. In fact, research in certain behavioral context (e.g., rehabilitation, anti-doping) also report positive relationship between controlled motivation and favorable behavioral response (Chan et al., 2014; Chan et al., 2014; Chan & Hagger, 2012b), and it was argued that controlled motivation could facilitate behavioral adherence when it matched the 'motivational climate' of the social environment (Sebire et al., 2009) or controlling contingencies for doing the behavior were made salient (Hagger & Chatzisarantis, 2014; Vansteenkiste & Lens, 2006). However, the long-term effectiveness of controlled motivation has been challenged by the fact that behaviors driven solely by controlled motivation are dependent on the external contingencies, and when these external factors were absent or less salient in certain situations (e.g., when the individuals do not received penalty for not wearing facemask outside school during a pandemic period), individuals with high controlled motivation would be more vulnerable to behavioral relapse or dropout (Chan et al., 2014; Chan & Hagger, 2012b; Chatzisarantis et al., 2007).

The statistically non-significant effects of the autonomy-supportive message on the theory of planned behavior variables and intention indicate that situational decision-making factors in the final stage of the motivational sequence of the theoretical integration between self-determination theory and the theory of planned behavior had the most pervasive effect in predicting intention (Hagger & Chatzisarantis, 2009; Hagger et al., 2006). Attitude, subjective norm, and perceived behavioral control explained a substantial percentage of the variance in intention to wear facemasks in the lecture hall during an H1N1 pandemic. This is consistent with previous studies adopting the theory in other health contexts (Chan et al., 2014; Chan & Hagger, 2012b; Chan et al., 2015; Chatzisarantis et al., 2007; Hagger & Chatzisarantis, 2009; Hagger et al., 2006). This suggests that presenting health behavior messages in an autonomy-supportive manner facilitated the perception of autonomy support and reduced controlled motivation toward using a facemask, but it had no actual effect on intentions themselves. One possibility is that the effect of autonomy-supportive message may affect behavior independent of intentions, such that motivational orientations engendered by the manipulation may lead to spontaneous use of facemasks without necessitating a planning or intentional process. This has been shown in previous studies where motivation predicts behavior directly (Chan et al., 2009; Levesque et al., 2007; Silva et al., 2010; Williams et al., 2006). An alternative explanation would be that the hypothetical scenarios might be sufficient to change perceptions of autonomy support and controlled motivation, but it may not have been sufficiently strong to impact on behavioral intention and its antecedent psychological factors.

There were some limitations to this research. The quasi-experimental design does not permit any inference about the causal relationships between the treatment of autonomy support and other psychological variables in the study.

Without any baseline measurement, it was not possible to examine whether the manipulation of autonomy support resulted in changes in motivation, intention, and other theory of planned behavior variables. Similarly, we did not include a longitudinal follow-up of behavior or other study variables, so we were unable to evaluate the long-term impact of autonomy-supportive health messages on students' behavior and perceptions. A panel design may also be appropriate measuring the psychological variables and behaviors at two or more time points and model change and directionality of effects using cross-lagged coefficients (Lindwall et al., 2011). Also, the use of a hypothetical scenario for experimental manipulation may raise problems concerning the ecological validity of the findings (Chan & Hagger, 2012a; Chan et al., 2011). The outcome variables were psychological variables measured by self-report so the responses could potentially be subject to response bias and social desirability. Findings therefore need to be interpreted cautiously and underscore the importance of further replications adopting randomized controlled trials in practical settings with objective measures of behavioral compliance, despite the challenges in conducting such experiments in illness contexts.

Conclusions

The present study was the first quasi-experimental study to test the effectiveness of autonomy-supportive and controlling health messages in promoting preventive actions (i.e., wearing a facemask in a lecture hall) in the face of H1N1 pandemic. The results indicated that students who received autonomy-supportive health advice reported higher perceived autonomy support, and lower controlled motivation. These motivational factors were linked to the social cognitive variables associated with wearing a facemask consistent with the theoretical integration between the self-determination theory and the theory of planned behavior. However, the autonomy support manipulation had no direct or indirect effects on intentions to use facemasks. The experimental findings might be useful to inform preventive interventions to reduce the spread of infection, and suggest that the promotion of motivation toward preventive actions for infectious diseases may be achieved by offering meaningful rationales, highlighting the personal values, and showing care and understanding about the potential challenges or inconvenience associated with the health actions. Current findings imply that successful behavior-change interventions that facilitate autonomous motivation for behaviors relating to H1N1 prevention should be supplemented with information that fosters individuals' attitude, perceived social norm, and perceived behavioral control of the health behavior as these are the most proximal predictors of intentions to use a facemask.

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Conflict of interest Derwin K. C. Chan, Sophie X. Yang, Barbara Mullan, Xiumin Du, Nikos L. D. Chatzisarantis, and Martin S. Hagger declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all participants for being included in the study.

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