

# Avoiding threats, but not acquiring benefits, explains the effect of future time perspective on promoting health behavior

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## ABSTRACT

Promoting health behavior among the public is always a pressing issue. The present research systematically investigated the association between future time perspective and adherence to health behavior including dietary habits, physical activities, and substance use in a Chinese college student sample ( $N = 519$ ). Results showed that individuals with stronger future time perspective were more likely to adhere to health behavior. Moreover, building upon the health belief model and the protection motivation theory, the present research further explored the underlying mechanisms. Results revealed that it is perceived threats of not carrying out health behavior, but not perceived benefits of carrying out health behavior, that asymmetrically explained the association between stronger future time perspective and greater adherence to health behavior. These findings contribute to both the future time perspective literature and the health behavior literature.

## 1. Introduction

Health behavior defined as a set of individual behavior that contribute to health and longevity, are crucial to health and well-being of individuals and populations. Commonly mentioned health behavior, such as regular meals, healthy diets, enough physical exercise and sleep, less smoking and drinking, are frequently reported to be associated with a number of physical and psychological benefits [1, 2]. In contrast, not carrying out health behavior is found to be related to numerous negative consequences. For instance, skipping breakfast is associated with chronic kidney diseases [3], lack of exercise increases the risk of cardiovascular disease, diabetes, and cancer [4], and alcohol consumption remains a leading risk factor for death and disability [5].

Accordingly, how to promote individuals' adherence to health behavior is always a pressing issue. Previous research has identified a variety of factors that might be related to individuals' likelihood to adhere to health behavior. These factors are including demographic characteristics such as gender, age, marital status, education, current as well as childhood socio-economic status [6,7], psychological traits such as self-efficacy and self-control [8], and social and political determinants such as access to sports facilities, neighborhood poverty, and economic inequality [9,10]. However, it is worth noting that the majority of prior work is focusing on present-oriented (e.g., marital status, education, and self-control) or past-oriented factors (e.g., access to sports facilities in school days

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and childhood socio-economic status), and there is inadequate research on whether future-oriented factors might affect individuals' adherence to health behavior. Given this inadequacy, our present research aims to systematically examine *whether* and *how* future time perspective (FTP), a future-oriented psycho-cognitive factor, might promote health behavior.

### 1.1. FTP and health behavior

FTP derives from the broader concept of time perspective. Time perspective has been proposed as a psychological trait regarding one's cognition, feeling, and action towards time [11,12]. Time perspective contains three orientations—past, present, and future, and FTP is generally considered as time perspective oriented towards the future. Specifically, people with stronger FTP hold a stronger belief that future outcomes will depend on their current actions, and they are consequently more likely to care about how their current behavior might affect their lives in future [11,12]. It is worth noting that FTP is also conceptually close to constructs such as *future time orientation* (i.e., “a general capacity to anticipate, shed light on and structure the future”; p.452) [13] and *consideration of future consequences* (i.e., “the extent to which individuals consider the potential distant outcomes of their current behavior and the extent to which they are influenced by these potential outcomes”; p.743) [14]. Therefore, we use FTP as the proxy of future-oriented factors and explore its potential in affecting health behavior.

Given that individuals' perceptions about the future are crucially related to their goals, motivations, and life plans, FTP has received increasing attention on its role in predicting individuals' behavior, achievements, and well-being [15]. For instance, stronger FTP has been found to be associated with more effective self-regulation [16], better academic performance [17], and greater life satisfaction [18]. When pertaining to health-related outcomes, there is also evidence suggesting that stronger FTP is related to greater adoption of health behavior such as more physical exercise [19,20] and less substance use [21,22]. Beyond reporting the relationship between FTP and health behavior, some research has further compared future versus present time perspectives [19,22] or different FTP operationalizations [20,23] in predicting health behavior. However, studies on mechanisms through which FTP affects health behavior remain relatively rare. Although there is a few exceptions, for instance, Hall et al. [21], has reported that individuals' quit intentions (as measured by one item “Are you planning to quit smoking within the next month, next 6 months, sometime in the future or not planning to quit”) mediated the effect of FTP on their smoking quit attempts, and Joireman et al. [24], has found that individuals' promotion orientations (e.g., “I frequently imagine how I will achieve my hopes and aspirations”) mediated the link between FTP and exercise attitudes, it is worth noting that these findings are limited on very specific mediators (e.g., smoking quit intention) or outcomes (e.g., exercise attitudes).

### 1.2. Underlying mechanisms: Perceived threats versus Perceived benefits

In the present research, we attempt to explain the effect of FTP on health behavior based upon the health belief model (HBM) and the protection motivation theory (PMT). The HBM, developed in the 1960s, is a classic theoretical model aiming to understand why individuals choose to (or not to) adopt health behavior [25,26]. According to HBM, there are three lines of factors that determine individuals' health behavior practices: perceived threats of a health issue, perceived benefits of taking action to prevent that health issue, and perceived cues to take action. To illustrate, one who smokes might learn that a friend who was a heavy smoker died of lung cancer. This information (i.e., the cue) would trigger one's concern about the smoking-related health issue, thereby stimulating one to consider this health issue seriously. One might then find out that smoking will render oneself to be more susceptible to lung cancer, which has severe consequences for one's health and life quality (i.e., perceived threats), whereas no smoking would be conducive to one's living healthier and longer (i.e., perceived benefits). Notably, both perceived threats and perceived benefits are likely to prompt one to smoke less or quit smoking (i.e., to adhere to the health behavior).

Extending the HBM, the PMT further elaborates the cognitive processes underlying individuals' health-related decision making [27,28]. The PMT proposes two cognitive appraisal processes behind individuals' decision to (or not to) health behavior: threat appraisal and coping appraisal processes. Specifically, the threat appraisal process evaluates the pros and cons of maladaptive responses, while the coping appraisal process evaluates the pros and cons of adaptive responses. For instance, when pertaining to smoking, the threat appraisal process focuses on weighing up the threats (e.g., health risks) and rewards (e.g., bodily pleasure) of smoking (i.e., the maladaptive response), while the coping appraisal process focuses on weighing up the benefits (e.g., health promotion) and costs (e.g., temporal unpleasantness) of no smoking (i.e., the adaptive response). Accordingly, as stressed by the PMT, it is the combination of threat appraisal and coping appraisal processes that result in the “protection motivation” which urges individuals to adhere to health behavior.

Taken together, when investigating whether or not individuals are likely to adhere to health behavior, the HBM pinpoints that both perceived threats and perceived benefits should be taken into consideration, while the PMT further highlights the cognitive process of weighing up threats and benefits. Therefore, given that one's likelihood to adhere to health behavior is, in essence, the dynamic interplay between perceived threats and benefits, we propose that the potential link between FTP and health behavior may also be explained by perceived threats and benefits.

In particular, since FTP captures individuals' concerns and consideration of future consequences resulted from their current actions, we expect that those with stronger FTP should also be more likely to perceive the threats and benefits of their current actions to their future selves. Namely, on the one hand, individuals with stronger FTP are more likely to realize the threats of not carrying out health behavior to themselves in the future—for example, poor dietary habits leads to malnutrition, lack of exercise results in unfit, and smoking increases the vulnerability to lung cancer—and thereby attach greater importance to adhering to health behavior now. On the other hand, these individuals are also more likely to perceive the benefits of carrying out health behavior to their future

selves—for example, eating a variety of foods keeps one nutritionally balanced, physical exercise improves one's cardiovascular function, and no smoking helps one generally live a longer and healthier life—and thereby become more prone to adhere to health behavior at the present moment. In this sense, we aim to investigate the mechanisms underlying the link between FTP and health behavior with considering both the mediating effects of perceived threats and benefits.

Moreover, having assumed that both perceived threats and benefits could explain the relationship between FTP and health behavior, we take one step further to explore whether the nature of health behavior *per se* might have an impact on *when* and *which* mechanism comes into effect. In particular, on the basis of previous literature, health behavior could be further divided into promotive and preventative health behavior [19,21,29,30]. Promotive health behavior, such as healthy dietary habits and physical exercise, could be generally regarded as activities that improve health or mainly convey health benefits. In contrast, preventative health behavior, such as consuming less alcohol and quitting smoking, could be generally regarded as activities that avoid impairment to health or mainly focus on reducing health threats.

Accordingly, we are interested to know whether there is a stronger link between perceived benefits (or threats) and promotive (or preventative) health behavior. This possibility has been implicated in past research as well. For instance, previous work has reported that it is individuals' promotion orientation, rather than prevention orientation, that is associated with promotive health behavior such as exercise and healthy eating [24]. There is also evidence that preventative health behavior such as quitting smoking is explained to a greater extent by perceived threats (i.e., concerns about damages caused by smoking to health and the negative impact of smoking on quality of life) compared to perceived benefits (i.e., perceived health benefits of quitting smoking) [31]. Therefore, we aim to explore this research question by comparing the strengths of perceived threats and benefits in explaining the effect of FTP across both promotive and preventative health behavior.

### 1.3. Overview

The aim of our present research is threefold. First, we aim to systematically examine the effect of FTP on health behavior in a number of areas including both promotive (e.g., eating breakfast and eating vegetables and fruits) and preventative health behavior (e.g., no smoking and no drinking). Second, we aim to further investigate the mechanisms underlying the relationship between FTP and health behavior by accounting for both perceived threats and benefits as potential mediators. Third, we aim to explore whether the mediating effects of perceived threats and benefits differ in their strengths across promotive and preventative health behavior.

Particularly, building upon previous literature relating FTP to health-related outcomes, we expect that individuals with stronger FTP are more likely to adhere to health behavior (H1). Moreover, in line with the HBM and the PMT theorizing, we propose that the relationship between FTP and adherence to health behavior is likely to be mediated by perceived threats of not carrying out (H2a) as well as perceived benefits of carrying out health behavior (H2b). In addition, we ask the research question whether the mediating effects of perceived threats and benefits vary as a function of the nature of the particular health behavior.

In the present research, we measured FTP, health behavior, perceived threats and benefits concerning health behavior in a Chinese adult sample. We tested H1 and H2 using correlation analyses and mediation analyses. We also conducted a series of pairwise contrasts analyses with regard to each health behavior in order to answer the exploratory research question. This research was approved by the Institutional Review Board of School of Social Development and Public Policy, Fudan University (approval number: FDU-SSDPP-IRB-2021-1-021). Informed consent was received from all participants involved in the study. All materials and data are available online at [https://osf.io/p45hm/?view\\_only=33206f18e289494d961917c8d406e311](https://osf.io/p45hm/?view_only=33206f18e289494d961917c8d406e311).

## 2. Materials and methods

### 2.1. Participants

Participants were Chinese college students recruited in three universities in China. We assumed a small-to-medium effect size ( $r = 0.10 - 0.30$ ) for the correlation between FTP and health behavior and aimed to collect a sample of around 500 participants ( $\alpha = 0.05$ ,  $1 - \beta > 0.95$ ) estimated using the G\*Power 3 software [32]. Between April 07 to April 27, 2021, we received 602 eligible responses. After excluding those who were less than 18 years old ( $N = 20$ ), whose response time was lower than the minimum amount of time required to answer accurately (i.e., those responded faster than the rate of 2 s per item were excluded;  $N = 12$ ) [33], and who had consistently responded with the same answer in the FTP questionnaire containing both positively and negatively scored items ( $N = 51$ ) [34], we included a final sample of 519 responses in analysis (53.6% female,  $M_{\text{age}} = 20.16$ ,  $SD_{\text{age}} = 1.67$ ).

### 2.2. Procedure and measures

Participants were invited to complete an online questionnaire which contained measures of FTP, health behavior, perceived threats of not carrying out and perceived benefits of carrying out health behavior, and demographic information.

#### 2.2.1. FTP

Participants' FTP was measured by the 20-item General FTP scale in Chinese (Cronbach's  $\alpha = 0.92$ ) developed by Huang and his colleagues [35,36]. Notably, this scale was developed with reference to existing FTP literature and covered most aspects of FTP investigated in previous literature. Therefore, we chose to use this scale to examine how FTP, in a general sense, would affect health behavior in the present research. Example items are "I achieve my goal on time by taking it step by step." and "I am very confident

about my future". Participants were asked to indicate whether each item is true to them or not on a 4-point scale from 1 (*totally untrue*) to 4 (*totally true*).

### 2.2.2. Health behavior

In line with previous literature [30,37], the present research included seven central areas of health behavior in everyday life: eating breakfast, eating vegetables and fruits, eating a variety of foods, physical exercise, sufficient sleep, smoking (reverse coded), and drinking (reverse coded). Individuals' adherence to each health behavior was measured on a scale from 1 (*never*) to 5 (*every day*) except for no smoking on a scale from 1 (*20 and more cigarettes a day*) to 5 (*never*). Scores of individuals' adherence to health behavior are reported in Table 1.

### 2.2.3. Perceived threats of not carrying out health behavior

After reporting their adherence to health behavior, participants reported their perceived threats of not carrying out health behavior (e.g., "To what extent do you think 'not eating breakfast' poses threats to your health") on a 5-point scale from 1 (very little) to 5 (very large). Scores are reported in Table 1.

### 2.2.4. Perceived benefits of carrying out health behavior

Participants then reported their perceived benefits of carrying out health behavior (e.g., "To what extent do you think 'eating breakfast' provides benefits to your health") on a 5-point scale from 1 (very little) to 5 (very large). Scores are reported in Table 1.

### 2.2.5. Demographic information

Participants reported their gender (1 = *male*, 0 = *female*), age (ranging from 18 to 35), residency status (1 = *urban*, 0 = *rural*), and family socio-economic status (from 1 = *lowest* to 10 = *highest*).

## 3. Results

### 3.1. Descriptive results

First, as shown in Table 1, overall, individuals have reported a relatively great adherence to health behavior compared to the midpoint of the 5-point scale (i.e., 3.00). In particular, individuals did better in no smoking ( $M = 4.83$ ,  $SD = 0.52$ ) and no drinking ( $M = 4.66$ ,  $SD = 0.63$ ), whereas worse in physical exercise ( $M = 3.37$ ,  $SD = 1.21$ ) and eating a variety of foods ( $M = 3.85$ ,  $SD = 1.11$ ).

With regard to perceived threats (see Table 1), in general, individuals' perceived threats of not carrying out health behavior were relatively great compared to the midpoint of the 5-point scale (i.e., 3.00). Particularly, individuals perceived greater threats in smoking ( $M = 4.59$ ,  $SD = 0.73$ ) and insufficient sleep ( $M = 4.40$ ,  $SD = 0.79$ ), whereas less threats in not taking physical exercise ( $M = 3.66$ ,  $SD = 1.02$ ) and not eating a variety of foods ( $M = 3.85$ ,  $SD = 1.11$ ).

With regard to perceived benefits (see Table 1), in general, individuals' perceived benefits of carrying out health behavior were relatively great compared to the midpoint of the 5-point scale (i.e., 3.00). Particularly, individuals perceived greater benefits in no smoking ( $M = 4.66$ ,  $SD = 0.68$ ) and sufficient sleep ( $M = 4.65$ ,  $SD = 0.64$ ), whereas less benefits in eating breakfast ( $M = 4.48$ ,  $SD = 0.75$ ) and eating vegetables and fruits ( $M = 4.52$ ,  $SD = 0.69$ ).

**Table 1**  
Summary of health behavior, perceived threats, perceived benefits, and indirect effect difference.

Health Behavior	Range	Adherence		Threats		Benefits		Indirect Effect Difference		
		M	SD	M	SD	M	SD	M	SE	95% CI
Eating breakfast	from 1 (never) to 5 (every day)	4.14	1.16	3.95	0.94	4.48	0.75	0.11	0.04	[0.04, 0.19]
Eating vegetables and fruits	from 1 (never) to 5 (every day)	4.22	0.96	3.89	0.92	4.52	0.69	0.07	0.03	[0.01, 0.14]
Eating a variety of foods	from 1 (never) to 5 (every day)	3.85	1.11	3.81	0.99	4.55	0.76	0.04	0.03	[-0.02, 0.09]
Physical exercise	from 1 (never) to 5 (every day)	3.37	1.21	3.66	1.02	4.55	0.65	0.04	0.03	[-0.02, 0.10]
Sufficient sleep	from 1 (never) to 5 (every day)	4.50	0.79	4.40	0.79	4.65	0.64	-0.01	0.02	[-0.06, 0.03]
No smoking	from 1 (20 and more cigarettes every day) to 5 (never)	4.83	0.52	4.59	0.73	4.66	0.68	0.12	0.04	[0.04, 0.20]
No drinking	from 1 (every day) to 5 (never)	4.66	0.63	4.32	0.90	4.57	0.77	0.09	0.03	[0.03, 0.16]

*Note.* Adherence = individuals' self-reported adherence to a particular health behavior (ranged from 1 to 5). Threats = individuals' perceived threats of not carrying out a particular health behavior (ranged from 1 to 5). Benefits = individuals' perceived benefits of carrying out a particular health behavior (ranged from 1 to 5). Indirect Effect Difference = the difference between the indirect effect of perceived threats and the indirect effect of perceived benefits. M = mean. SD = standard deviation.

### 3.2. Correlation analyses

Second, as shown in Table 2, stronger FTP was significantly correlated with greater adherence to all areas of health behavior. These results offer support to the hypothesis that individuals with stronger FTP are more likely to adhere to health behavior (H1).

Also, it is worth noting that stronger FTP was significantly correlated with both greater perceived threats of not carrying out and perceived benefits of carrying out health behavior (see Table 2). Moreover, greater perceived threats and perceived benefits were significantly correlated with greater adherence to health behavior (see Table 2). These results lay the foundation for further examinations of the mediating roles of perceived threats and benefits.

In addition, across all areas of health behavior, perceived threats and benefits are significantly correlated with each other (see Table 2).

### 3.3. Mediation analyses

Next, we conducted a series of mediation bootstrapping analyses [38] using 5000 resamples and a 95% bias-corrected CI (all numerical variables were standardized in mediation analyses). As shown in Fig. 1 (A-G), the indirect effect of perceived threats was significant for almost all areas of health behavior including eating breakfast,  $b = 0.13$ ,  $SE = 0.03$ , 95% CI [0.08, 0.18], eating vegetables and fruits,  $b = 0.08$ ,  $SE = 0.02$ , 95% CI [0.04, 0.13], eating a variety of foods,  $b = 0.05$ ,  $SE = 0.02$ , 95% CI [0.01, 0.09], physical exercise,  $b = 0.06$ ,  $SE = 0.02$ , 95% CI [0.02, 0.10], no smoking,  $b = 0.10$ ,  $SE = 0.02$ , 95% CI [0.06, 0.15], and no drinking,  $b = 0.09$ ,  $SE = 0.02$ , 95% CI [0.05, 0.13], except for sufficient sleep,  $b = -0.00$ ,  $SE = 0.02$ , 95% CI [-0.04, 0.03].

However, the indirect effect of perceived benefits was not significant for any areas of health behavior including eating breakfast,  $b = 0.02$ ,  $SE = 0.02$ , 95% CI [-0.02, 0.06], eating vegetables and fruits,  $b = 0.01$ ,  $SE = 0.02$ , 95% CI [-0.02, 0.04], eating a variety of foods,  $b = 0.01$ ,  $SE = 0.02$ , 95% CI [-0.02, 0.04], physical exercise,  $b = 0.02$ ,  $SE = 0.02$ , 95% CI [-0.01, 0.05], sufficient sleep,  $b = 0.01$ ,  $SE = 0.01$ , 95% CI [-0.01, 0.04], no smoking,  $b = -0.02$ ,  $SE = 0.02$ , 95% CI [-0.06, 0.03], and no drinking,  $b = -0.00$ ,  $SE = 0.02$ , 95% CI [-0.04, 0.04]. These findings remained almost identical when controlling for gender, age, residency status, and family socio-economic status (see Fig. S1 (A-G)). Together, these results provide support for the proposed mediating role of perceived threats (H2a) but not perceived benefits (H2b) underlying the association between FTP and adherence to health behavior.

We further conducted a series of pairwise contrasts of indirect effects [38] with regard to each health behavior. As shown in Table 1, the indirect effect of perceived threats (compared to perceived benefits) was significantly stronger for eating breakfast, eating vegetables and fruits, no smoking, and no drinking, and stronger (but not significant) for eating a variety of foods and physical exercise. The only exception was for sufficient sleep. In general, these results suggest that the strengths of the mediation processes by perceived threats versus perceived benefits are asymmetrical, with perceived threats outweighing perceived benefits for almost all areas of health behavior regardless of their promotive (i.e., eating breakfast, eating vegetables and fruits, eating a variety of foods, physical exercise, and sufficient sleep) or preventative nature (i.e., no smoking and no drinking).

## 4. Discussion

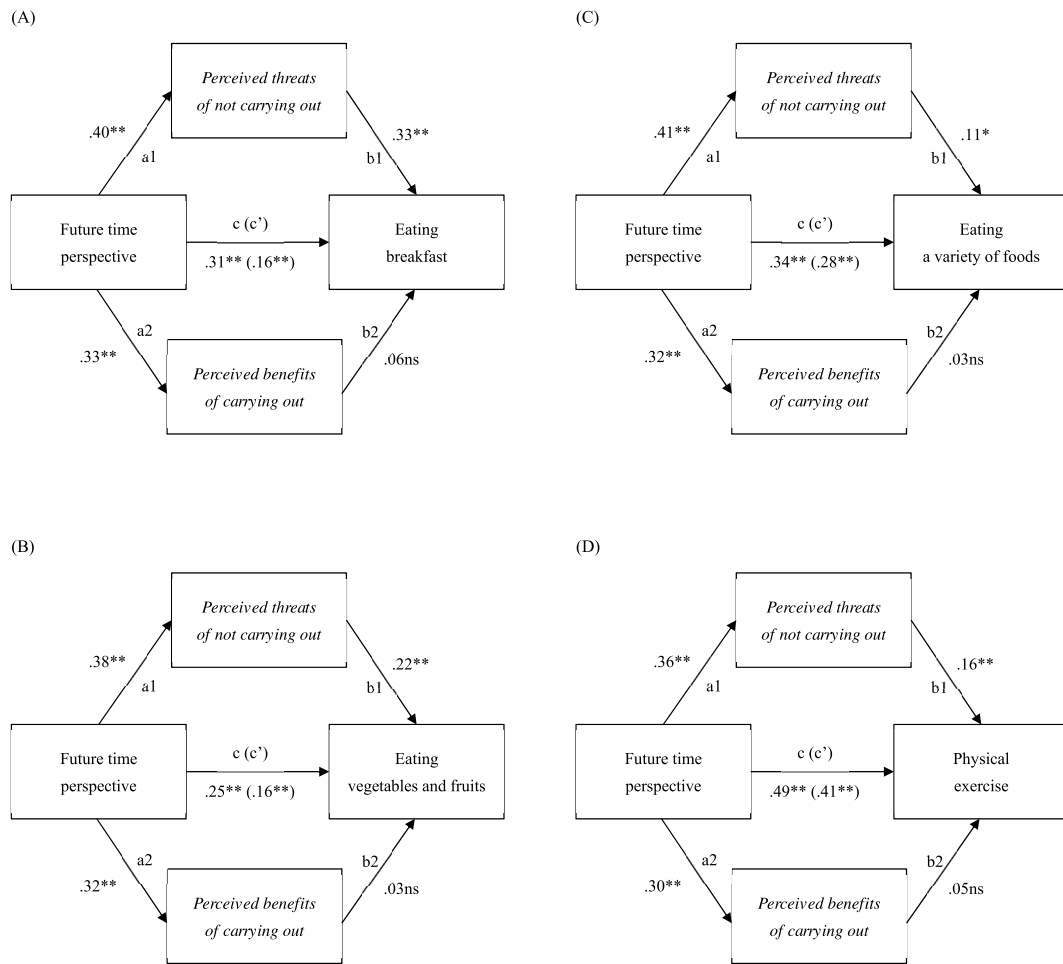
How to promote health behavior is always a key issue for both individuals and societies. The present research provides evidence that stronger FTP, a future-oriented psycho-cognitive factor, is associated with greater adherence to health behavior. Our analyses further reveal the underlying mechanism: those with stronger FTP are likely to perceive greater threats of not carrying out health behavior, therefore being more likely to adhere to health behavior. In contrast, the mediating effect of perceived benefits of carrying out health behavior appears not significant.

The present work has several implications. First, it systematically examines the link between FTP and health behavior in a number

**Table 2**  
Correlations between FTP, health behavior, perceived threats, and perceived benefits.

Correlation	Eating Breakfast		Eating Fruits and Vegetables		Eating a Variety of Foods		Physical Exercise		Sufficient Sleep		No Smoking		No Drinking	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
	FTP ~ Adherence	.31	<.001	.25	<.001	.34	<.001	.49	<.001	.24	<.001	.16	<.001	.19
FTP ~ Threats	.40	<.001	.38	<.001	.41	<.001	.36	<.001	.29	<.001	.27	<.001	.28	<.001
FTP ~ Benefits	.33	<.001	.32	<.001	.32	<.001	.30	<.001	.25	<.001	.27	<.001	.27	<.001
Threats ~ Adherence	.42	<.001	.29	<.001	.24	<.001	.33	<.001	.07	0.091	.37	<.001	.34	<.001
Benefits ~ Adherence	.28	<.001	.18	<.001	.17	<.001	.24	<.001	.10	0.028	.16	<.001	.19	<.001
Threats ~ Benefits	.51	<.001	.47	<.001	.42	<.001	.39	<.001	.46	<.001	.52	<.001	.54	<.001

*Note.* FTP ~ Adherence = the correlation between FTP and individuals' self-reported adherence to a particular health behavior. FTP ~ Threats = the correlation between FTP and individuals' perceived threats of not carrying out a particular health behavior. FTP ~ Benefits = the correlation between FTP and individuals' perceived benefits of carrying out a particular health behavior. Threats ~ Adherence = the correlation between individuals' perceived threats of not carrying out a particular health behavior and their self-reported adherence to that health behavior. Benefits ~ Adherence = the correlation between individuals' perceived benefits of carrying out a particular health behavior and their self-reported adherence to that health behavior. Threats ~ Benefits = the correlation between individuals' perceived threats of not carrying out and their perceived benefits of carrying out a particular health behavior.



**Fig. 1.** (A–G). The relationship between future time perspective and individuals' self-reported adherence to a particular health behavior mediated by perceived threats of not carrying out (a1b1) and perceived benefits of carrying out (a2b2) that health behavior. On the c (c') path, the value outside parentheses is the total effect, and the value inside parentheses is the direct effect.

\* $p < .05$ , \*\* $p < .01$ .

of areas with both promotive (e.g., eating breakfast and eating vegetables and fruits) and preventative health behavior (e.g., no smoking and no drinking) considered. By revealing the promising role of FTP in promoting health behavior, it contributes to both the FTP literature and the health behavior literature.

More importantly, building upon traditional health behavior theorizing including the HBM and the PMT [25–28], the present research explores underlying mechanisms. Even though we have assumed that FTP will affect individuals' adherence to a particular health behavior through the cognitive trade-off between perceived threats of not carrying out that health behavior and perceived benefits of carrying out it, our results demonstrate that perceived threats rather than perceived benefits asymmetrically explain the relationship between FTP and health behavior. It is also worth noting that stronger FTP is indeed associated with perceiving both greater threats and benefits, but only perceived threats further predict adherence to health behavior. These findings suggest that *how* FTP promotes health behavior is nuanced.

To understand this asymmetry, we resort to the literature on the loss aversion bias. Specifically, the prospect theory proposes that individuals will attach greater importance to avoiding losses compared to acquiring equivalent gains (i.e., the loss aversion bias) [39, 40]. In line with this bias, it is possible that even though individuals with stronger FTP perceive both greater threats and benefits, their intention to avoid threats (i.e., to avoid "health losses" such as becoming ill and impotent) is greater than their intention to acquire benefits (i.e., to acquire "health gains" such as becoming strong and vigorous), which further accounts for their greater adherence to health behavior. Thus, our current work reveals the loss aversion bias in explaining the association between FTP and health behavior, and it is important for policy makers to consider this difference between perceived threats and benefits in mediating the effect of FTP when designing campaigns to promote health behavior [41].

In addition, even though stronger FTP is associated with greater adherence to sufficient sleep, neither perceived threats nor

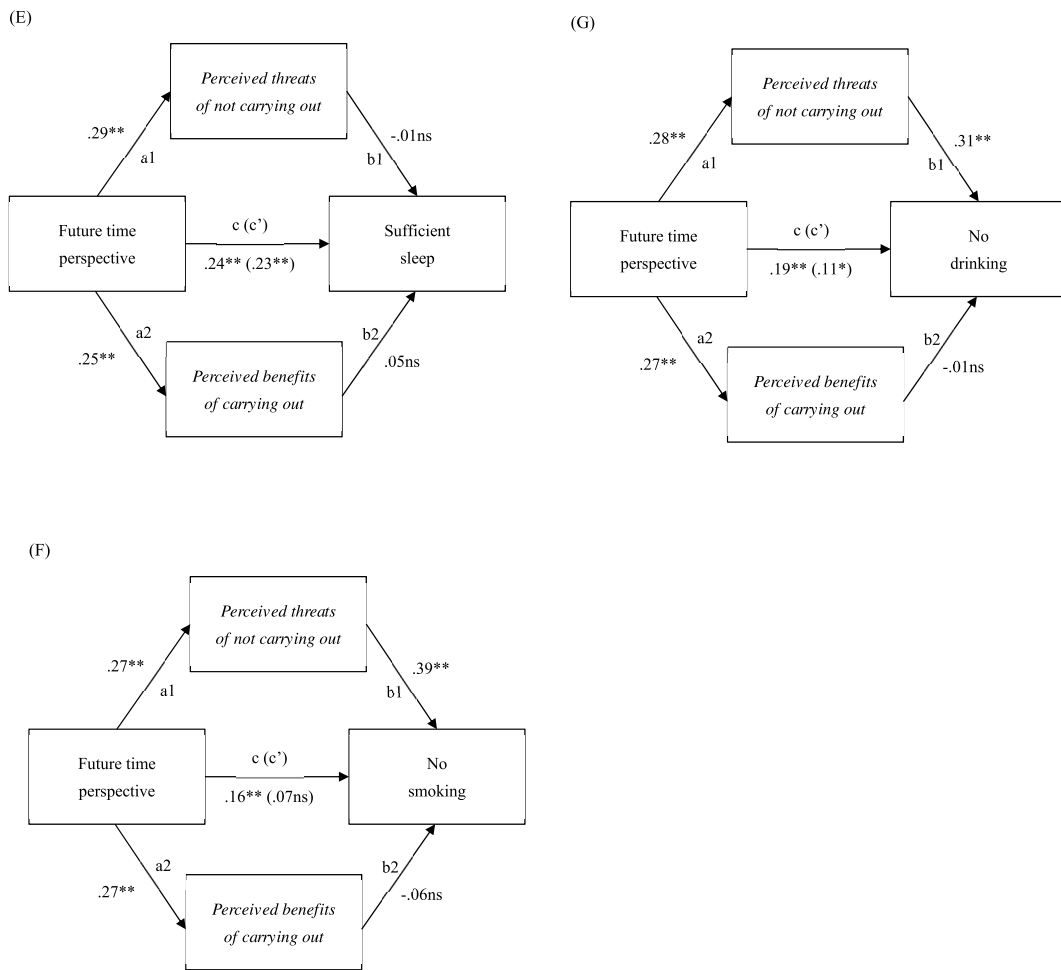


Fig. 1. (continued).

perceived benefits explain this association. We argue that this might be due to a methodological issue. Particularly, we were measuring individuals' perceived threats of "staying up late" as a proxy of perceived threats of insufficient sleep, and perceived benefits of "not staying up late" as a proxy of perceived benefits of sufficient sleep (as reported in the Supplemental Materials). We admit that this difference in operationalizing the health behavior of sufficient sleep might affect the mediating process, and we aim to address this issue by using more consistent terms in future research.

#### 4.1. Limitations and future directions

The present research is not without limitations. First, given our current study is correlational, we are unable to determine the causality between variables. In order to address this issue, it is important for future research to use longitudinal data or even directly manipulate FTP [42,43].

Second, even though our results show that the association between stronger FTP and greater adherence to health behavior were partially explained by perceived threats, there might be still other potential mechanisms. For instance, in line with the HBM and the PMT [25–28], individuals' perceived cues to take action (i.e., the chance to notice the health issue), perceived costs of taking action (e.g., one might have to spend more money on healthy foods in order to eat a healthy diet), and self-efficacy should all be taken into consideration in future research.

Third, with regard to potential interventions to promote health behavior, it is worth noting that strategies designed in light of our findings (e.g., emphasizing the threats of not carrying out health behavior) might be most effective on individuals with relatively strong FTP, whereas these strategies might not equally well apply to those with relatively weak FTP. Therefore, it is necessary for future research to continue to probe and test potential pathways to promote health behavior covering a wider population.

Fourth, since our findings are based on a Chinese sample, we cannot rule out the possibility that these findings might be culture-specific. In particular, from the approach and avoidance motivation perspective, individuals from East Asian cultures are more likely to embrace avoidance motivation (i.e., to avoid negative outcomes or threats) than approach motivation (i.e., to achieve positive

outcomes or benefits) [44]. In this sense, our findings that only perceived threats but not benefits significantly explained the effect of FTP on health behavior might be influenced by this culture-specific motivation preference as well. And it is beneficial for future research to examine whether our findings generalize across different cultural contexts.

## 5. Conclusion

The present research provides a systematic examination on the association between FTP and health behavior. It also explores underlying mechanisms by showing that perceived threats of not carrying out health behavior (compared to perceived benefits of carrying out health behavior) predominantly explain the association between stronger FTP and greater adherence to health behavior. These findings suggest that when designing policies aiming to promote health behavior, it is important to account for future-oriented factors and the threat/loss aversion bias.

## Ethics statement

This research was approved by the Institutional Review Board of School of Social Development and Public Policy, Fudan University (approval number: FDU-SSDPP-IRB-2021-1-021).

## Author contribution statement

Shijin Sun: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper. Xuemin Cao: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper. Xiangqian Li: Analyzed and interpreted the data. Yeopham Nyeong: Performed the experiments. Xin Zhang: Analyzed and interpreted the data. Zhechen Wang: Conceived and designed the experiments; Analyzed and interpret; Wrote the paper.

## Data availability statement

Data associated with this study has been deposited at <https://osf.io/p45hm/>.

## Declaration of competing interest

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

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2023.e19842>.

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