

# Public risk perception and coping response to COVID-19 is moderated by positive emotions: Evidence from Chinese college students

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## Research Article

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## Abstract

**Background:** People tend to develop serious psychological problems if they perceive the threat of a special disease. Seeking and contributing risk perception has laid the groundwork for studies that explore public response in the face of a health emergency, and are helpful for the understanding of students by determining how positive emotions(PE) moderates COVID-19-related risk perception(CRP) and can further lead to an improvement in coping response to COVID-19(CRC). We still have little knowledge

**Results:** There were a moderating relationship between CRP and positive-coping behavior(PCB) and moderating relationship between CRP and risk-taking behavior(RTB) through PE. Two interactive effects were identified. First, CRP was positively predicting PCB interacting with observed PE). Second, COVID-19-related risk perception interacted with observed PE predicting risk-taking behavior(RTB)

**Conclusions:** The current study established a moderated model to explore the influence mechanism of CRP on two categories of coping response. For public health managers, they should have different coping response behavior and addressed the moderating role of PE in the process of coping with a public health emergency.

## Background

In December 2019, the coronavirus disease (COVID-19) was detected in Wuhan, in the Hubei Province of China. The patients with COVID-19 developed symptoms such as fatigue, diarrhea, shortness of breath, cough, and fever. The complications included severe syndrome of respiratory system, pneumonia, renal insufficiency, and several patients died of the disease[1]. In late January 2020, COVID-19 was announced as a Public Health Emergency of International Concern (PHEIC). The declaration of PHEIC refers to the serious consequences brought by unexpected or unusual incidents, such as the possibility of worldwide spread of the infection and strict restrictions on transportation or transactions in the world [2].

In general, people tend to judge the risk by their intuitive understanding, that is, their individual perception of risk[2]. The perception of risk implies that people would evaluate the danger facing them intuitively, such as a number of bad consequences that are commonly associated with a special cause [3]. Slovic (2000) proposed that the department responsible for managing and assessing public safety and health needed to survey how people understand and cope with the risk[4].

To fight the COVID-19 epidemic and prevent the spread of disease at educational campuses, the Ministry of Education of the People's Republic of China has taken measures to isolate and manage infectious sources, cut off all kinds of transmission routes and protect the susceptible population. Meanwhile, the Ministry of education has issued several notices aimed at strengthening the management of colleges and universities. Most colleges and universities have taken measures to postpone the spring semester and open online courses. Studies have also shown that these measures can have the positive psychological effect and protect mental health [5, 6, 7]. For college students, the holidays were extended and they stayed at home for a long time. They had to reduce going out and were unable to normally attend classes and participate in social activities. Furthermore, it has been found by some researchers that people tend to develop serious psychological problems such as stress, anxiety, and depression, if they perceive the threat of a special disease[8, 9], and these problems might be associated with the emotional tiredness of people in dealing with such situations. While it is necessary to narrow down and utilize existing psychological techniques to analyze public risk perception and behavioral response, it is important specifically, to start with how college students perceive, communicate, and interact in this situation.

College students constitute a unique group of people in the sense that they can easily accept new things and adapt to changes, have many channels for information acquisition, and display high social media activity. However, there is very little information on college students' risk perception, emotional and coping response to COVID-19. Therefore, the current study aimed to measure how positive emotions(PE) moderate the relationship between COVID-related risk perception(CRP) and coping response to COVID-19(CRC) adopted by Chinese college students.

Table 1  
Demographic statistics of the samples

Item	Variable	Freq.	Per(%)
<b>Gender</b>	Male	478	27.6
	Female	1251	72.4
<b>Age</b>	17	12	0.7
	18	249	14.4
	19	434	25.1
	20	301	17.4
	21	268	15.5
	22	197	11.5
	23	123	7.15
	24	71	4.13
	25	65	3.8
<b>Nationality</b>	Han Nationality	1541	89.1
	Minority	188	10.9
<b>Residential area</b>	CHRA	1174	5.5
	CMRA	351	20.3
	CLRA	95	67.9

## Literature Review

### Relationship between COVID-19 related perception and coping response to COVID-19

An expansive body of research has investigated public risk perception and coping response[10, 11]. While much of this research has been published in the sociology literature, a remarkable number of publications have also appeared in the psychology literature. In the former field, contributors have generally explored the risk reality and its underlying explanation from social and cultural perspectives, while contributors to the latter have generally explored individual factors that impact risk perception and assessment from a cognitive perspective[12], and contributors to both lines of inquiry have recently come together to investigate these issues at a deeper level.

Research related to risk perception has laid the groundwork for studies that explore public response in the face of a health emergency. Some scholars have found that risk perception has a positive impact on positive coping behavior, that is, the higher the risk perception, the higher the frequency of public active response behavior[13]. Researchers have noted that risk perception should be kept at a reasonable level to prevent the public from acting irrationally[14]. Savoia et al. (2009) analyzed data collected by the local departments of health in the entire country to provide a picture of public emergency preparedness for health challenges, and found that local health departments providing services to more people are more capable of coping with an emergency[15]. Wang et al. (2018) conducted a training program that encouraged more participatory actions for emergency response in China and found that training on the preparedness for emergency response helped enhance knowledge and strengthen behavioral and attitudinal awareness for the emergency[16].

Lazarus and Folkman (1984) believed that coping refers to the behavior of individuals when dealing with stressful situations[17]. Compas, Connor and Saltzman et al. (2001) defined coping as an individual's efforts to reduce stress by adjusting emotions, cognition and behavior when facing stress events[18]. Lyne and Roger (2000) grouped coping measures into rational coping, emotional coping and avoidance. Accordingly, people put the coping strategies into practice through the displayed coping behaviors[19]. According to Billings and Moos(1981), the method of coping can be divided into three types that are namely; active cognitive, active behavioral and avoidance[20]. Combination with the previous research, the characteristics of COVID-19 and the observation of residents, this study grouped the coping response to COVID-19 into two categories: firstly, positive-coping behavior(PCB), that is, taking corresponding coping measures to reduce the possibility of risk occurrence and its harm; secondly, risk-taking behavior(RTB), that is, actively or passively ignoring the risk situation in which you are, and showing some behaviors that may threaten your safety.

The higher the risk perception of college students, the more willing to reduce the loss of COVID-19 or relieve the pressure brought by COVID-19 through their behavior. On the contrary, people who don't think COVID-19 has risks, that is, college students with low risk perception of COVID-19 may ignore their special situation and tend to normal life or work. Furthermore, they will take risk-taking behavior to satisfy their curiosity seeking

psychology. Combined with the previous research, COVID-19-related risk perception can predict that in the face of COVID-19, college students will perceive emotional tiredness in coping response with it. Thus, this study proposed the hypothesis as follows:

### **Hypothesis 1**

(H1): CRP positively influences the PCB of college students.

### **Hypothesis 2**

(H2): CRP negatively influences RTB of college students

### **Positive emotion moderate the relationship between COVID-19-related risk perception and coping response**

Emotion have been considered as an important aspect of human behavior by psychologists. Emotion plays an important role in interpersonal communication, attitude change, work performance and even the effect of learning and memory[21]. Positive emotion is an extremely concerned center of positive psychology. Positive emotion refers to the emotion accompanied by pleasant feeling due to the internal and external stimulation and events meeting individual needs. Positive emotion can activate general action tendency, have primed and expanding effect on cognition, and can construct individual resources and cancel the activation level of negative emotion[22]. Positive emotion is an important part of mental health. At the same time, it can promote physical health. Positive emotion has a wide range of functions and significance for individual adaptation

Emotion is an important component in the field of psychological research. We can develop a better understanding of the stress-mental health mechanism by going through people's emotional response and their recovery in everyday life [21]. From the perspective of valence, emotion can be divided into positive and negative emotions. Studies have previously been conducted in terms of physiological changes during the experience of different emotions. One study measured the changes in the diameter of pupils of infants when they are distressed, happy, or in a state that can be described as emotionally neutral. The results showed that babies develop arousal response to both positive and negative emotions when they are 6 to 12 months old [22]. Another recent finding showed that prolonged running accentuates positive emotions and dampens negative emotions in the prefrontal cortex; running also increased the choice to use cognitive reappraisal, but not its ultimate success[23].

The results of modern medical research show that change of emotion can directly affect various physiological and behavioral responses in the human body[24, 25]. Positive emotions can expand people's abilities of cognition, and create physical, social, and intellectual resources. Positive emotions can directly affect health care by reducing individuals' overall feeling of stress or pressure, so it can improve people's overall health status and quality of life.

The dynamic model of effect proposed by Zautra, Smith, Affleck and Tennen(2001), considers both negative and positive emotions in the process of stress[26]. In general, positive emotions and negative emotions are relatively independent, positive emotions may weaken the negative emotions caused by stress, that is, positive emotions moderate the stress response. Many researches have shown that positive emotion can regulate stress response and weaken the relationship between stress and negative emotion. Therefore, positive emotions have protective function, which can reduce the impact of stress on individuals[27].

Previous study showed that coping strategies can be grouped into two types, approach and avoidant. Substantial levels of stress were reported by teachers. Correlations show that positive psychological outcomes (wellbeing, health, happiness, resilience, and growth during trauma) correlated positively with approach coping and negatively with avoidant coping[28].

From the emotional point of view, traumatic events bring people not only negative effects, but also considerable positive effects. This study shows that: tension, fear, anger and other negative emotions only account for a small part, helplessness and numbness are few. It showed that timely propaganda and training on the prevention and control of influenza A among college students is an effective measure to increase the control of the incident, and timely scientific, objective and real disclosure of the epidemic situation is a necessary means to reduce fear[29]

The worldwide COVID-19 pandemic has led to a large-scale health crisis; however, there is no formula for coping with this current global pandemic. From experience, Polizzi et al. (2020) described many strategies to cope with the situation, for example, the practices of kindness-loving, the practices of mindfulness, and coping actions based on acceptance and behavioral activation[30]. Other experts highlight key insights from social and behavior science including researches on moral decisions, scientific communication, influences of culture and society on people's behavior and navigating threats, etc., to effectively respond to this pandemic[31]. Among them, Pitas and Ehmer (2020) point out that social capital brings a lot of advantages to crisis response, and those communities which have access to greater social capital can respond more effectively than those which do not have such access[32].

It has been observed that emotional regulation is related to reliable alterations in the somatic and autonomic responsiveness of reflexes[33]. Many researches have explored the emotional activities of positive emotional responses in relation to either psychological symptoms or social behavior. For instance, Bai and Repetti (2018) developed a multi-level model to assess how children's emotional responses were linked to their correlations with psychological symptoms[34]. Another study showed that schizophrenic patients have similar experiences to stimuli that elicit negative and

positive emotions[35]. Recent studies have indicated positive emotions of self-consciousness related to the risk of transmission after the HIV diagnosis[36].

In the present study, we sought to explore how the risk perception of college students influenced their Coping Response to COVID-19, with a particular focus on how Positive Emotion served to affect this relationship. We conceptualized this study in light of the following two hypotheses:

### **Hypothesis**

(H3): PE moderate the relationship between CRP and PCB adopted by Chinese college students responding to the COVID-19 pandemic

### **Hypothesis**

(H4): PE moderate the relationship between CRP and RTB adopted by Chinese college students responding to the COVID-19 pandemic

## **Materials And Methods**

This study applies internet-based questionnaire survey for data collection and test the hypothesis quantitatively. The survey have been performed in accordance with the Declaration of Helsinki Ethics approval for the study protocol was obtained from the Ethics Committee of Shaoutou University Medical College. IRB code is SUMC-2020-80. Informed consent was obtained from all participants through online responses before the start of the survey. The Ethics Committee of Shaoutou University Medical College approved the procedure for obtaining informed consent.

### **Results Of Descriptive Statistics**

Table 1 shows the results of demographic statistics. There were significantly more female respondents (1251 out of 1729) than male ones. Participants' ages ranged from 17 to 25 years (M = 21), nine is missing; 1541 of them were of Han nationality and 188 belonged to a minority nationality. Further,95 were from COVID-19 high risk area(CHRA), 351were from COVID-19 median risk area(CMRA) ,and 1174 were from COVID-19 low risky area(CIRA),. Participants ranged in age from 17 to 25 years.

### **Data Collection Technique And Tools**

An online questionnaire was developed after corresponding with our colleagues at the target universities. Our colleagues then sent this link – [www.wenjuan.com](http://www.wenjuan.com) through a WeChat group and a QQ group, two widely-used social media platforms in China to all eligible college students. The number of participants was determined by data obtained from a survey conducted among six public universities, in three provinces(Guangdong province, Hubei province,and Shandong Province) of China.We conducted the pilot study on February 9, we collected 30 responses, then we deleted unqualified items from the questionnaire and modified the questionnaire. Before issuing the questionnaire, the investigators were asked to fill in the latest national and local COVID-19 epidemic reports. Participants completed and submitted formal questionnaires during the data collection period (March 1 to March 17, 2020). All participants completed an informed consent form before answering any questionnaire items; the process was designed such that they were only able to access the questionnaire after providing consent. 1729 valid responses were collected.

This study evaluated students using the Social Demography and Personal Information (SDPI) scale, the COVID-19-related Risk Perception Scale, the Positive and Negative Affect Scale, and the Coping Response to COVID-19 Scale. The SDPI consisted of six items (including those on gender, age, nationality, grade, residential area, school location) to obtain descriptive characteristics related to sociodemographic and university variables.

### **Measures**

The survey questionnaire was divided into four parts: demographic data, self-reported COVID-19-related risk perception, positive emotion, and coping response to COVID-19.

#### **Social Demography And Personal Information (SDPI)**

Demographic information included age, gender (0 = female, 1 = male), nationality (0 = Han, 1 = minority), residential area (1 = "COVID-19 low risk area," 2 = "COVID-19 medium risk area," and 3 = "COVID-19 high risk area").Notably, the risk classification standard is based on the county units, with no confirmed cases or no confirmed cases for 14 consecutive days as the low risk area; the newly diagnosed cases within 14 days were not more than 50 as the medium risk area; and the more than 50 confirmed cases within 14 days are the high-risk areas(State Council of China,2020).

#### **COVID-19-related Risk Perception Scale (CRPS)**

The level of COVID-19-related risk perception was evaluated COVID-19-related Risk Perception Scale (CRPS), CRPS combined with using the SARS Risk Perception Questionnaire(SRPQ) [37], the Chinese SARS Risk Perception Questionnaire(CSPPQ) [38, 39]and Typhoon controllability and familiarity scale(TCFS)[40]. Shi et al. (2003) used two risk measurement indicators, namely "known" and "controllable," to investigate the six typical risk events of etiology of SARS, transmission and infection of SARS, cure rate, preventive measures, effect on the body after recovery, and infection after recovery[13].Li(2014)based on the CSPQD developed TCFS[40]. A pilot study including 30 participants was performed, we used EFA to test the

CRPS. After deleting the unqualified variables, we obtained symptoms of COVID-19, route of transmission of COVID-19, infectivity of COVID-19, preventive measure. Sample items include "To what extent do you think it is possible to control the spread of COVID-19" and "What do you think you know about the symptoms of COVID-19." The higher the score, the higher the individual's COVID-19-related risk perception. Confirmatory factor analysis in the formal CRPS showed that the scale had good structural validity:  $\chi^2/df = 3.14$ , CFI(comparative fit index) = 0.91, RMSEA(root mean square error of approximation) = 0.057[0.034,0.072], SRMR (Standardized Root Mean Square Residual) = 0.048 [0.028,0.056]. The results of CRP found Cronbach's alpha of 0.76(pilot study) and 0.82(formal study), respectively. Responses were given on a 5-point Likert-type scale (0 = not at all to 5 = absolutely yes).

### Positive Affect Scale (PAS-revision)

Watson et al. (1988) developed the Positive and Negative Affect Scale (PANAS) on the basis of a two-dimensional structure of emotion in 1988 [41]. It has been proved to have good reliability and validity. Following the introductions, all the participants finished a form for an emotional report where they rated themselves on a 5-point scale (1 = not at all to 5 = extremely) by evaluating the degree to which they experienced positive emotions (enthusiastic, happy, energetic, alert, proud, active, joyful, interested, calm, satisfied, relaxed, and at rest they felt. We used a confirmatory factor analysis (CFA) to test the PE.  $\chi^2/df = 3.23$ , CFI = 0.95, RMSEA = 0.067, SRMR = 0.035. In the pilot study, PE found Cronbach's alpha of 0.87. The composite formal measures of PE found Cronbach's alpha of 0.92.

### Coping Response Of COVID-19 Scale(CRC)

To evaluate the Coping Response of COVID-19 using a 12-item scale on the basis of Coping Behavior Scale(CBS)[40]. In this Coping Response of COVID-19 Scale(CRC), the items were grouped into two categories of coping response. Positive-coping Behavior items, and Risk-taking Behavior items cut from CBS, combined and adapted these items. Regarding positive-coping behavior. Sample items, "You take the initiative to control measures to reduce the frequency of going out", and risk-taking behavior, sample items "You go out without a mask". Confirmatory factor analysis showed that the formal scale had good structural validity:  $\chi^2/df = 5.23$ , CFI = 0.90, RMSEA = 0.067, SRMR = 0.035. The reliability of this scale was measured. The results of CRC found Cronbach's alpha of 0.78(pilot study) and 0.84(formal study), respectively.

### Data Analysis

We explored how PE moderated the relationship between CRP and CRC through structural equation modeling(SEM) by using Mplus(8.3). The bias-corrected bootstrapped standard error and confidence interval (CI) for indirect effects are based on 1,000 bootstrap resamples. Results regarding moderating effect are based on whether or not the pathways are statistically significant when testing 95 percent bias-corrected bootstrapped CI around the standardized correlations. Full information maximum likelihood estimation methods apply for emphasizing the missing value.

## Results

### Descriptive statistics

A Pearson correlation test was also completed using IBM SPSS21.0 to check the construct validity of each dimension, a good correlation was found among them, as presented in Table 2.

Table 2  
The results of COVID-19-related perception

	M	SD	1	2	4	6
1.CRP	3.215	0.985	-			
2.PE	3.221	0.803	.302**	-		
3.PCB	4.45	1.190	.592**	.330**	-	
4.RTB	2.020	0.758	-.105**	0.009	-.101**	-

*Note.* PE = positive emotion; CRP = COVID-19-related risk perception; PCB = Positive-coping behavior; RTB = Risk-taken behavior.

From the perspective of known risk, the variance test found that there were significant differences in familiarity with the six types of risk events,  $F = 9.852$ ,  $p < 0.001$ . Multiple comparisons found that the six types of events from known to unknown were transmission and infection, etiology of COVID-19, cure rate, preventive measures, effect on the body after recovery, and infection after recovery. From the perspective of risk control, there were significant differences in the degree of control degree of the six risk events,  $F = 13.128$ ,  $p < 0.001$ . The degree of control over these six events from controllable to uncontrollable were preventive measures, cure rate, infection after recovery, etiology of COVID-19, effect on the body after recovery, transmission, and infection, as present in Table 3.

Table 3  
The results of COVID-19-related perception

Risk events	Known		Controllable	
	M	SD	M	SD
Etiology of COVID-19	3.56	1.01	2.73	1.08
Transmission and infection	4.43	0.98	2.45	1.05
Cure rate	3.44	1.04	4.05	1.02
Preventive measures	3.21	1.09	4.43	1.07
Effect on body after recovery	2.89	1.25	2.36	0.65
Infection problem after recovery	2.23	1.08	2.79	0.49
Overall COVID-19-related risk perception	3.29	1.08	3.14	0.89

It can be seen from Fig. 1 that the six risk events are distributed in three quadrants. The COVID-19-related risk perception in early March 2020 in China is at the upper right space in the figure, that is, people's risk perception of COVID-19 tends to be known and controllable. However, the effects on the body after recovery and infection after recovery are distributed in the uncontrollable and unknown quadrant, that is to say, the public feels the most vulnerable concerning infection problems after recovery and effects on the body after recovery. This is followed by the etiology of COVID-19 and transmission and infection, which are distributed in the unknown and controllable quadrant, that is, although people feel uncertainty regarding these two risk events, they can still control it. Other events (preventive measures and cure rate) are distributed in the quadrants of known and controllable; that is, people feel that they are familiar with these two risk events and that they can be controlled, thus the corresponding risk level is relatively low.

Compared to the sense of control over the infection by COVID-19, the respondents in the survey reported an only greater sense of control over preventive measure. The symptoms and infection showed the college students know well, however, they felt most of these risk events uncontrollable. What is particularly noteworthy is that the COVID-19-related route of transmission problem was viewed as completely uncontrollable and unknown. Research on risk perception shows that the greater the uncertainty surrounding a particular risk, the more scared the individual will be. People's assessment of risk will be improved only if they have more information about the risk, so that uncertainty can be eliminated and turned into hope (Ropeik, 2014).

### Hypothesis testing

Based on Baron and Kenny's (1986) criteria[42], the result of the stepwise regression analysis is shown in Table 3, which shows that CRP strong positively association with PCB (Model2,  $\beta = 0.27, SE = 0.02, 95\%CI[0.24, 0.30]$ ), but negatively association with RTB (Model6,  $\beta = -0.13, SE = 0.02, 95\%[-0.17, -0.09]$ ). Thus, H1 and H2 were supported. Entering the moderation variables of PE and PE\*CRP into the relationship CRP and two categories of CRC, the data shows as follows, 2) the data revealed a moderating relationship between CRP and PCB through PE (Model 4,  $\beta = 0.27, SE = 0.02, 95\%CI[0.23, 0.30]; n.s.$ ), a moderating relationship between CRP and ATB through PE (Model8,  $\beta = -0.13, SE = 0.02, 95\%[-0.17, -0.09]; n.s.$ ). Therefore, H3 and H4 were verified. 3) After entering the CRP and PE, the correlation between PE and ARB lost power (Model8,  $\beta = -0.01, SE = 0.02, 95\%CI[-0.04, 0.02]; n.s.$ ), as presented in Table 4a, Table 4b.

Table 4  
a. Hypothesis testing

Variable	PCB			PCB			PCB			PCB		
	Model1			Model2			Model3			Model4		
	$\beta$	SE	95%CI	$\beta$	SE	95%CI	$\beta$	SE	95%CI	$\beta$	SE	95%CI
Controlled Variable												
Gender <sup>a</sup>	-0.07**	0.03	[-0.13,-0.02]	-0.07**	0.03	[-0.12,-0.02]	-0.10**	0.03	[-0.15,-0.04]	-0.07**	0.02	[-0.12,-0.03]
Minority <sup>b</sup>	0.09*	0.04	[0.02,0.17]	0.06	0.04	[-0.01,0.13]	0.09*	0.04	[0.02,0.17]	0.07*	0.04	[0.00,0.14]
Age	0.02	0.01	[-0.01,0.07]	-0.01	0.01	[-0.03,0.02]	0.05	0.01	[-0.01,0.18]	0.00	0.01	[-0.02,0.09]
CHRA <sup>d</sup>	-0.08	0.05	[-0.18,0.03]	-0.03	0.05	[-0.12,0.07]	-0.08	0.05	[-0.18,0.02]	-0.04	0.05	[-0.13,0.06]
CMRA <sup>e</sup>	-0.02	0.03	[-0.08,0.04]	0.00	0.03	[-0.06,0.05]	-0.03	0.03	[-0.08,0.03]	0.00	0.03	[-0.06,0.05]
Independent Variables												
CRP				0.27**	0.02	[0.24, 0.30]				0.27**	0.02	[0.23,0.30]
<b>Moderating Variables</b>												
PE							0.10**	0.01	[0.08, 0.12]	0.03*	0.01	[0.00,0.05]
CRP*PE										0.04*	0.01	[0.01,0.07]
R <sup>2</sup>	0.009			0.171			0.049			0.178		
$\Delta R^2$	0.006			0.169			0.046			0.003		
F	3.80**			71.25**			17.74**			53.153**		

Table 4  
b. Hypothesis testing

	RTB			RTB			RTB			RTB		
	Model5			Model6			Model7			Model8		
	$\beta$	SE	95%CI	$\beta$	SE	95%CI	$\beta$	SE	95%CI	$\beta$	SE	95%CI
Controlled Variable												
Gender <sup>a</sup>	0.05	0.03	[-0.02,0.11]	0.04	0.03	[-0.02,0.11]	0.06	0.03	[-0.01,0.12]	0.05	0.03	[-0.02,0.11]
Minority <sup>b</sup>	0.02	0.05	[-0.07,0.13]	0.03	0.05	[-0.03,0.15]	0.02	0.05	[-0.07,0.13]	0.03	0.05	[-0.03,0.15]
Age	-0.03	0.01	[-0.08,0.12]	-0.04	0.01	[-0.08,0.12]	-0.03	0.01	[-0.08,0.12]	-0.04	0.01	[-0.08,0.12]
CHRA <sup>c</sup>	-0.06	0.07	[-0.19,0.07]	-0.09	0.07	[-0.21,0.04]	-0.06	0.07	[-0.19,0.07]	-0.08	0.07	[-0.21,0.05]
CMRA <sup>d</sup>	0.01	0.04	[-0.06,0.09]	0.01	0.04	[-0.07,0.08]	0.02	0.04	[-0.06,0.09]	0.00	0.04	[-0.07,0.08]
Independent Variables												
CRP				-0.13**	0.02	[-0.17, -0.09]				-0.13**	0.02	[-0.17,-0.09]
<b>Moderating Variables</b>												
PE							-0.05**	0.02	[-0.08,-0.02]	-0.01	0.02	[-0.04,0.02]
CRP*PE										-0.04**	0.02	[-0.08,-0.01]
R <sup>2</sup>	0.002			0.03			0.007			0.03		
$\Delta R^2$	0.001			0.02			0.004			0.003		
F	0.78			8.45**			2.50**			7.14**		

Structural Equation Modeling (SEM) was adopted to test the moderated model of the CRC-CRP relationship which was moderated by PE (Fig. 2), the fit indices were observed to be satisfactory as to the  $\chi^2/df$ , Tucker-Lewis index (TLI), CFI, Standardized Root Mean square Residual (SRMR), and RMSEA statistics, as shown in the following:  $\chi^2/df = 3.65$ , CFI = 0.98, TLI = 0.95, RMSEA = 0.43, SRMR = 0.47. Bootstrapping tests indicated that the moderating paths were quite different from zero, and were small to medium in magnitude. The findings were consistent with our H3 and H4.

### Interactions With PE

The interaction effects involving COVID-19-related risk perception, PE, and two categories of coping responses to COVID-19 were good, and two interactive effects were identified. First, COVID-19-related risk perception was significantly associated with PCB interacting with observed PE, positively predicting PCB (constant = 3.54,  $\beta = 0.004$ ,  $se = 0.0019$ ,  $p < 0.001$ ; see Fig. 3). Second, COVID-19-related risk perception interacted with observed PE predicting RTB (constant = 1.53,  $R = 0.016$ ,  $se = 0.0025$ ,  $p < 0.05$ ; see Fig. 4).

## Discussion

### Evaluation of conclusions

This paper sought to prove the effect of CRP on two categories of coping response to COVID-19 by checking the moderating role of PE. There was a significant correlation of CRP with two categories of CRC among college students: positive-coping behavior and risk-taking behavior. This is identical with relevant research results which show that risk perception of terrorism differs by coping type [43]. Risk perception is an important predictive variable of coping behavior [44]. Ye et al. (2018) stated further that the perception of health risk can be considered as a critical psychological element in the prediction of adaptive behaviors [45]. According to the prior studies, it was found that people with a higher level of risk perception tend to accept the warning information more easily and are also inclined to respond to it earlier, compared to people who have no risk perception [45, 46, 47]. Given that CRP influences positive-coping behavior, we found that, in relevant researches, many scholars have revealed that the CRP of college students had a great positive influence on their positive-coping behavior, such that improvements in CRP corresponded to increase in positive-coping behavior [27]. Previous research demonstrated that the influence of risk perceptions on risk activities of teenagers and developed the indices [48]. Compared to students with low levels of CRP, students with high risk perception of symptoms of COVID-19, route of transmission, infectivity of COVID-19, and preventive measures for COVID-19, tend to actively respond to coping behavior and self-protection behavior. Our results agree with the findings of Dominicus et al. (2015) that greater levels of perception of risk are likely to impose a positive influence in enhancing the willingness of people to deal with an environmental risk [49].

Our research findings show that during the epidemic of COVID-19, the behaviors aimed at coping with the situations that involve risk played a role among college students in China. On the one hand, the coping of risk had a negative association with the risk of COVID-19 that people perceived. On the other hand, the coping of risk related to COVID-19 had positive associations with the sex (male) of participants, and these findings are identical to some of the recent studies based on samples collected from Italy [50].

Emotion affected the coping strategies supported by many researchers. Our hypothesis 3 and 4 were that PE would moderate the relationship between the CRP and CRC, and our results supported this hypothesis. The moderating effect of positive emotion on CRP and PCB, CRP and RTB was significant. Our results show that, in Chinese universities, those students with a higher level of PE than their peers, possess superior psychological resources. Previous related reports demonstrated that those students with higher levels of PE may have more psychological capital, thereby allowing them to exhibit more engagement in response to COVID-19. Those students with higher levels of PE might develop a deeper knowledge of their parents, local culture, and school, so they can deal with the situation more effectively during a public health crisis and solve related problems. This shows that college students need to share their opinions with their peers in terms of empowerment exercises to improve the CRP and PCB and decrease the risk-taking behavior of all students. This will be useful when students are developing their own practical perception of COVID-19.

### Contributions To The Research

This study tried to establish a moderated model to explore the influence mechanism of CRP on two categories of coping response. Although many researches on the correlations between coping response and various variables in different contexts have been made, few studies concentrated on the impact of CRP on CRC among college students in China.

Our findings make two significant theoretical contributions. First, this study has augmented the findings of previous studies. Our finding is not consistent with related research demonstrating that PE plays a moderating role. However, considering the broad connotation of coping response as a framework, the relationship between emotion and coping response is quite complex [51]. Our research shows that PE might have potential associations with specific behaviors of coping response, at least in the context of COVID-19. To date, few studies have been conducted in which researchers have specifically focused on college students, with minimal information regarding the relationship between PE and different categories of coping response to COVID-19 of college students in China being available. Some researchers have found that risk perception shows that if an individual feels a kind of risk uncertainty, the individual would feel more afraid [38]. Only by gathering more information about risk, eliminating uncertainty, and turning it into hope can improve the assessment of risk.

Second, a moderated structural model was used, which supposed that there was a causal relationship between CRP and two categories of CRC. This implies that CRP can increase positive-coping behavior to COVID-19, but that PE moderates this relationship and influences how CRP shapes coping response to COVID-19 in college students. Students with higher levels of positive emotions, compared with the rest of the participants in our study, displayed greater positive-coping response behavior, and the degree to which CRP increased CRC among students with high PE was superior to this influence in those with low PE. Even though a number of studies have been conducted on CRP and CRC, few studies have explored the influence of interacting and mediating variables on this relationship among moderating variables and that there were definite causal directions. Therefore, the theoretical framework set out in the present paper is that CRP has a positive effect on PE, which will lead to the increase of PCB, and then lead to the decline of RTB, with PE as a buffer in these relationships.

### **Implications Of Public Health**

The findings of this study can be further applied to provide the relevant government sectors with guidance for formulating appropriate public health policies such as the COVID-19 pandemic, especially in China.

In terms of public health management, the government should pay attention to the effect of PE, and address the awakening of public positive emotion. In public health emergencies, various information factors and the control degree of public health emergencies of relevant government departments have an impact on risk perception. Since March 2020, the government has strengthened its publicity and efforts on the infectious, preventive, and curative aspects of COVID-19, and formulated corresponding policies and regulations, so that the public can quickly contact, be familiar with, and master COVID-19-related knowledge. For this reason, the level of public COVID-19-related risk has been moderate. This shows that the public needs to share their opinions with others in terms of empowerment exercises to improve the public's positive-response behavior and decrease risk-taking behavior. This will be useful when people are developing their practical perceptions of COVID-19. Under the joint action of these factors, college students, as a group sensitive to information, may enlarge or reduce their risk perception, which may lead to Individual coping behavior and ultimately lead to group positively active behavior. Therefore, effective risk communication is very important[52]. Risk communication should run through the whole process of public health crisis management. It should not only be used to deal with the outbreak stage of public health emergencies, but also be used for publicity and education of the public before and after the occurrence of risk events.

### **Study Limitations And Future Suggestion**

Our research is generally new, with very little information on these terms available in China. The present study provides a theoretical framework of risk perception and shows its correlation with the public response in the face of an emergency such as the COVID-19 pandemic. Moreover, the findings of the current study are consistent with previous findings that COVID-19-related risk perception can successfully predict PCB of college students owing to positive emotions. These results can be considered as significant contributions to the relevant research field for the understanding of higher education system and students by determining how PE moderates COVID-19-related risk perception and can further lead to an improvement in the coping response of college students to COVID-19. It was also indicated that the college instilling a program for COVID-19-related risk perception had a great influence on students' positive coping response to COVID-19. Therefore, the present study enriched the previous study in theory and provide suggestions for public health management.

The limitations of the current study include the role of moderator variables was relatively limited. In the future, more sensitive indicators of mediator variables need to be found. The prediction model adopts the overall coping behavior indicators, and the development of measurement tools for coping behavior needs to be further solved in the future.

Also, the data that has been collected were self-reported, thus, to some extent introducing subjective predictive validity. Further research is therefore needed on this topic, and future studies should integrate an assortment of other mechanisms for assessment such as teacher ratings, observations, and interview to overcome these limitations. Moreover, the sampling was performed regionally, so regional differences and the small size of the sample might affect the generalizability of results; therefore, it is necessary to carry out a large-scale study by including the samples collected from the entire country. Additionally, females accounted for 72.4% in this study, and the proportion of males and females was unbalanced. The findings showed a significant positive prediction of risk-taking coping behavior and negative prediction of self-protection coping behavior. This may, to some extent, affect the magnitude of the correlation prediction effect. In the future research, more males should be invited to participate in the relevant survey.

## **Conclusion**

The correlation analyses conducted in the present study revealed that COVID-19-related risk perception and two categories of coping response were significantly related to one another among our participant group of college students in China, and that positive emotions moderated this relationship. Our H1,H2,H3,H4 were verified in our study. COVID-19-related risk perception would enable the students to adopt a variety of coping responses to reduce inner tension and anxiety. The results indicated that the higher the degree of risk perception people have, the higher is the frequency of various coping responses shown by them. It was verified that positive emotion played moderating roles in CRP and CRC.

The theoretical enlightenment of this paper is to prove that the moderating effect of PE on CRP impact two categories of CRC(PCB and RTB). Therefore, the important implication of this study for public health is that positive emotions such as enthusiastic, happy, energetic can improve college students' positive coping response to COVID-19, but the decline of these positive emotions due to CRP will reduce the level of risk coping response to COVID-19. Our results suggest that students with higher CRP reserves will exhibit increased positive-coping behavior and lower risk-taking behavior. Moreover, CRP interventions such as those proposed by Liu et al., (2020), be implemented to improve daily teaching activities for students, such as lectures and sports competitions, to cultivate college students' consciousness of independent exercise and establish the concept of lifelong exercise[27]. We also recommend that Chinese college students' CRP be enhanced to improve their positive-coping behavior, and reduce risk-taking behavior. Our findings suggest that a focus on CRP and more positive emotion is essential for efforts to improve positive-coping behavior, and reduce the risk-taking behavior of Chinese college students. Therefore, it is an important measure of disease prevention to enhance college students' consciousness of independent physical exercise. During the COVID-19 epidemic period, college students should be guided to strengthen indoor physical exercise. Besides, they should pay attention to nutrition, consume balanced meals, and ensure the balance of their body's internal state to improve immunity. It is hoped that this study can draw more scholars' attention to the positive or negative effects of CRC. We suggest that future studies should provide more exhaustive research on other possible moderators such as subjective well-being ,helpless, and family conflict to test the causal correlation between CRP and CRC.

## List Of Abbreviations

COVID-19 = coronavirus disease; PHEIC = Public Health Emergency of International Concern; PE = positive emotion; CRP = COVID-19-related risk perception; PCB=Positive-coping behavior;RTB=Risk-taken behavior; CRC = coping response to COVID-19; SDPI = Social Demography and Personal Information; CRPS = COVID-19-related Risk Perception Scale; PAS = Positive Affect Scale.

## Declarations

### Ethics approval and consent to participate

Ethics approval for the study protocol was obtained from the Ethics Committee of Shaoutou University Medical College. IRB code is SUMC-2020-80. Informed consent was obtained from all participants through online responses before the start of the survey. The Ethics Committee of Shaoutou University Medical College approved the procedure for obtaining informed consent.

### Consent for publication

Not applicable

### Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available because the datasets are currently used for another project, but are available from the corresponding author on reasonable request.

### Competing interests

The authors declare no conflict of interest.

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### Authors' contributions

Y.G. took overall responsibility for the study design, coordination of the survey, development of the analysis framework and writing of the manuscript. Q.F.participated in the design of the research, revised suggestion of manuscript. All authors read and approved the final manuscript.

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## Figures

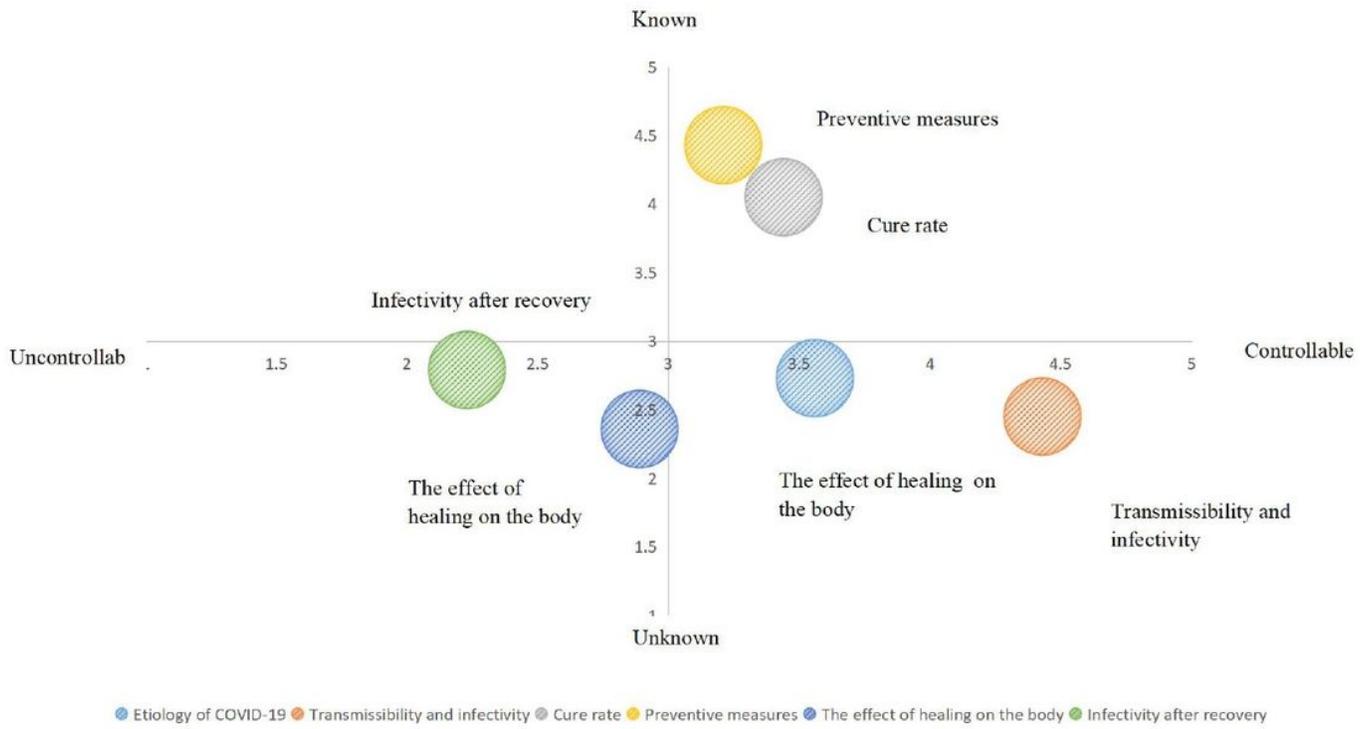


Figure 1

The map of public risk perception on COVID-19 epidemic information

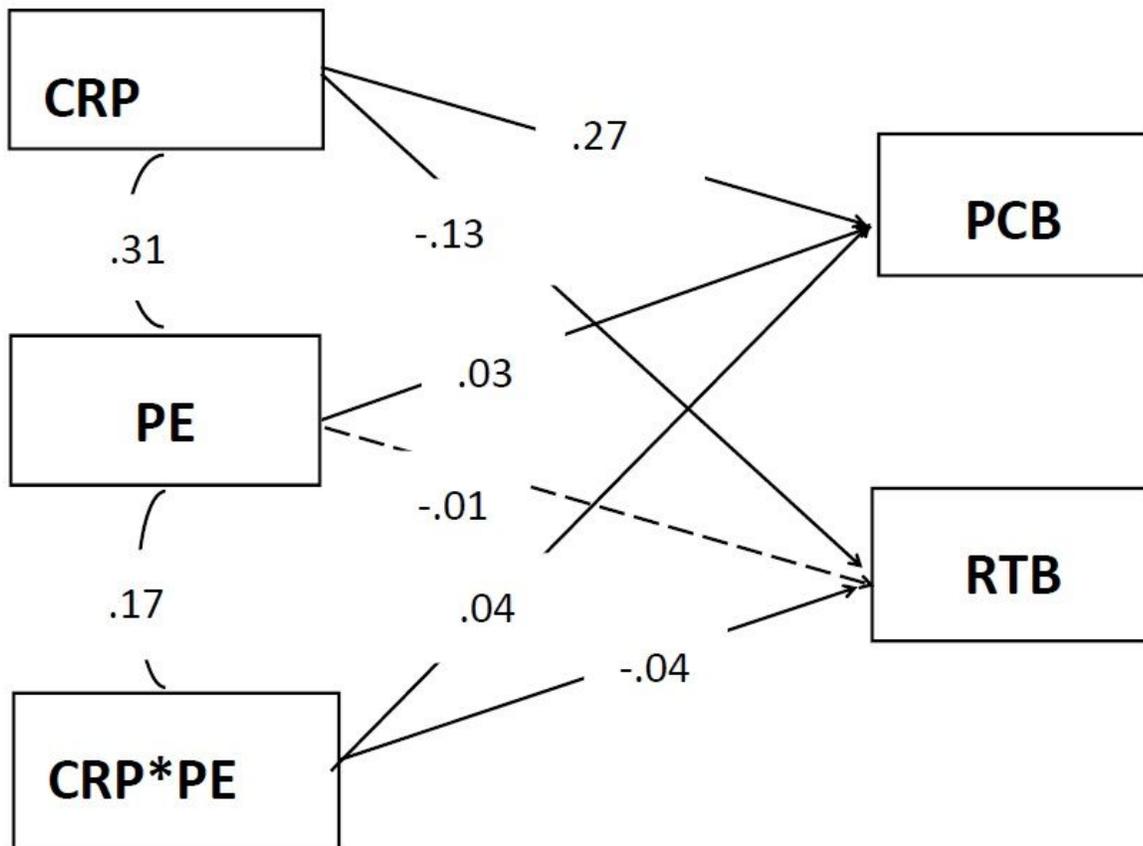


Figure 2

The moderating effect of PE on the relationship between CRP,PCB and RTB. Note. PE = positive emotion; CRP = COVID-19-related risk perception;PCB=Positive-coping behavior;RTB=Risk-taken behavior.Non-significant coefficients were presented with dotted line. demographic variables controlled.n=1729

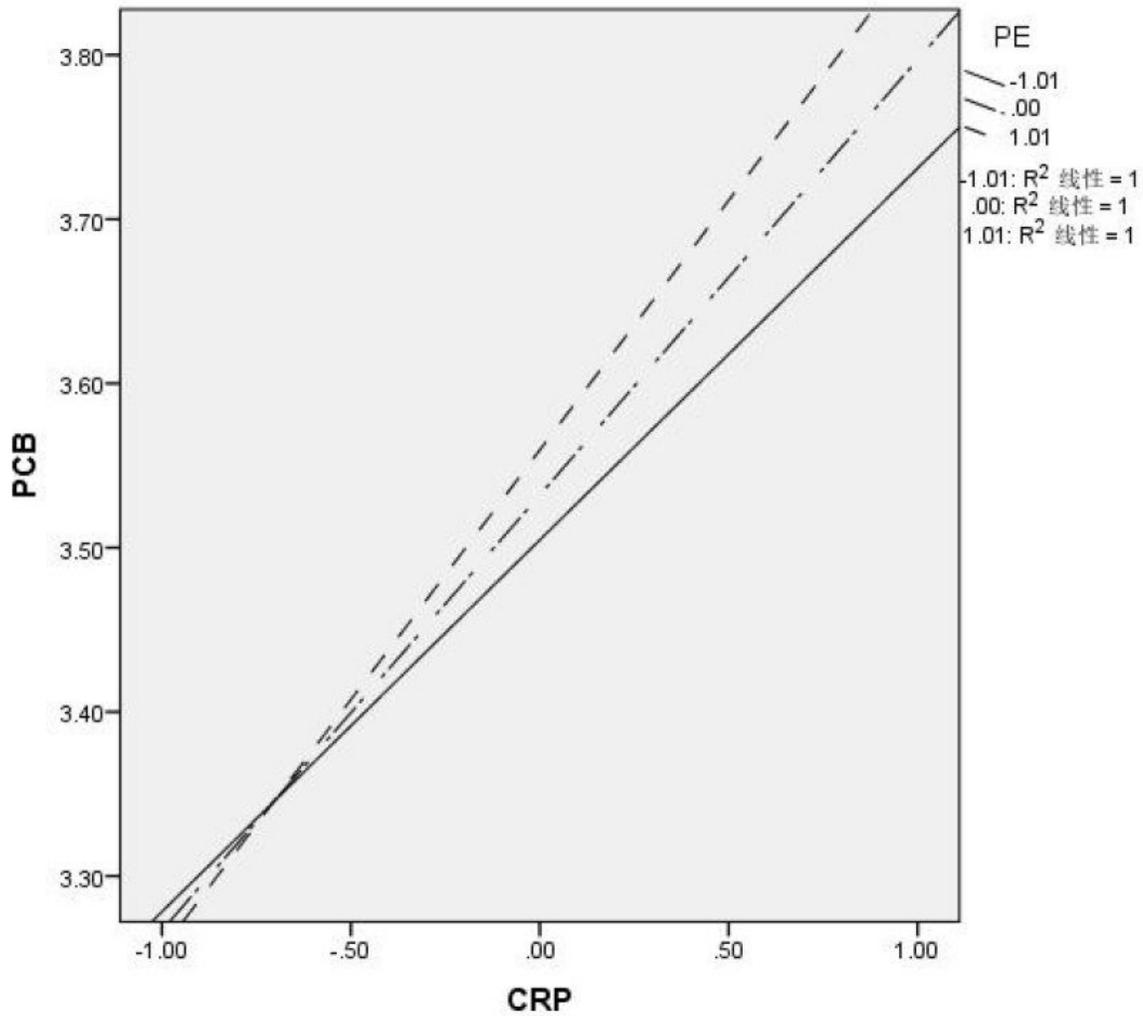


Figure 3

COVID-19-related risk perception interacted with positive emotions predicting positive-coping behavior.

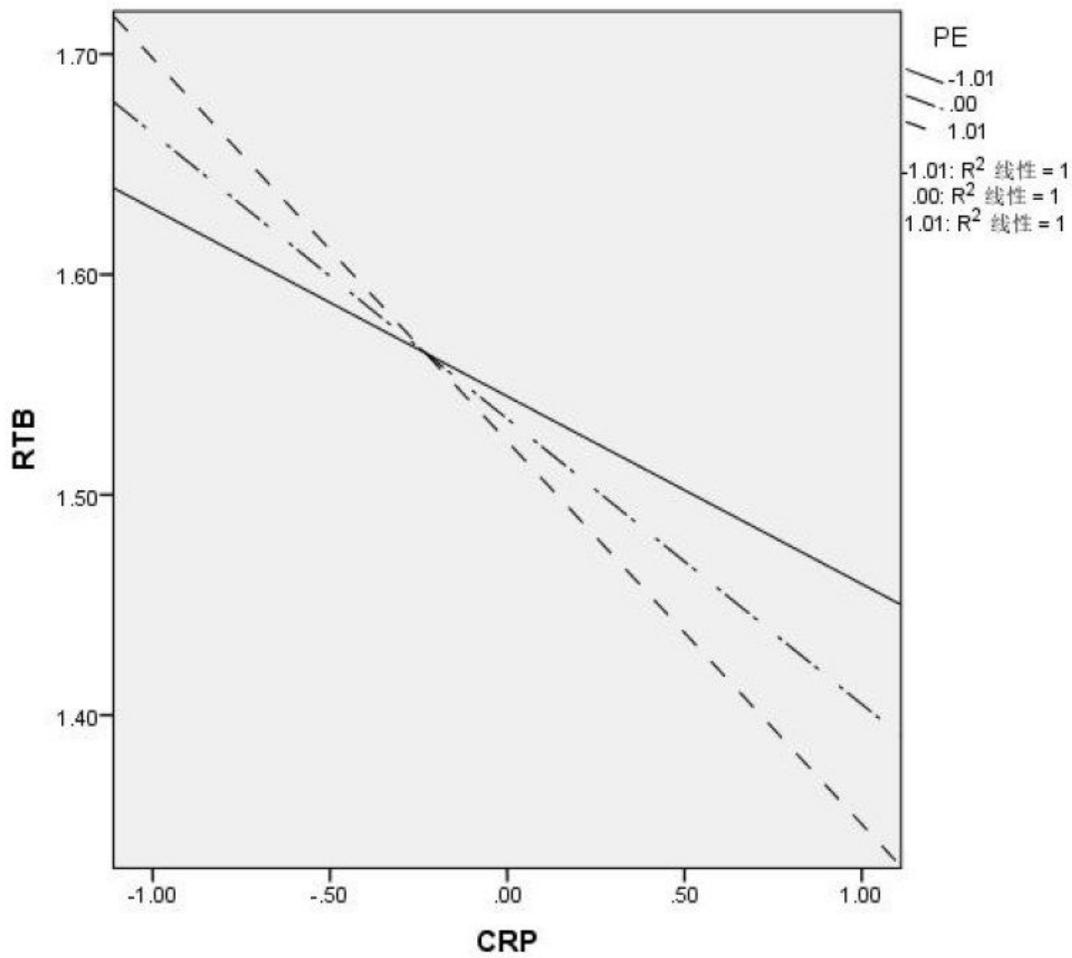


Figure 4

COVID-19-related risk perception interacted with positive emotion predicting risk-taking behavior. Note. PE = positive emotion; CRP = COVID-19-related risk Perception; PCB=Positive-coping behavior; RTB=Risk-taken behavior.