Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Individual differences in social distancing and mask-wearing in the pandemic of COVID-19: The role of need for cognition, self-control and risk attitude

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ABSTRACT

In the United States, while the number of COVID-19 cases continue to increase, the practice of social distancing and mask-wearing have been controversial and even politicized. The present study examined the role of psychological traits in social distancing compliance and mask-wearing behavior and attitude. A sample of 233 U.S. adult residents were recruited from Amazon Mechanical Turk. Participants completed scales of social distancing compliance, mask-wearing behavior and attitude, need for cognition, self-control, risk attitude, and political ideology. Epidemiological information (seven-day positive rate and the number of cases per 100,000) was obtained based on the state participants resided in. As a result, epidemiological information did not correlate with social distancing compliance mask-wearing. Political ideology, on the other hand, was a significant factor, with a more liberal tendency being associated with greater engagement in social distancing compliance and mask-wearing behavior an attitude. Importantly, those who were more risk averse, or had a higher level of self-control or need for cognition practiced more social distancing and mask-wearing, after controlling for demographics, epidemiological information, and political ideology. Furthermore, for mask-wearing behavior, political ideology interacted with both need for cognition and self-control. Collectively, the study revealed the psychological roots of individual differences in social distancing and mask-wearing compliance.

1. Introduction

The number of coronavirus cases has been increasing rapidly in the United States. On August 9th, 2020, the U.S. topped five million coronavirus cases (Li & Calfas, 2020). To control the spread of the virus, health experts have recommended social distancing and mask-wearing (Chinazzi et al., 2020; Eikenberry et al., 2020). However, violation of social distancing is not uncommon (Taylor, 2020). Moreover, mask-wearing appears to be a controversial and even politicized issue in the U.S. (Saey, 2020; Syal, 2020). Therefore, to promote protective behaviors, it is imperative to understand the psychological factors associated with social distancing and mask-wearing.

Our primary goal is to advance the knowledge of the role of psychological traits in social distancing and mask-wearing. Some recent studies on behavioral immune system have shown disgust sensitivity predicts COVID-19-related concerns and behaviors (Makhanova & Shepherd, 2020; Olivera-La Rosa et al., 2020; Shook et al., 2020). Differed from those studies, we address this topic from the judgment and decision-making perspective. While social distancing and mask-wearing bring health benefits, they deviate from normal daily routines and may bring physical and/or psychological uncomfortableness. Thus, trade-offs are involved in these behaviors. In the present study, we choose to focus on three cognitive based traits: self-control, need for cognition, and risk attitude (Casey, 2015; Mohammed & Schwall, 2012; Tittle et al., 2003). Previous studies have shown these traits correlate to each other (Bertrams & Dickhäuser, 2009; Freeman & Muraven, 2010; Grass et al., 2019; Zuckerman & Kuhlman, 2000), and thus capture overlapped psychological constructs. Furthermore, as detailed below, these traits are extensively related to both the decision-making process and subsequent decision implementation (Mohammed & Schwall, 2012).

1.1. Self-control

The trait of self-control refers to an individual's tendency to resist

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temptation and seek long-term benefits (Stillman et al., 2017). Self-control is also viewed as the level of executive resource that can be depleted with repetitive use but strengthened with practice (Baumeister et al., 2007; Hagger et al., 2010). Self-control impacts human behavior through variant decision stages, including but not limited to information processing, selection of decision strategy, and decision implementation. For example, higher self-control is associated with more balanced information processing when encountering threatening information (Ruttan & Nordgren, 2016), higher tendency to engage in deliberative reasoning over heuristic reasoning (Williams et al., 2017), and greater ability in carrying out original plans (Mischel et al., 1989). Therefore, self-control is crucial for a wide range of behaviors that lead to a successful life (de Ridder et al., 2012). Conversely, low self-control is related to many behavioral problems such as obesity, impulse buying, substance abuse, and procrastination (Cheng et al., 2012; Johnson & Bruner, 2012; Schiff et al., 2016; Vohs & Baumeister, 2004). Additionally, a recent study found better social distancing compliance was associated with greater working memory capacity, partly because people with a larger working memory capacity could better handle a variety of information and thus develop a better understanding of benefits over costs of social distancing (Xie et al., 2020). Working memory capacity is closely related to self-control and rational decision-making (Broadway et al., 2010). Hence, it is reasonable to expect a critical role of self-control in protective behaviors. Taken together, we expect individuals with higher self-control to practice more protective behaviors.

1.2. Need for cognition

Need for cognition (NFC) refers to the tendency to enjoy and engage in effortful, systematic thinking (Cacioppo et al., 1984). Individuals with higher NFC are motivated to seek information. They value scientific and professional books more than individuals with lower NFC (Juric, 2017), and have more knowledge about AIDS and a more positive attitude toward condom usage (Bakker, 1999). They are also more willing to invest cognitive effort to solve demanding tasks, and employ an elaborated information processing style instead of a heuristic processing style (Cacioppo,1996; Verplanken et al., 1992). Consistently, NFC can increase judgment and decision-making competence. For example, in syllogistic reasoning, when logical validity was incongruent with conclusion believability, higher NFC people were more likely to follow logical principles to evaluate the conclusion (Ding et al., 2020). Additionally, NFC relates to individuals' susceptibility to decision biases such as the framing effect and sunk cost effect (Carnevale et al., 2011). Not surprisingly, NFC is associated with great academic achievement (Bertrams & Dickhäuser, 2009; Richardson et al., 2012), and better treatment outcomes for smoking cessation intervention (Haug et al., 2010). However, higher NFC does not always guarantee better decisions. Under some situations, such as when a task is ambiguous, an individual with higher NFC might be more susceptible to subtle priming effect than those with low NFC (Petty et al., 2008). Therefore, NFC does not eliminate all bias, but rather certain biases arise due to overreliance on heuristics (Carnevale et al., 2011).

Moreover, effortful thinking and self-control rely on the same energy resource (Masicampo & Baumeister, 2008). Therefore, higher NFC provides more resource for self-control. Consistently, studies showed that NFC increases performance in self-control tasks (Stroop), and is positively correlated with self-control (Bertrams & Dickhäuser, 2009; Grass et al., 2019). Altogether, these studies suggest that higher NFC people are more likely to recognize the value of social distancing and mask-wearing, and practice these protective behaviors.

1.3. Risk attitude

Risk attitude affects how people evaluate decision context and possible decision outcome. It is a key determinant of decision-making processes and has been incorporated into multiple decision-making theories (Blais & Weber, 2006; Mohammed & Schwall, 2012). Research on risk attitude primarily found that those higher in risk-averse are less likely to make risky decisions. For example, in the health-related domain, risk-averse individuals were less likely to engage in smoking and heavy drinking, and had a better control of their weight (Anderson & Mellor, 2008). More pertinently, recent studies have shown that risk attitude predicted protective behaviors during the COVID-19 pandemic. Specifically, these studies showed that greater risk-averse was associated with a reduction of human mobility and travel intention (Chan et al., 2020; Luo & Lam, 2020), and with more compliance to containment measures such as social distancing (Miguel et al., 2021).

Additionally, past research has found a relationship between self-control and risk attitude. For example, people with lower self-control were more likely to engage in inappropriate risk-seeking behaviors such as unprotected sexual behaviors and dangerous driving, possibly due to failing to resist temptation (Vavrik, 1997; Wulfert et al., 1999). Together, the present study expects that risk averse is positively related to social distancing compliance and mask-wearing.

1.4. Goal and overview

The present study aims to advance the understanding of the psychological traits underlying social distancing and mask-wearing during the COVID-19 pandemic. To further examine the role of the traits described above, the study also measures political ideology and epidemiological information as covariates. Political ideology is related to the attitude toward a variety of health behaviors and choices, including smoking, drinking, exercise, vaccination and (healthy/unhealthy) food selections (Kannan & Veazie, 2018). A Gallup poll found that Democrats, as opposed to Republicans, were more likely to practice social distancing and wear a mask during COVID-19 pandemic (Bird & Ritter, 2020). Furthermore, political ideology can moderate the effect of psychological trait on perceptions and behaviors. For example, risk averse increased the likelihood to call police in a potentially risky situation, but its effect was stronger in conservatives than in liberals (Zubrod, 2019). A recent study showed that the number of confirmed cases increase risk perception of the COVID-19 pandemic, but this effect is also moderated by political ideology (Barrios & Hochberg, 2020). Therefore, the present study examines the influence of political ideology on protective behavior and its moderate effect on psychological traits.

A recent study showed that the number of confirmed cases enhanced perceived risk of the COVID-19 and protective behaviors (Barrios & Hochberg, 2020). Therefore, the present study also included epidemiological information with seven-day average positive test rate and the number of coronavirus cases in a certain U.S. state. We examine whether social distancing and mask-wearing practice is correlated with epidemiological information. More importantly, the study tests whether the effects of psychological traits are still significant after controlling for epidemiological information and political ideology.

2. Methods

2.1. Participants

The study was approved by IRB before data collection. Participants were recruited from Amazon Mechanical Turk (mTurk) on August 10, 2020. To be eligible for the study, participants must be an adult, a U.S. resident, and have an approval rating greater than 98% in mTurk. As a result, 233 participants were enrolled into the study. Each participant received $1.50 for their time. Demographics are found in the Results section. A sensitivity analysis was performed with G*Power 3.1.9 to estimate the effect size that could be detected with the current sample size. With $\alpha = 0.05$ and power $= 0.80$, the sample size allowed to detect an R^2 as low as 0.09 in a linear regression reported below.

2.2. Materials and procedures

Participants took an online survey via Qualtrics. The following questionnaires were completed:

2.2.1. Mask-wearing behavior and attitude scale

The three-item Likert-type scale was developed in the present study to measure participants' mask-wearing behavior and attitude. The items were:

(1) Over the past month, did you wear a mask when going outside? (1 = Never and 7 = Always).
(2) Do you agree with mask mandate? (1 = No, not at all and 7 = Yes, absolutely).
(3) Do you agree with the statement that mask can slow virus spread? (1 = No, not at all and 7 = Yes, absolutely).

The reliability of this scale (Cronbach's α) was 0.85 based on the current sample. Item 1 measured mask-wearing behavior. Average of item 2 and 3 measured mask-wearing attitude, with a higher score indicating more positive attitude toward mask-wearing.

2.2.2. Social distancing compliance scale

The scale was a modified version based on the one used in Xie et al. (2020). Participants were asked to recall a set of social distancing practice over the past month, including (1) held social gathering with friends; (2) went to events or gatherings; (3) went to church or attending other community activities; (4) had handshakes, hugs or kisses when greeting; and (5) kept at least 6 ft from other people who are not from your household in both indoor and outdoor spaces. Participants responded with a Likert scale with 1 = Never and 7 = Always (the last item was reverse coded). An average was taken across the five items, with a lower score indicating a stronger tendency of social distancing compliance. The reliability of this scale was 0.89 in the study.

2.2.3. Risk attitude scale

The Doman Specific Risk-Taking Scale (DOSPERT, Blais & Weber, 2006) was used to measure risk attitude (risk seeking vs. risk averse). The scale contains five subscales that assess risk attitude in five different specific domains (i.e., ethical, financial, health/safety, recreational, and social). Participants were asked to evaluate how risky the action or behavior was in each item using a 7-point Likert rating scale, ranging from 1 (Not at all risky) to 7 (Extremely risky). Example items include: "Disagreeing with an authority figure on a major issue" (social); "Bungee jumping off a tall bridge" (recreational); "Drinking heavily at a social function" (health/safety). The present study focused on risk attitude in the health domain. Thus, in addition to the whole scale, the subscale of health/safety risk scale was also computed. For both the whole scale and the subscale, an average was taken across the items, with a higher sore indicating a higher level of risk averse (or lower intention to engage in risky behaviors). The reliability of the whole scale and the health/safety subscale was 0.90 and 0.77, respectively.

2.2.4. Tangney self-control scale

Tangney Self-control Scale (TSC, Tangney et al., 2004) were employed to measure self-control. It has 10 items and adopted a five-point Likert scale. In the present study, for items describing low self-control (e.g., I get distracted easily), participants responded from 1 (Not at all like me) to 5 (Very much like me). By contrast, for items describing high self-control (e.g., I'm good at resisting temptation), the coding was reversed, with 1 (Very much like me) to 5 (Not at all like me). Therefore, in the current work, a lower score means greater self-control. The reliability of TSC was 0.87.

2.2.5. Need for cognition scale

The need for cognition scale (NFC, Cacioppo et al., 1984) adopts a 5-point Likert scale where 1 denotes "extremely uncharacteristic of me" and 5 denotes "extremely characteristic of me." The scale has 18 items. Example statements on this scale include "I find satisfaction in deliberating hard and for long hours" and "I only think as hard as I have to." An average was taken across the items, with a higher score indicating a higher tendency to enjoy deeper thinking. In the present study, the reliability of this scale was 0.94.

2.2.6. Demographic variables

After completing the scales presented above, participants were asked to report their demographic information including race, age, gender, education, annual household income, and political ideology. Race was coded with 1 = White or Caucasian, 2 = Hispanic or Latinx, 3 = Black or African American, 4 = Asian or Asian American, and 5 = Other. Gender was coded with 1 = male and 2 = female. Education was coded with six levels: 1 = Less than high school graduate, 2 = High school graduate or equivalent, 3 = Some college or associate degree, 4 = Bachelor's degree, 5 = Master's degree, 6 = Doctoral degree. Annual household income was measured with 13 levels and ranged between under $9999 and above $120,000 with increments of $9999.

Political ideology was obtained by asking participants to rate four items from 1 (Very conservative) to 5 (Very liberal). These four items were: overall political orientation, views on social issues, views on economic issues, and views on foreign policy (Inbar & Lammers, 2012). An average was taken across the items, with a higher score indicating a more liberal orientation. The reliability of the political ideology scale was 0.94.

2.2.7. Epidemiological information

Participants were asked to report the state (e.g., NY) they resided in. For each state reported by participants, an average positive test rate over the past seven days (as of August 10, 2020) was obtained from John Hopkins Coronavirus Resource Center (https://coronavirus.jhu.edu/testing/tracker/overview). Additionally, for each state that was reported, the number of COVID cases per 100,000 people as of August 10, 2020 was acquired from CDC Covid Data Tracker website (https://www.cdc.gov/covid-data-tracker/#cases).

2.3. Data analyses

SPSS 24.0 was employed for data analyses. Descriptive statistics were used to describe the demographics and performance on a variety of scales described above. Correlations were conducted to display the zero-order relationships between social distancing compliance, mask-wearing behavior and attitude, and demographics, political ideology, psychological traits, and epidemiological information. To further test the role of psychological traits, for each of the dependent variables, a hierarchical linear regression was performed, with age, gender, education, income, political ideology, and epidemiological information in the first block; need for cognition, self-control and risk attitude in the second block, and the interactions between need for cognition, self-control, risk attitude and political ideology in the third block. The variables of political ideology, need for cognition, self-control and risk attitude were mean-centered. Partial correlation was adopted to show the effect size of the coefficients.

It is worth noting the dependent variable of social distancing compliance was positively skewed (skewness = 0.95). Mask-wearing behavior and attitude were negatively skewed (skewness = −1.88 and −1.87 respectively). Natural-log was performed for each of the variable. After transformation, social distancing compliance was approaching normal (skewness = 0.49). However, both mask-wearing behavior and attitude were even more skewed (skewness = −3.29 and −3.06).

Therefore, for the correlations and regressions performed below, natural-logged social distancing compliance and original mask-wearing behavior and attitude were adopted as dependent variables.[1]

3. Results

Across 233 participants, there were 140 males (60.1%) and 93 females. The variable of age ranged from 20 to 74, with a mean of 38.55 ($SD = 11.88$). For political ideology, it ranged from 1 to 5, with a mean of 3.36 ($SD = 1.13$). Table 1 displays the descriptive statistics for race, education, and income.

Table 2 exhibits the performance on social distancing compliance, mask-wearing behavior and attitude, need for cognition, self-control and risk attitude scales. For social distancing compliance, the mean was relatively small, indicating an overall tendency to follow social distancing across participants. For both mask-wearing behavior and attitude, the mean was extremely high. In particular, 131 (56.2%) and 129 (55.4%) participants had a score of 7 for mask-wearing and mask-attitude, respectively, suggesting a potential ceiling effect.

Table 3 displays the correlations between the demographics, performance on the behavioral scales, and COVID situation (epidemiological information) in participants' state. The dependent variable social distancing compliance was moderately related to mask wearing behavior and attitude, suggesting they captured different constructs of coping strategies in the pandemic. For both behavioral dependent variables, those who were more liberal, or risk averse in the health/safety domain, or had a higher level of self-control and need for cognition were more likely to follow social distancing or wear masks. Interestingly, even though mask behavior and mask-wearing attitude were strongly correlated, they showed different patterns with relation to other behavioral scales. Compared to mask-wearing behavior, attitude was more strongly correlated to political ideology, slightly less correlated to need for cognition, and not related to self-control or risk aversion.

The study adopted two measures (seven-day positive rate and positive cases per 100,000 in a U.S. state) to index the severity of the COVID situation. However, neither measures were related to social distancing compliance or mask-wearing behavior and attitude. Additionally, the overall risk attitude scale (RA) was not related to social distancing compliance. This finding echoed the notion that people might have different risk attitudes in different domains, and a specific scale might be more appropriate to use (Blais & Weber, 2006). Therefore, in the following analyses, risk attitude in the health/safety domain (HSRA) was used.

Table 1
Descriptive statistics for race, education, and income.

Variable	Category	Frequency	Percentage (%)
Race	White or Caucasian	174	74.7
	Hispanic or Latinx	5	2.1
	Black or African American	40	17.2
	Asian or Asian American	13	5.6
	Other	1	0.4
Education	Less than high school graduate	0	0
	High school graduate or equivalent	24	10.3
	Some college or associate degree	55	23.6
	Bachelor's degree	108	46.4
	Master's degree	42	18
	Doctoral degree	2	0.9
Income ($)	Under 9999	6	2.6
	10,000–19,999	21	9.0
	20,000–29,999	29	12.4
	30,000–39,999	20	8.6
	40,000–49,999	27	11.6
	50,000–59,999	36	15.5
	60,000–69,999	19	8.2
	70,000–79,999	22	9.4
	80,000–89,999	13	5.6
	90,000–99,999	6	2.6
	100,000–109,999	9	3.9
	110,000–119,999	7	3.0
	Above 120,000	18	7.7

Table 2
Performance on SDC, MWB, WMA, RA, HRA, TSC, and NFC scales.

Variable	SDC	MWB	MWA	RA	HSRA	TSC	NFC
Mean	2.34	6.12	6.08	4.97	5.40	2.49	3.34
SD	1.54	1.34	1.45	0.81	1.03	0.89	0.89
Minimum	1	1	1	2.1	1.83	1	1
Maximum	5.8	7	7	6.8	7.0	4.6	5

SDC: social distancing compliance; MWB: mask-wearing behavior; MWA: mask-wearing attitude; RA: risk attitude; HSRA: health/safety risk attitude; TSC: Tangney self-control; NFC: need for cognition.

As noted above, a hierarchical linear regression was performed on social distancing compliance, mask-wearing behavior, and mask-wearing attitude, respectively. The results are presented in Table 4. For both social distancing compliance and mask-wearing behavior, across the three blocks, political ideology was a consistent predictor. That is, in the presence of other variables, a more liberal person was more likely to follow social distancing. Consistent with the zero-order correlations, all three psychological traits could predict social distancing compliance and mask-wearing behavior, after controlling for other variables. However, for social distancing compliance, none of the interaction between political ideology and psychological trait was significant. For mask-wearing, political ideology interacted with need for cognition and self-control. To unpack the interactions, for each predictor variable, a high and a low group was created with median split. Fig. 1 depicts the interactions. As shown in the left and right panels respectively, for both predictors, a higher level of need for cognition and self-control were associated with a higher likelihood of mask-wearing behavior, such a tendency was more pronounced in the more liberal participants than in the more conservative participants. In other words, the roles of both need for cognition and self-control were moderated by political ideology. In contrast, mask-wearing attitude was only predicted by political ideology and need for cognition, consistent with the zero-order correlations.

4. Discussion

The present study found that greater self-control, NFC and health/safety risk averse all predicted a higher level of behavioral engagement in practicing social-distancing and mask-wearing. NFC also predicted the attitude toward mask-wearing. Additionally, protective behaviors were more common and mask-wearing attitude was more positive in participants with a more liberal tendency. Furthermore, political ideology moderated the effect of NFC and self-control on mask-wearing behavior, as depicted in Fig. 1.

The discovered relationships between the three psychological traits and the protective behaviors added to the literature that signifies the importance of these traits on judgment and decision making (Mohammed & Schwall, 2012; Williams et al., 2017). For example, while previous studies have shown that risk-averse was associated with a reduction of human mobility and travel intention (Chan et al., 2020; Luo & Lam, 2020), the study further found that individuals with higher health/safety risk-averse were more likely to practice social distancing and mask-wearing, thus illustrating the role of risk attitude in the COVID-19 pandemic. Additionally, the positive relationships between self-control, NFC and practice of social distancing and mask-wearing echoed the notion that these two traits were associated with the

[1] Significance of the coefficients remained the same when using natural-logged dependent variables of mask-wearing.

Table 3
Correlations between demographics, performance on the behavioral scales, and epidemiological information.

	MWB	MWA	Age	Gen	Edu	Inc	PI	RA	HSRA	TSC	NFC	Rate	Case
SDC	−0.32***	−0.31***	−0.09	−0.10	0.34***	−0.05	−0.24***	0.01	−0.22**	0.54***	−0.26***	−0.06	0.06
MWB	–	0.64***	0.07	0.07	0.04	0.04	0.20**	0.20**	0.20**	−0.21**	0.25***	0.05	0.05
MWA		–	−0.02	0.00	0.05	0.01	0.32***	0.07	0.09	−0.12	0.18**	0.03	0.01
Age			–	0.28***	0.03	−0.01	−0.06	0.27***	0.30***	−0.15*	0.06	0.07	0.05
Gen				–	−0.04	−0.10	0.07	0.27***	0.32***	−0.03	−0.05	0.09	0.004
Edu					–	0.23***	−0.18**	0.17**	0.04	0.20**	0.01	−0.09	0.08
Inc						–	0.22**	−0.04	−0.06	−0.21**	0.11	0.01	−0.04
PI							–	−0.06	−0.02	−0.06	0.03	−0.07	−0.11
RA								–	0.81***	0.01	−0.08	0.10	0.06
HSRA									–	−0.20**	−0.03	0.13	0.04
TSC										–	−0.30***	−0.13	−0.004
NFC											–	−0.01	0.02
Rate												–	0.27***

SDC: social distancing compliance; MWB: mask-wearing behavior; MWA: mask-wearing attitude; Gen: gender; Edu: education; Inc.: income; PI: political ideology; RA: risk attitude; HSRA: health/safety risk attitude; TSC: Tangency self-control; NFC: need for cognition; Rate: average positive rate in the past week; Case: cases per 100,000.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 4
Hierarchical regressions on social distancing compliance and attitude toward mask-wearing.

Blocks and variables	Social distancing		Mask-wearing behavior		Mask-wearing attitude	
	B(SE)	Partial correlation	B(SE)	Partial correlation	B(SE)	Partial correlation
Block 1						
R^2 change	0.19***		0.05		0.12***	
Age	−0.004(0.003)	−0.08	0.007(0.01)	0.06	−0.001(0.01)	−0.01
Gender	−0.08(0.08)	−0.06	0.007(0.19)	0.02	−0.11(0.19)	−0.04
Education	0.23(0.04)***	0.32	0.09(0.10)	0.06	0.17(0.10)	0.10
Income	−0.04(0.01)**	−0.18	0.04(0.03)	0.09	0.03(0.03)	0.07
PI	−0.12(0.03)**	−0.20	0.25(0.08)**	0.21	0.42(0.08) ***	0.33
Positive rate	−0.003(0.005)	−0.03	0.01(0.01)	0.04	0.01(0.01)	0.05
Cases per 100k	<0.000	0.02	<0.000	0.04	<0.000	0.01
Block 2						
R^2 change	0.24***		0.11***		0.05**	
Age	0.001(0.003)	0.02	−0.002(0.01)	−0.01	−0.01(0.01)	−0.05
Gender	−0.04(0.07)	−0.03	−0.009(0.18)	−0.003	−0.14(0.19)	−0.05
Education	0.16(0.04)***	0.22	0.14(0.10)	0.09	0.20(0.11)	0.12
Income	−0.01(0.01)	−0.05	0.01(0.03)	0.02	0.02(0.03)	0.03
PI	−0.09(0.03)**	−0.16	0.22(0.08)**	0.18	0.40(0.08)***	0.31
Positive rate	0.002(0.004)	0.02	0.002(0.01)	0.01	0.01(0.01)	0.04
Cases per 100k	<0.000	0.03	<0.000	0.03	<0.000	0.001
HSRA	−0.09(0.04)*	−0.14	0.20(0.09)*	0.14	0.11(0.10)	0.07
TSC	0.28(0.04)***	0.36	−0.22(0.11)*	−0.13	−0.12(0.11)	−0.06
NFC	−0.09(0.04)*	−0.13	0.33(0.10)**	0.22	0.27(0.10)*	0.16
Block 3						
R^2 change	0.003		0.04*		0.01	
Age	0.001(0.003)	0.02	−0.001(0.01)	−0.01	−0.01(0.01)	−0.05
Gender	−0.03(0.07)	−0.02	0.08(0.18)	0.03	−0.11(0.20)	−0.03
Education	0.16(0.04)***	0.21	0.14(0.10)*	0.09	0.21(0.11)	0.12
Income	−0.01(0.01)	−0.06	0.002(0.03)	0.004	0.01(0.03)	0.03
PI	−0.09(0.03)**	−0.17	0.19(0.08)*	0.16	0.40(0.08)***	0.31
Positive rate	0.001(0.005)	0.02	0.001(0.01)	0.01	0.01(0.01)	0.04
Cases per 100k	<0.000	0.03	<0.000	0.02	<0.000	−0.01
HSRA	−0.10(0.04)*	−0.14	0.18(0.09)*	0.12	0.12(0.10)	0.08
TSC	0.29(0.04)***	0.36	−0.19(0.10)	−0.11	−0.10(0.11)	−0.06
NFC	−0.09(0.04)*	−0.13	0.37(0.10)***	0.24	0.30(0.11)**	0.18
HSRA×PI	0.02(0.03)	0.04	0.06(0.07)	0.06	−0.06(0.08)	−0.05
TSC × PI	−0.02(0.03)	−0.02	−0.17(0.08)*	−0.13	−0.07(0.09)	−0.05
NFC × PI	−0.01(0.03)	−0.01	−0.18(0.07)*	−0.15	−0.12(0.08)	−0.09

HSRA: health/safety risk attitude; TSC: Tangency self-control; NFC: need for cognition; PI: political ideology.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

tendency to use effortful analytical reasoning over heuristics (Williams et al., 2017). The significant relationship between self-control and NFC was also in line with the theory that the two traits consume the same executive energy resource (Cacioppo et al., 1996; Masicampo & Baumeister, 2008). Together, the present study elucidated how the processes of judgment and decision making could be related to behaviors in the pandemic (more broadly speaking, public health). The findings implied that the executive energy, which shared by both self-control

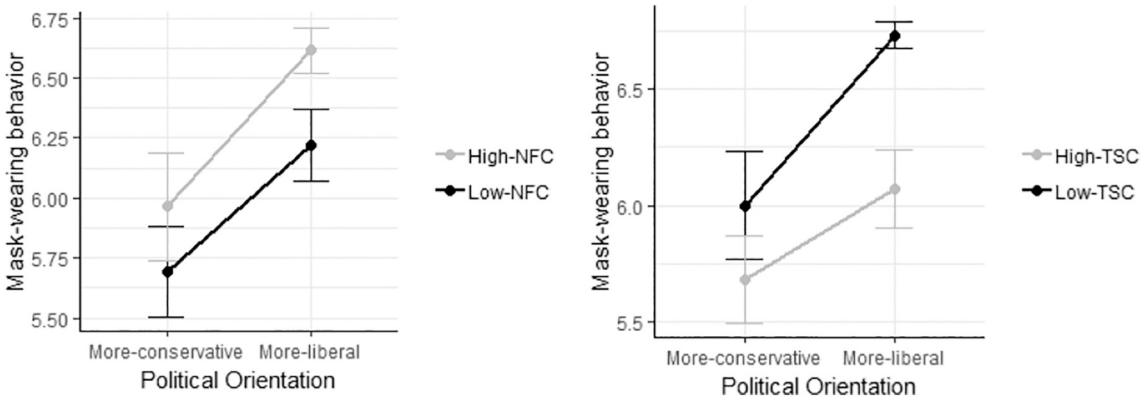

Fig. 1. Interactions of political ideology with need for cognition, and with self-control on mask-wearing behavior. Left panel shows the interaction with need for cognition, and right panel shows the interaction with self-control. TSC score was reversed coded, with a higher score indicating weaker self-control.

and effortful thinking, was critical for practicing protective behaviors.

The present study was correlational in its nature. However, the findings still generated implications for promoting protective behaviors via the three psychological traits examined in this study. Some past studies have found self-control, need for cognition and risk attitude can be changed or improved. For example, self-control can be strengthened with practices such as delay gratification (Hagger et al., 2010; Hester, 1995). Innovative pedagogy approaches, such as cooperative learning and reflective learning, as opposed to traditional lecture, could improve need for cognition scores in college students (Castle Jr, 2014; Wang et al., 2015). As for risk attitude, news report and message framing could affect how people evaluate the risk of an incident or situation (Agha, 2003; Wahlberg & Sjoberg, 2000). Therefore, although our study did not directly address how to improve social distancing and mask-wearing, we believe the study could serve as a starting point and that future research could examine how improved self-control and NFC could lead to more protective behaviors.

The study found political ideology was a powerful factor. For all dependent variables, political ideology was consistently significant, with a more liberal tendency being associated with more practice on social distancing and mask-wearing. Moreover, whereas both self-control and NFC were related to mask-wearing behavior, the relationships were stronger in the more liberal participants than in the more conservative participants. This result was consistent with the finding that risk perception of COVID-19 increased with the number of confirmed cases, but such an effect was muted in counties with higher Trump (Republican) vote share (Barrios & Hochberg, 2020). Thus, while this study's primary focus was not on politics, the study added to the literature that political ideology moderated the effect of psychological factors (Zubrod, 2019). Moreover, together with other research (Barrios & Hochberg, 2020; Conway III et al., 2020), the present study empirically demonstrated that the protective behaviors in the pandemic of COVID-19 were highly politicized (Yamey, 2020). The study was also in line with the argument that politicization might have a detrimental impact to public health (Gostin, 2018). It is worth noting that 2020 election was one of the most influential and heated elections in the U.S. history. As the election is over, the impact of political ideology on protective and other COVID-related behaviors demands continuing research.

While experts recommend both social distancing and mask-wearing, the study found they were moderately correlated, indicating people might have different strategies and opinions on them. For instance, some people believed keeping social distancing was more inconvenient and burdensome than wearing a mask (Lazer et al., 2020). Additionally, unlike mask-wearing behavior, we detected no interaction for social distancing. A possible explanation was that compared to social distancing, mask-wearing was a more controversial and politicized measure (Syal, 2020).

Interestingly, epidemiological information such as positive test rate and confirmed cases were not related to protective behaviors. The result was in conflict with previous finding that the number of confirmed cases increased risk perception and social distancing (Barrios & Hochberg, 2020). We speculated that the divergency might be related to the timing of the studies. Barrios et al. collected their data between Feb 24th and March 31st, during which the pandemic was still in its early stage and its impact was largely unknown. During this period, risk perception of the virus and subsequent coping behaviors changed rapidly on a daily basis, depending on the confirmed cases (Barrios & Hochberg, 2020). By contrast, in August when the present study was conducted, the seriousness of the pandemic has been widely realized. The majority of participants conducted protective behaviors and held positive attitude toward mask-wearing (more than half people had the highest scores for both behavior and attitude). Accordingly, people's attitude and behavior were no longer associated with the number of confirmed cases. Our study demonstrated that in the later stage, traits related to better judgment and decision making became a more important factor than epidemiological information. Thus, the study implied that cognitive and behavioral training in promoting self-control is an approach that deserves further investigation.

The present study met a potential ceiling effect of mask-wearing. As discussed above, the ceiling effect might be due to the timing of the study. In other words, we speculated that the ceiling effect reflected wide acceptance of mask-wearing as the seriousness of the pandemic became indubitable. However, it is also possible that the current study might have missed those who had a negative view on mask-wearing. To further examine the role of psychological traits, future studies may use a different method to recruit participants (e.g., community outreach) to obtain more diverse views on mask-wearing.

CRediT authorship contribution statement

Ping Xu: Conceptualization, Formal analysis, Writing – review & editing. **Jiuqing Cheng:** Conceptualization, Formal analysis, Data curation, Writing – original draft, Writing – review & editing.

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