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# How anxiety predicts interpersonal curiosity during the COVID-19 pandemic: The mediation effect of interpersonal distancing and autistic tendency

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## ABSTRACT

With the worldwide implementation of quarantine regulations to suppress the spread of the COVID-19, anxiety, interpersonal distancing and autistic tendency may decrease individuals' desire to seek interpersonal information and thus might have negative effects on their interpersonal curiosity. Through behavioral paradigms and scales, two studies were conducted (Study 1:  $n = 570$ ; Study 2:  $n = 501$ ). We explored the predictive effect of anxiety on interpersonal curiosity in situations when mandatory isolation measures have led to dramatic changes in interpersonal distancing and autistic tendency. We found that interpersonal distancing and autistic tendency negatively predicted interpersonal curiosity, and these predictive effects suppressed the positive prediction of state anxiety to interpersonal curiosity. Our research provides insights into the relationships among anxiety, curiosity, interpersonal distancing, and autistic tendency during the COVID-19 pandemic.

## 1. Introduction

Understanding the possible psychological effect of public health emergencies is one of the foremost parts of global concern (Bavel et al., 2020). Recent work shows that COVID-19 has brought immense psychological pressure to people all over the world (Cao, Fang, et al., 2020; Cao, Qi, et al., 2020; Duan & Zhu, 2020; Xiao, 2020), which may not only amplify the intensity of the effects of the disease itself (Ahorsu et al., 2020), but may impair individual mental health, life satisfaction, and sleep quality (Cao, Fang, et al., 2020; Cao, Qi, et al., 2020; Chen et al., 2020; Cong, 2021; Li, Wang, Yang, Lei, & Yang, 2020; Lin, 2020; Yang et al., 2020). Besides, existing research have proved that longer quarantine duration, less social communication, fear of infection, frustration, boredom, inadequate supplies, and inadequate information may all cause residual unwanted effects, such as loneliness, post-traumatic

stress symptoms, confusion, and anger (Bavel et al., 2020; Brooks et al., 2020).

At the same time, the information gap between the knowledge that people possess of COVID-19 and the facts, might function to exacerbate individual uncertainty and anxiety (Lin, 2020). Obtaining and updating information to fill the information gap is one of the basic motivations of human information-seeking behavior (Loewenstein, 1994). Many researchers think that curiosity is a special type of the broader category of information-seeking (Huang, Chen, Luo, & Wu, 2021; Kidd & Hayden, 2015). Curiosity is defined as the desire to acquire knowledge or information in response to experiencing or seeking out collative variables (i.e., uncertainty, surprise, and novelty), which is often accompanied by positive emotions, increased arousal, or exploratory behavior (Grossnickle, 2016). There are different kinds of curiosity during the COVID-19, including trait curiosity, perceptual curiosity, epistemic curiosity,

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and interpersonal curiosity (Huang et al., 2021). Many researchers have studied curiosity alongside anxiety, marking their fundamentally intertwined relationship (Gruber & Ranganath, 2019; Kashdan & Roberts, 2004, 2006; Litman, 2010; Litman & Jimerson, 2004; Spielberger & Starr, 1994). For example, previous research have shown that probabilistic electric shock, inducing stress, inhibits the risk behavior of relieving the curiosity (Lau, Ozono, Kuratomi, Komiya, & Murayama, 2020) or exploratory behavior (Brown, Gagnon, & Wagner, 2020). Te Poel, Baumgartner, Hartmann, and Tanis (2016) found the reciprocal relationship between online health information seeking and health anxiety, which has been labeled as cyberchondria.

However, to our knowledge, fewer empirical research studies focus on the direct effect of anxiety on curiosity, especially on interpersonal curiosity during the COVID-19. Interpersonal curiosity is an individual's desire for new information about other people, including other people's life experience, habits, and details, as well as thoughts, feelings, and interests (Li & Yu, 2015; Litman & Pezzo, 2007), and is one of the most important kinds of curiosity in daily life for building interpersonal relationships (Kashdan, McKnight, Fincham, & Rose, 2011), reducing aggressive behavior (Kashdan et al., 2013), and maintaining social norms (Dunbar, 2004). It is helpful for us to expand our understanding of anxiety states and information-seeking behavior in current situations by further study of the possible relationship between general anxiety and different kinds of curiosity, in particular for interpersonal curiosity during the COVID-19.

Anxiety states have different influences on different populations, especially in the case of increased interpersonal distance caused by mandatory quarantine measures during the COVID-19 pandemic (Bavel et al., 2020; Cartaud, Quesque, & Coello, 2020; Venkatesh & Edirappuli, 2020). Previous studies showed that social anxiety is correlated with autistic traits (Freeth, Bullock, & Milne, 2012). Perry, Levy-Gigi, Richter-Levin, and Shamay-Tsoory (2015) found that social anxiety and interpersonal distance preferences are positively correlated in the ASD group but not in the control group, which indicated the possible relationship between social anxiety, interpersonal distance, and autistic tendency. Considering the high similarity and correlation between state anxiety and social anxiety (Beard & Amir, 2010; Schulz, Alpers, & Hofmann, 2008), and higher sensitivity of state anxiety in the current situation, we expect to find relationship among state anxiety, interpersonal relationships, and autistic tendency. DSM-5 firstly described the autism disorder as being on a spectrum (American Psychiatric, 2013; Lai, Lombardo, Chakrabarti, & Baron-Cohen, 2013), so we need to pay attention to not only the mental health of the autistic group during the COVID-19 pandemic (Cassidy et al., 2020; Oakley et al., 2020), but also the mental health of the sub-health group with autistic tendency during the COVID-19 pandemic (for example, Zhao, Shi, Li, Li, & Li, 2021). In the current situation of mandatory isolation, their autistic tendencies may be more susceptible to anxiety and interpersonal distance.

Interpersonal distancing and autistic tendency may correlate with human curiosity, especially for interpersonal curiosity in the COVID-19 time. Millions of people in lock-down and practice social and physical distancing to curb the spread of highly infectious disease (Cong, 2021), however, the social interaction is significant for acquiring interpersonal information. Besides, a previous study showed that children with ASD have less information-seeking behavior in response to instructions that exceeded their level of understanding than children with developmental delays (Young, Hudry, Trembath, & Vivanti, 2016). Interpersonal curiosity is one of the most important kinds of curiosity in daily life for building interpersonal relationships (Kashdan et al., 2011). So we hypothesize that interpersonal distancing and autistic tendency may negatively predict participant's social information seeking (for example, interpersonal curiosity).

In the current research, several variables were be considered, including anxiety (trait anxiety, state anxiety, social anxiety, and certain emotions associated with anxiety), curiosity (trait curiosity, epistemic curiosity, perceptual curiosity, and interpersonal curiosity), the

interpersonal state of people during the quarantine period (interpersonal distancing), and autistic tendency. To investigate the relationship among these variables during COVID-19, two online datasets (Study 1 and Study 2) was collected and analyzed to explore the correlations between anxiety and different types of curiosity, and focuses on the predictive effect of anxiety on interpersonal curiosity in situations when mandatory isolation measures have led to dramatic changes in interpersonal distancing and autistic tendency. Particularly, we pay attention to the relationship among state anxiety, interpersonal curiosity, interpersonal distancing, and autistic tendency during the COVID-19 pandemic, and hypothesize the predictive relationship between them may be directional.

## 2. Method

### 2.1. Participants

We collected two datasets on an online platform ([www.wjx.cn](http://www.wjx.cn)) during the emerging infectious COVID-19 outbreak. Participants were asked to provide some demographic information about themselves including location, age, gender, education, etc. The first dataset (570 participants, 204 males and 366 females, mean age = 25.08, SD = 8.75) was collected on February 23, 2020 to February 24, 2020, while the second dataset (501 participants, 181 males and 320 females, mean age = 24.31, SD = 7.83) was collected on March 13, 2020. 91 participants failed the attention detection question (e.g., "Please choose the second item for this question."), and their data were removed from the further analysis.

### 2.2. Online study

We adopted well-known psychological scales, and behavioral paradigms, including State-Trait Anxiety Inventory (STAI), Curiosity and Exploratory Inventory-II (CEI-II), Autism Spectrum Quotient (AQ-10), COVID-19 related questions, and a trivia question task in Study 1. In Study 2, we also adopted the Liebowitz Social Anxiety Scale (LSAS), Interpersonal Curiosity Scale (IPCS), blurred picture task and Social Relationship during Quarantining questionnaire (SRQ) additionally (Fig. 1A). In our research, we mainly focused on the trends in different state variables and trait variables, rather than comparing scores with relevant cut-off values for the survey instruments used.

#### 2.2.1. Trivia questions task

Following previous studies that using trivia questions to induce epistemic curiosity (Kang et al., 2009; Ligneul, Mermillod, & Morisseau, 2018; Liquin & Lombrozo, 2020; Marvin & Shohamy, 2016), we used the trivia questions adapted from Liquin and Lombrozo (2020). First, the Chinese versions of the questions were used with four different kinds of questions (e.g., physics, human physiology and psychology, human history, and animal). We measured the degree of curiosity with a 5-point scale from 1 = 'not curious at all' to 5 = 'very curious'. To control the curiosity of the materials of the questions of Liquin's research and our research, we tested the epistemic curiosity of Chinese participants concerning these questions and excluded the questions with the lowest average curiosity score of 10%. For example, "What invention should make Ts'ai Lun, a 2nd-century inventor, a household name?" may be a trivia question for Americans, but for Chinese people, this is a well-known historical and cultural fact. Finally, we randomly selected five trivia questions from each question type and summed up these 20 questions as each participant's state epistemic curiosity score. The state epistemic curiosity scores range from 20 to 100. The Cronbach's  $\alpha$  coefficient of the questionnaire in this study was 0.87.

#### 2.2.2. Blurred pictures task

A new task was supplemented in Study 2. The materials were adapted from Jepma, Verdonschot, Van Steenberg, Rombouts, and

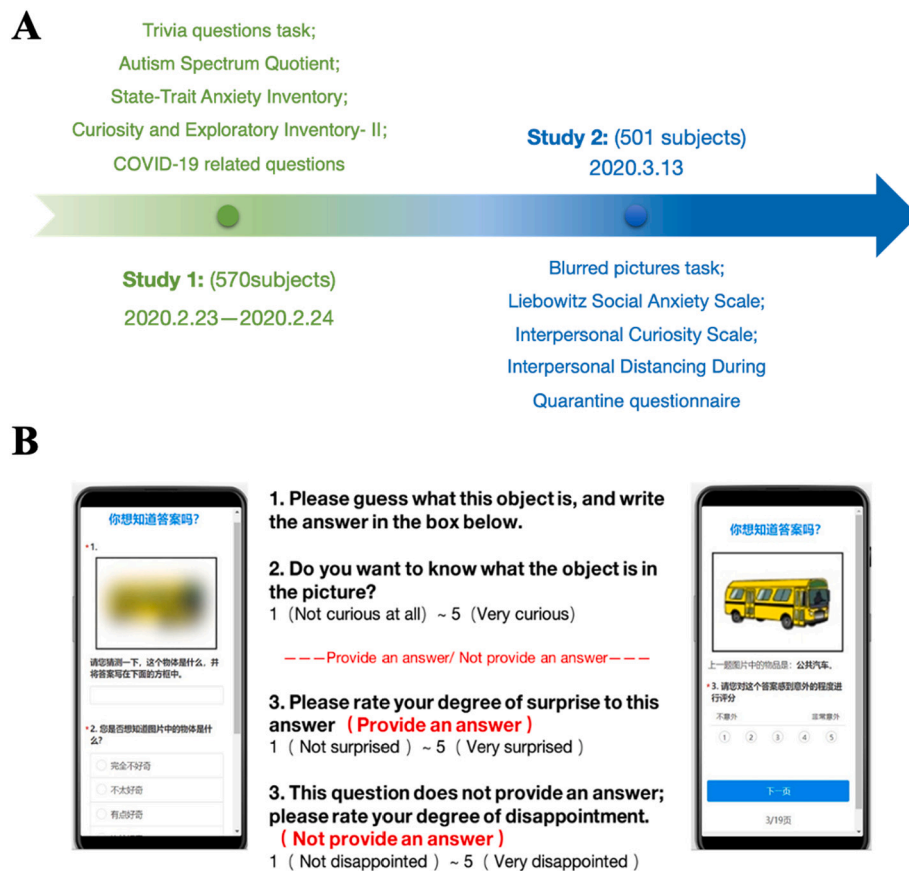


Fig. 1. Questionnaires and tasks of the two online studies.

(A) We used STAI, CEI-II, AQ-10, COVID-19 related questions, and trivia questions task in Study 1. Based on the questionnaires used in Study 1, we added LSAS, IPCS, SRQ and blurred pictures task to Study 2. (B) Schematic diagram and specific problem flow of the blurred pictures task in Study 2.

Nieuwenhuis (2012), who induced participants' perceptual curiosity in a series of experiments to check the neural correlates of curiosity in real-time. Wiggin, Reimann, and Jain (2018) used the same materials to measure the degree of perceptual curiosity. In our blurred pictures task, three blurred pictures were presented to the participants consecutively (see Fig. 1B). Then the participants were asked to take a guess at the identity of the blurry picture and write down their answer. Additionally, they need to evaluate "How curious are you to know the identity of the object?" with a 5-point scale from 1 = 'not curious at all' to 5 = 'very curious'. Participants were informed that there is a 50/50 chance the correct answer would show. However, only the first and third blurred picture will show a clear picture, not the second one.

Participants were asked to rate their level of surprise when the identity of the blurred pictures was revealed. For the second picture, which was not revealed, participants were asked to rate their level of disappointment. There was no time limit for participant responses and no feedback per each response. The next blurred picture was presented after all the questions had been answered. We summed up the three curiosity-rating as each participant's state perceptual curiosity score.

### 2.2.3. Other questionnaires

STAI was included to capture both the trait anxiety and state anxiety components (Spielberger, 2010). The Cronbach's  $\alpha$  coefficient of the questionnaire was 0.94 in Study 1 and 0.95 in Study 2. CEI-II was used to capture participants' trait curiosity (Kashdan et al., 2009). The Cronbach's  $\alpha$  coefficient of the questionnaire was 0.87 in Study 1 and 0.89 in Study 2.

IPCS was used to capture the curiosity of others' new emotions, behaviors, and information (Litman & Pezzo, 2007). Three factors were identified in the IPCS: curiosity about emotions (CE), spying and prying

(SP), and snooping (Sn). The Cronbach's  $\alpha$  coefficient of the questionnaire in this study was 0.81.

The items of interpersonal distancing during quarantine questionnaire come from the social relationship network questionnaire prepared by Zou (1999). 18 items that are suitable for the current COVID-19 pandemic were selected and the time qualifier "Compared with before, ... since the disease outbreak" was added to capture their social relationships during the COVID-19. The "Interpersonal Distancing During Quarantine" questionnaire uses a 5-point scoring method from 1 = 'always' to 5 = 'never'. We summed up the scores as each participant's interpersonal distancing. The Cronbach's  $\alpha$  coefficient of the questionnaire in this study was 0.84.

The Autism Spectrum Quotient (AQ) is designed to measure the degree to which an individual possesses autistic tendency Spectrum Disorder (Hoekstra, Bartels, Cath, & Boomsma, 2008). AQ-10 is a 10-item condensed version (Allison, Auyeung, & Baron-Cohen, 2012), with high sensitivity and specificity (Allison et al., 2012; Booth et al., 2013). We measured with a 4-point scale and converted each item into a dichotomous response (0 = slightly disagree/definitely disagree, 1 = definitely agree/slightly agree, Allison et al., 2012). The idea of the spectrum refers to the continuity between the general population and the clinical population (Lai et al., 2013), which means that autism does not exist as a binary but rather as a spectrum with significant variability in sensitivity or reactivity across individuals. We used AQ-10 to measure the degree of autistic tendency spectrum during the COVID-19 in our research. Previous studies have used AQ to measure the autistic tendency spectrum in the ordinary population (Zhao et al., 2021; Zhao, Li, Song, & Shi, 2019). Besides, Freeth et al. (2012) measured the autistic traits by AQ in an ordinary UK college student population; Crewther and Crewther (2014) used AQ to measure autistic tendency and divided the

ordinary participants into high AQ group and low AQ group.

LSAS is one of the most used self-report scales and is validly employed in the assessment of social anxiety disorder (Fresco et al., 2001). It was used to capture individuals' degree of social anxiety in our research, and the Cronbach's  $\alpha$  coefficient of the questionnaire in this study was 0.92.

Furthermore, we asked participants to complete a questionnaire about the emerging COVID-19 outbreak (see Supplementary information). We asked the participants to evaluate their level of knowledge of COVID-19, knowledge regarding the current development and control over the COVID-19 pandemic, and knowledge regarding the interpersonal impact created by COVID-19, from 1 = "no knowledge at all" to 10 = "know it very well". The sum of these three questions was used to quantify knowledge of COVID-19 (the individual's knowledge about COVID-19 during the quarantine period). We also asked the time spent daily in paying attention to the COVID-19, from 1 = 'Not concerned with the outbreak', 2 = 'Within 5 min', 3 = '5–15 min', 4 = '15–30 min', to 5 = '30 min or more', which was used to quantify the attentional duration of COVID-19 (the time spent daily in paying attention to the COVID-19).

### 2.3. Statistical analysis

Data were analyzed in SPSS 21.0 statistical software (IBM Corp., Armonk, NY) and R language. Based on the hypotheses of the research, descriptive analysis was conducted in SPSS without normalization. After normal scoring procedures, Pearson correlation analysis and linear regression analysis were executed using R function *corr.test()* and *lm()*, respectively. The serial mediation and the simple mediation models were computed with PROCESS 3.4 in SPSS (Hayes, 2017). Then we re-examined these models by R function *mediate()* from *psych* packages in R language (Revelle, 2017). We performed with 10,000 Bootstrap to examine the mediator effect in both R function and PROCESS in SPSS. Based on the 0 were not in the CI indicating that the mediating effects were significant. After analyzing the first dataset in Study 1, we added some scales to the original scale set and collected the second dataset in Study 2. We did not compare the two datasets but would like to validate the findings in our Statistical analysis.

## 3. Results

We summarized the participants' average scores on each task and questionnaire, as well as the age and gender ratios of the participants in Study 1 and Study 2 (Table S1). Additionally, we collected participant responses about the perspective and feelings of COVID-19 both in Study 1 and Study 2 (Table S2).

### Study 1

In study 1, we explored the relationship between curiosity, anxiety, and autistic tendency during COVID-19. First, we found a positive correlation between epistemic curiosity and trait curiosity ( $r = 0.255, p < 0.001$ ). Trait anxiety was negatively correlated with trait curiosity ( $r = -0.261, p < 0.001$ , see Fig. S2). State anxiety was positively correlated with autistic tendency ( $r = 0.244, p < 0.001$ ). In contrast, state anxiety and autistic tendency were not correlated with epistemic curiosity respectively (state anxiety:  $p = 0.370$ , also see Fig. S2; autistic symptoms tendency:  $p = 0.478$ ).

The results indicated that trait anxiety negatively correlated with individuals' trait curiosity; however, state anxiety and autistic tendency were not correlated with epistemic curiosity. The results of Study 1 sparked an interest in the relationship between anxiety and different types of curiosity, especially the predictive effect of anxiety on interpersonal curiosity in the situation when mandatory isolation measures have led to dramatic changes in interpersonal distancing and autistic tendency. We would pay more attention to the relationship between state anxiety, interpersonal curiosity, interpersonal distancing and

autistic tendency during the COVID-19 pandemic in Study 2.

### Study 2

Three kinds of specific curiosity (perceptual curiosity, epistemic curiosity and interpersonal curiosity) significant correlated with trait curiosity ( $r = 0.189, p < 0.001$ , for perceptual curiosity;  $r = 0.227, p < 0.001$ , for epistemic curiosity;  $r = 0.412, p < 0.001$ , for interpersonal curiosity) in Study 2. However, there was a low correlation among the three specific curiosities (see Fig. 2). The curiosity about different domains may vary greatly, which suggests that the relationship between state anxiety and different kinds of curiosity and its underlying mechanisms may differ.

#### 3.1. Correlations between trait anxiety, trait curiosity and attentional duration of COVID-19

All the main results in Study 1 were further validated in Study 2. The correlation between trait anxiety and trait curiosity was still significant ( $r = -0.234, p < 0.001$ ), which confirmed the potential relationship. A linear regression model was used to explore the predictive direction of trait curiosity and trait anxiety. We found trait anxiety negatively predicted the trait curiosity ( $\beta = -0.234, p < 0.001, R^2 = 0.055$ ). State anxiety positively predicted the autistic tendency ( $\beta = 0.233, p < 0.001, R^2 = 0.054$ ).

We measured the time individuals spent paying attention to COVID-19 daily (attentional duration of COVID-19) by asking COVID-19 information-related questions (Fig. S3A). To examine the predictive effect of trait anxiety and trait curiosity on the attentional duration of COVID-19, data were standardized in the analysis of the mediation models and we used PROCESS in SPSS for the mediation analysis (model 4 in PROCESS, Fig. 3). Table 1 showed the coefficient and 95% CI of each path, total effect and direct effect in the mediation model. It was evident that trait anxiety directly predicted attentional duration of the COVID-19 ( $\beta = -0.151, p = 0.002, 95\% \text{ CI: } [-0.247, -0.054]$ , total effect). Furthermore, it showed that trait curiosity negatively predicted trait anxiety ( $\beta = -0.234, p < 0.001, 95\% \text{ CI: } [-0.329, -0.139]$ , path A). The attentional duration of the COVID-19 was positively predicted by trait curiosity ( $\beta = 0.140, p = 0.006, 95\% \text{ CI: } [0.041, 0.237]$ , path B), and negatively predicted by trait anxiety ( $\beta = -0.118, p = 0.019, 95\% \text{ CI: } [-0.216, -0.020]$ , direct effect). The relationship between trait anxiety and attentional duration of COVID-19 was partially mediated by trait curiosity as well ( $\beta = -0.033, 95\% \text{ CI: } [-0.064, -0.007]$ , Indirect effect).

#### 3.2. No correlations between state anxiety, and epistemic curiosity

State anxiety and trait anxiety were all associated with epistemic curiosity insignificantly (state anxiety:  $p = 0.811$ ; trait anxiety:  $p = 0.326$ ) in Study 2. These maintained the same results as in Study 1 and might indicate epistemic curiosity has no relationship with anxiety during COVID-19. However, epistemic curiosity was correlated with knowledge of COVID-19 ( $r = 0.097, p = 0.05$ ).

#### 3.3. Correlations between state anxiety and perceptual curiosity

State anxiety and interpersonal distancing during quarantine were all significantly negatively correlated with perceptual curiosity (state anxiety:  $r = -0.140, p = 0.004$ ; interpersonal distancing:  $r = -0.220, p < 0.001$ ). We also found perceptual curiosity was significantly correlated with an individual's happiness during the pandemic ( $r = 0.197, p < 0.001$ ).

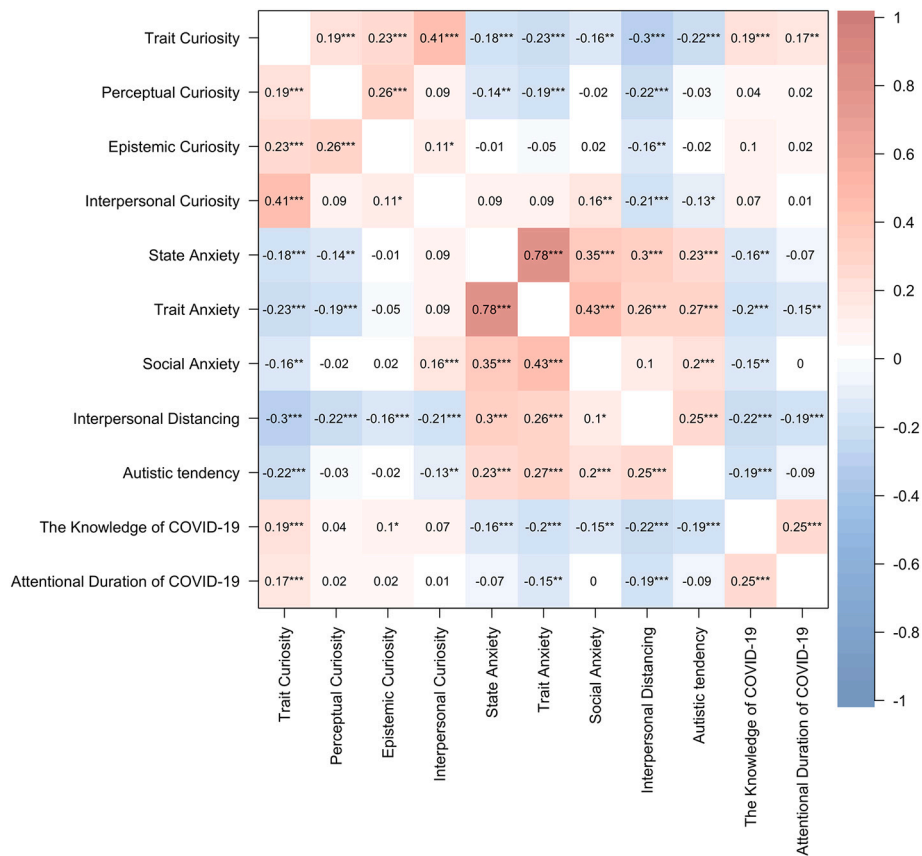


Fig. 2. The Pearson correlation matrix of main variables in Study 2.

The matrix showed a Pearson correlation matrix with a corresponding possibility matrix of main variables in Study 2. The zero-order probabilities are below the diagonal, and Benjamini and Hochberg’s FDR correction for multiple comparisons are above the diagonal. Note: \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ .

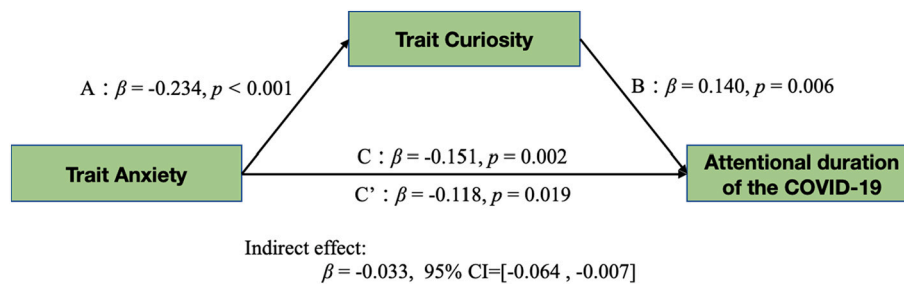


Fig. 3. The simple mediation model.

The relationship between trait anxiety and attentional duration for COVID-19 news is partially mediated by trait curiosity. In the mediation model, trait curiosity partially mediates the relationship between trait anxiety and attentional duration of the COVID-19 (Indirect effect:  $\beta = -0.033$ , 95% CI =  $[-0.064, -0.007]$ ).

Table 1

Indirect effect of trait anxiety on the attentional duration of the COVID-19 via trait curiosity.

Path	Coefficient	95% CI	
		LL	UL
TA → TC	-0.234	-0.329	-0.139
TA → AD	0.140	0.041	0.237
TA → TC → AD	-0.033	-0.064	-0.007
Total effect	-0.151	-0.247	-0.054
Direct effect	-0.118	-0.216	-0.020

Note. CI: confidence interval; LL: lower limit; UL: upper limit; TA: trait anxiety; TC: trait curiosity; AD: attentional duration of the COVID-19.

### 3.4. Relationship between state anxiety, interpersonal distancing, autistic tendency, and interpersonal curiosity

As expected, interpersonal distancing and autistic tendency were negatively correlated with interpersonal curiosity (interpersonal distancing:  $r = -0.206$ ,  $p < 0.001$ ; autistic tendency:  $r = -0.132$ ,  $p = 0.007$ ). Social anxiety and state anxiety were correlated with interpersonal distancing positively (social anxiety:  $r = 0.102$ ,  $p = 0.04$ ; state anxiety:  $r = 0.3$ ,  $p < 0.001$ ). The anxiety and anger felt during the COVID-19 pandemic, and social anxiety were correlated with interpersonal curiosity (anxiety:  $r = 0.116$ ,  $p = 0.019$ ; anger:  $r = 0.147$ ,  $p = 0.004$ ; social anxiety:  $r = 0.164$ ,  $p < 0.001$ ), and the correlation between state anxiety and interpersonal curiosity was marginally significant ( $p = 0.063$ ). Therefore, we would like to know whether and how other relative social variables—interpersonal distancing and autistic tendency

during the COVID-19 pandemic—involved in the relationship between state anxiety and interpersonal curiosity. We separately analyzed the mediation effect of autistic tendency and interpersonal distancing on the relationship between state anxiety and interpersonal curiosity. The results showed that autistic tendency and interpersonal distancing during the COVID-19 pandemic partially mediated the predictive effects of state anxiety on interpersonal curiosity (Fig. S6A, B).

Regarding to the relationship between state anxiety, interpersonal curiosity, interpersonal distancing and autistic tendency during the COVID-19 pandemic, we found that interpersonal distancing and autistic tendency had a suppressing effect on the predictive relationship between state anxiety and interpersonal curiosity (Zhonglin & Baojuan, 2014). Based on these results, we established a serial two-mediator model with a suppressing effect (model 6 in PROCESS, Fig. 4). Table 2 showed the coefficient and 95% CI of each indirect effect, total effect, direct effect and total indirect effect in the serial two-mediator model. It indicated that state anxiety directly predicted attentional duration of COVID-19 ( $\beta = -0.092, p = 0.063, 95\% \text{ CI}: [-0.005, 0.189]$ , total effect). State anxiety positively predicted interpersonal curiosity ( $\beta = 0.189, p < 0.001, 95\% \text{ CI}: [0.090, 0.290]$ , direct effect). When the mediators were analyzed, what was concurred to be of significance, was that through interpersonal distancing during quarantine, state anxiety was an indirect predictor of interpersonal curiosity,  $\beta = -0.070, 95\% \text{ CI}: [-0.120, -0.029]$ . Likewise, state anxiety was seen also to predict interpersonal curiosity indirectly through autistic tendency during the COVID-19 quarantine,  $\beta = -0.021, 95\% \text{ CI}: [-0.045, -0.003]$ . On a final note, it was determined that state anxiety was a predictor of interpersonal curiosity, through interpersonal distancing and autistic tendency, in a sequential manner,  $\beta = -0.007, 95\% \text{ CI}: [-0.016, -0.001]$  The effect size of this model was  $[(A_1 \times B_1) + (A_1 \times D_1 \times B_2) + (A_2 \times B_2)]/C' = 0.519$ .

#### 4. Discussion

Through the blurred pictures task, trivia questions, and questionnaires, the current research investigated how anxiety predicted interpersonal curiosity during the COVID-19 pandemic and the mediating role of interpersonal distancing and autistic tendency. Our results suggested that state anxiety and interpersonal distancing during the COVID-19 pandemic positively correlated with autistic tendency. Besides, Interpersonal distancing and autistic tendency negatively predicted interpersonal curiosity, and these predictive effects suppressed the positive prediction of state anxiety to interpersonal curiosity. When the outbreak was raging, it became evident that closely regulated social networks harmed people’s demands for information, causing mental instability.

**Table 2**

Indirect effect of state anxiety on interpersonal curiosity via interpersonal distancing and autistic tendency.

Path	Coefficient	95% CI	
		LL	UL
SA → IPD → IPC	-0.070	-0.120	-0.029
SA → AT → IPC	-0.021	-0.045	-0.003
SA → IPD → AT → IPC	-0.007	-0.016	-0.001
Total effect	0.092	-0.005	0.189
Direct effect	0.189	0.090	0.290
Total indirect effect	-0.098	-0.153	-0.051

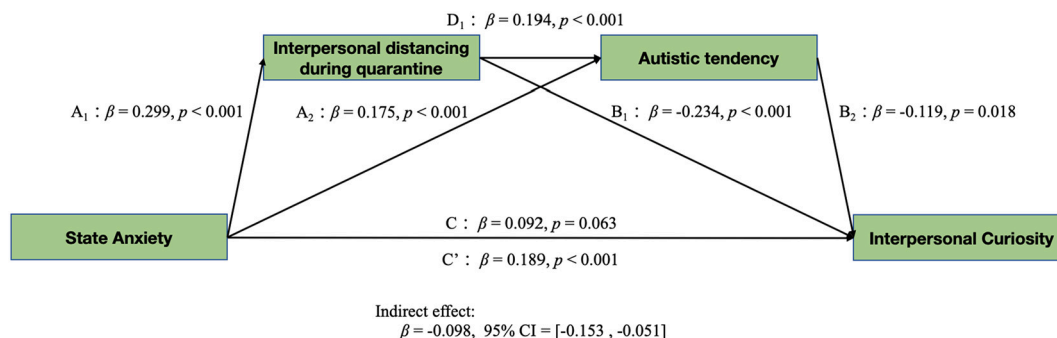
Note. CI: confidence interval; LL: lower limit; UL: upper limit; SA: state anxiety; IPD: interpersonal distancing; AT: autistic tendency; IPC: interpersonal curiosity.

#### 4.1. Correlations between curiosity and anxiety

Our study extends the existing literature on the relationship between curiosity and anxiety. We found that the correlation between trait curiosity and trait anxiety and the correlation between perceptual curiosity and state anxiety were negative, which were in line with previous studies. The previous studies showed that trait curiosity and state curiosity were both significantly negatively correlated with social anxiety (Kashdan & Roberts, 2004, 2006). Our research found that trait anxiety and social anxiety were both significantly negatively correlated with trait curiosity.

Interest-type curiosity (I-type, obtaining information expected to stimulate positive feelings of interest) is negatively correlated with anxiety, while deprivation-type curiosity (D-type, obtaining information concerned with reducing undesirable states of informational deprivation) is positively correlated with anxiety (Litman, 2010; Litman & Jimerson, 2004). In this study, blurred pictures that lack some information were used to induce participant’s curiosity about them. The participant did not need to make cognitive efforts or exploratory behaviors, but only needed to wait for the passive presentation of the pictures. This might stimulate the participants’ expectation of obtaining positive and effective information. Therefore, we can understand it as interest-type curiosity. Our research results also showed that there was a significant negative correlation between perceptual curiosity and anxiety.

At the timepoint of the research, individuals were required to self-isolate, and the interpersonal distance was strictly controlled. Therefore, the social information and interpersonal relationship information that individuals obtained might be significantly reduced, and they were more eager to obtain information that could reduce the information gap. This could be understood as a kind of deprivation-type curiosity, which was positively related to anxiety. Our research results showed that social anxiety and negative emotions (i.e., anxiety and anger feelings) during



**Fig. 4.** The serial two-mediator model with the suppressing effect.

In the serial two-mediator model, interpersonal distancing and autistic tendency mediated the relationship between state anxiety and interpersonal curiosity, which contained three significant mediating pathways: the separate mediating effects of interpersonal distancing during quarantine and autistic tendency, the serial mediating effect of interpersonal distancing during quarantine and autistic tendency (Indirect effect:  $\beta = -0.098, 95\% \text{ CI} = [-0.153, -0.051]$ ).

the COVID-19 were significantly positively correlated with interpersonal curiosity. However, trait anxiety and state anxiety were not significantly related to interpersonal curiosity, which is consistent with the results of Litman and Pezzo (2007).

The inconsistent findings suggest that the relationship between interpersonal curiosity and anxiety may be complex. Considering the mandatory self-isolation regulations during the COVID-19 pandemic may lead to reduced social contacts and increased interpersonal distance, the relationship between state anxiety and interpersonal curiosity deserves further discussion after paying attention to interpersonal distancing and autistic tendency.

#### 4.2. Anxiety, interpersonal distancing and autistic tendency

As expected, our findings showed that anxiety can positively predict interpersonal distancing and autistic tendency. State anxiety and social anxiety were positively correlated with interpersonal distancing, which echoes the results of Jetten, Haslam, and Alexander (2012). It suggests that people with the high level of anxiety may keep less social connection with others (parents, friends, colleagues and classmates). State anxiety and interpersonal distancing during the COVID-19 pandemic were positively correlated with autistic tendency, which is in line with the previous study (Perry et al., 2015). The COVID-19 pandemic and strict self-quarantine regulations may cause less social communication, loneliness and anxiety level (Bavel et al., 2020; Brooks et al., 2020; Lin, 2020). For people with a high level of anxiety and immense interpersonal distancing, they may exhibit autistic symptoms to a greater extent. Taking into account the different sensitivities of individual's autistic tendencies, this result reflects the possible predictions of anxiety and interpersonal distance for their mental health.

#### 4.3. Interpersonal distancing, autistic tendency and interpersonal curiosity

Interpersonal curiosity was negatively predicted by interpersonal distancing and autistic tendency during the COVID-19 pandemic, which is in consistent with the results of Young et al. (2016). This result is plausible because previous study indicates that interpersonal curiosity drives social interaction in daily life (Kashdan et al., 2011), which could be challenged in the COVID-19 pandemic. Interpersonal information includes knowledge about individuals' experiences, their public and private behaviors, and also their thoughts and feelings (Litman & Pezzo, 2007). Social interaction and interpersonal communication are significant for acquiring interpersonal information, which are decreased due to self-quarantine regulations. Greater interpersonal distance and autistic tendency may indicate less social contact, which further reduces individual's interpersonal information-seeking behaviors.

#### 4.4. Both autistic tendency and interpersonal distancing mediates correlations between state anxiety and interpersonal curiosity

Interestingly, our current study showed the positive prediction of state anxiety to interpersonal curiosity was suppressed by negatively predictive effects of interpersonal distancing and autistic tendency on interpersonal curiosity. This prevents us from directly observing the relationship between state anxiety and interpersonal curiosity. These results together suggested that state anxiety, interpersonal distancing and autistic tendency during the COVID-19 pandemic could predict interpersonal curiosity.

In the series mediation model, the extent of state anxiety can positively predict individual's interpersonal curiosity (direct effect), and the interpersonal distancing and autistic tendency can negatively predict individual's interpersonal curiosity (indirect effect). At the timepoint of our data collection, most of our participants had been quarantined for over a month (see Fig. S3). The self-isolation regulation might increase interpersonal distance and decrease interpersonal communication and

social network (Bavel et al., 2020). People had less interpersonal information, so they formed more interpersonal information gaps (Loewenstein, 1994). Therefore, individuals urgently needed to obtain information to reduce the undesirable state of information deprivation. Interpersonal curiosity might also be a kind of deprivation curiosity during the COVID-19 pandemic. After separating the suppressing effects of interpersonal distancing and autistic tendency, state anxiety had a positive predictive effect on interpersonal curiosity.

#### 4.5. Limitation

The present study has several limitations. First, subject to the realistic conditions of participants quarantining at home, some of the experiments could not be conducted in the laboratory, so it was impossible to define the triggers of anxiety from specific source individually to explore the causal relationship between state anxiety, interpersonal curiosity, interpersonal distancing and autistic tendency. Second, data was obtained from a sample that was not fully randomly distributed. We distributed questionnaires and tasks on an online platform to facilitate sampling. Future studies should take gender, age, and occupational diversity into consideration when collecting data. Third, the number of questions in the blurred pictures task is relatively small due to the limitation of materials and time. In future studies, researchers may quote or make more picture materials for use when conducting the blurred pictures task. Fourth, we could not formally evaluate the specific psychometric properties of our questionnaire on the psychological effects. Since we do not have data before the pandemic for comparison, we may not be able to see the true change of mental state before and after the pandemic, and we can only explore the relative relationships during the pandemic and after.

#### 4.6. Future research

Different groups have different psychological sensitivities, so that anxiety may have different effects on different groups. Our research focused on the relationship between anxiety and autistic tendency. Future research may further focus on the impact of anxiety during the public health events on other mental health of pre-existing mental disorders and sub-healthy groups, as well as frontline workers, those in the most severely affected areas during the outbreak and infected or suspected patients (Cao, Fang, et al., 2020; Cao, Qi, et al., 2020; Wang et al., 2021). Further research is expected to allow us to intervene and reduce the effects of quarantine on mental health.

Anxiety, interpersonal distancing and autistic tendency all affect individual's interpersonal information-seeking behavior. Obtaining and updating information to fill the information gap is one of the basic motivations of human information-seeking behavior (Loewenstein, 1994), which is significant for us to find social support and build interpersonal relationship, especially in the case of increased interpersonal distance caused by mandatory quarantine measures during the COVID-19 pandemic. The pandemic, in many parts of the world, is still grim. Researchers can delve into the effect of anxiety on individual's interpersonal communication and social behavior, including usage of social media, information seeking on the web, online social networking, etc.

Our research not only contributes evidence that anxiety in quarantine has negative effects on mental health from the standpoint of curiosity, but it also provides insight and inspiration for the study of the relationship between anxiety and curiosity. Our study focused on the relationship between anxiety and curiosity during the COVID-19 pandemic. Future research can create isolated conditions such as shock-induced anxiety (Brown et al., 2020) or using STAI to group subjects with high and low state anxiety. The occurrence and development of curiosity have a complete psychological component and neural mechanism (Gruber & Ranganath, 2019), thus future research can combine behavioral experiments with neuroimaging.



Our research found anxiety has very different effects on different kinds of curiosity at the same time, which shows that the relationship between anxiety and different kinds of curiosity may have different psychological components and neural mechanisms. Therefore, future research would benefit from delving into the difference between various curiosities, which not only provides psychological and neural basis evidence for the classification of curiosity but also promotes the development of common research on curiosity separately.

### Data availability

The data that support the findings of this study are openly available in the Open Science Framework at <https://osf.io/mb7sv/>.

### CRedit authorship contribution statement

**Qi Huang:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. **Siqi Cao:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Writing – review & editing. **Shengkang Zhou:** Conceptualization, Writing – review & editing. **Diksha Punia:** Conceptualization, Writing – review & editing. **Xiangru Zhu:** Conceptualization, Writing – review & editing. **Yuejia Luo:** Conceptualization, Writing – review & editing. **Haiyan Wu:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.paid.2021.110973>.

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