Trait mindfulness and college student interpersonal sensitivity: The mediating role of negative emotions and the moderating role of effectiveness/authenticity

Xiaoqian Ding¹, Tian Zhao¹, Xiaoxi Li², Zirong Yang³, Yi-Yuan Tang⁴*

ABSTRACT

Background: College student interpersonal sensitivity has received increased attention in recent years, and trait mindfulness has been found to be a protective factor in interpersonal relationships. However, little is known about the mediating and moderating mechanisms underlying this relation. The aim of this study was to investigate (a) the mediating role of negative emotions in the association between trait mindfulness and interpersonal sensitivity, and (b) the moderating role of the effectiveness/authenticity in the indirect relationship between trait mindfulness and college student interpersonal sensitivity.

Methods: This model was examined with 1419 Chinese college students (mean age=18.38 years, SD= 0.86); the participants completed measurements regarding trait mindfulness, negative emotions, the effectiveness/authenticity, and interpersonal sensitivity.

Results: The correlation analyses indicated that trait mindfulness was significantly negatively associated with college student interpersonal sensitivity, and the effectiveness/authenticity was significantly negatively associated with college student interpersonal sensitivity. Mediation analyses revealed that negative emotions partially mediated the link between trait mindfulness and interpersonal sensitivity. Moderated mediation further indicated that the relationship between trait mindfulness and negative emotions was more significant for college students with high level of effectiveness/authenticity; the relationship between negative emotions and interpersonal sensitivity was more significant for college students with low level of effectiveness/authenticity.

Conclusion: Mindfulness training may help reduce interpersonal sensitivity in college students. When college students have strong effectiveness/authenticity, lower negative emotions may be a protective factor to prevent interpersonal sensitivity.

Keywords: trait mindfulness, interpersonal sensitivity, negative emotions, effectiveness/authenticity
1 BACKGROUND

The mental health problems of college students have been widely concerned by researchers, among which interpersonal sensitivity is one of the more prominent problems [1]. Some results show that the number of students detected with moderate intensity is second only to the symptoms of compulsion, which is significantly higher than other common psychological symptoms [1]. Studies also show that interpersonal sensitivity is a psychological risk factor for infectious diseases and possibly cardiovascular diseases (CVD) [2]. In addition, interpersonal sensitivity is associated with or can be used as a predictor of many mental disorders and personality disorders, such as depression, paranoia, social phobia, and borderline personality disorder[3,4] [5-7]. In a 50-year longitudinal study of community populations in Sweden, individuals were initially assessed as sensitive or vulnerable to others doubled their risk of developing psychosis [8]. In view of these negative effects, it is of great theoretical and practical significance to explore the factors that may lead to interpersonal sensitivity.

Interpersonal sensitivity, a type of personality associated with low self-esteem and negative self-concept [5]. Boyce et al. (1991) defined interpersonal sensitivity as “an undue and excessive awareness of, and sensitivity to, the behaviour and feelings of others… particularly to perceived or actual situations of criticism or rejection…” So, they are highly alert to the expectations of others, afraid of being judged negatively, and will adjust their behavior to minimize the risk of social exclusion. In other words, they often avoid behaviors that make them less confident [3].

So far, most studies of interpersonal sensitivity have used it as one of the only indicators to test the mental health of the subjects or the level of symptoms in psychopaths [9]. As far as we know, only a handful of studies have focused on factors that might contribute to increased interpersonal sensitivity, such as perfectionism [10], cognitive emotion regulation strategies [11], positive psychological capital [12], and low self-esteem [13]. While some protective and risk factors have been identified, it is still unclear the mediating and moderating relationships between trait mindfulness and interpersonal sensitivity.

1.1 Trait mindfulness and interpersonal sensitivity

Mindfulness has been described as a kind of nonreactive, nonjudgmental and present-centered awareness in which each thought, feeling or sensation is acknowledged and accepted as it is [14]. Some theories of mindfulness suggest that it is similar to character advantages in positive psychology, which represents a trait that exists naturally and varies within the population, as well as a state of consciousness that can be development with mindfulness training [15]. As far as we know, no studies have shown that trait mindfulness is related to interpersonal sensitivity, but some studies have shown that mindfulness training can reduce interpersonal sensitivity [16,17]. Therefore, the correlation between trait mindfulness and interpersonal sensitivity is obvious.
It is worth noting, however, the mediating mechanism behind this relationship (i.e., what does trait mindfulness have to do with interpersonal sensitivity) and regulatory mechanisms (i.e., when is the link most effective) remains largely unknown. Therefore, this study aims to examine a conditional process model based on young adults, in which negative emotions mediate the relationship between trait mindfulness and interpersonal sensitivity. Second, the direct and indirect relationship between trait mindfulness and interpersonal sensitivity is moderated by effectiveness.

1.2 The mediating role of negative emotions

Interpersonal sensitivity is related to negative emotions [18]. Studies have shown that emotional states of depression and anxiety are risk factors for interpersonal sensitivity [19]. The ability to successfully control emotional experiences is a basic human skill that promotes interpersonal function, positive impact, and overall well-being [20]. Individuals differ in their habitual use of emotional regulation strategies, and these differences are related to specific behavioral, emotional, and interpersonal outcomes [21,22].

Many studies show that long-term mindfulness-based interventions can directly affect the attention distribution of emotion regulation [23], which then reduces the negative mood. For example, mindfulness is effective at decreasing long-lasting maladaptive cognitive content and affective symptoms mainly based on depressive and anxious symptoms [24]. People in the mindfulness group can better regulate their mood, thereby reporting fewer difficulties with emotional awareness and clarity and greater positive mood [25]. In addition, mindfulness is negatively related to negative affectivity [26], suggesting that trait mindfulness is conducive to the awareness and acceptance of negative emotions and negative thinking. Together, these studies support the notion that higher trait mindfulness is related to lower negative emotions.

Although not yet tested, there is reason to believe that negative emotions regulate the relationship between trait mindfulness and interpersonal sensitivity. Therefore, we hypothesized that negative emotions mediate between trait mindfulness and interpersonal sensitivity.

1.3 The moderating role of effectiveness/authenticity

Although trait mindfulness may influence interpersonal sensitivity through the mediating effect of negative emotions, not all individuals with the same level of mindfulness have the same level of negative emotions and interpersonal sensitivity. The heterogeneity of outcomes may be due to other individual characteristics.

A study showed that when faced with stressful situations, individuals with high emotional creativity preferred strategies of self-control, planned problem solving, seeking social support, and positive reappraisal, which helped to reduce interpersonal
sensitivity. In addition, there is a significant correlation between effectiveness/authenticity and the extraversion personality [27]. The effectiveness/authenticity is also positively correlated with openness and agreeableness [28]. While interpersonal sensitivity was negatively correlated with introversion (a component of Eysenck Personality Questionnaire-Adults), therefore, it is reasonable to think that effectiveness/authenticity could predict interpersonal sensitivity.

Moreover, emotional creativity refers to the ability to honestly perceive and express novel and effective mixed emotions [29], that is, the ability of people to honestly and uniquely perceive and express emotions to meet the needs of individuals or interpersonal situations [30], which focuses on the internal emotions generated in the context of interpersonal interaction. While effectiveness/authenticity, one of the emotional creativity’s indicators, which means the skill to express emotions adroitly and honestly [27,31], may help to reduce negative emotions. Therefore, effectiveness/authenticity may moderate the indirect relations between trait mindfulness and interpersonal sensitivity.

1.4 The present study

In this study, we tested a conceptual model of the process by which trait mindfulness will be a protective factor for interpersonal sensitivity. In particular, the purposes of this study were twofold: (a) to test whether college students’ negative emotions mediates the relation between trait mindfulness and interpersonal sensitivity, and (b) to test whether the indirect association between trait mindfulness and interpersonal sensitivity through negative emotions would be moderated by effectiveness/authenticity. Altogether, these two research questions constitute a moderated mediation model. This integrated model can address questions about both mediation (i.e., how trait mindfulness relates to interpersonal sensitivity) and moderation (i.e., when and for whom is the link least or most potent) in a single model. Figure 1 illustrates the proposed model. Based on the literature reviewed above, we put forward the following hypotheses:

Hypothesis 1. Trait mindfulness will decrease negative emotions, which in turn will decrease interpersonal sensitivity. That is, negative emotions will mediate the link between trait mindfulness and interpersonal sensitivity.

Hypothesis 2. Effectiveness/authenticity will negatively predict interpersonal sensitivity. Furthermore, the indirect association between trait mindfulness and interpersonal sensitivity through negative emotions will vary as a function of effectiveness/authenticity.
2 METHODS

2.1 Participants
Participants were selected by simple random sampling from several universities in Liaoning Province, China. A total of 1528 participants were assessed using questionnaires, with 1419 participants had usable data. Participants ranged from 17 to 23 years old (standard deviation SD=0.86, mean=18.38 years), and about 72% of the participants were females.

2.2 Measures

2.2.1 Mindful Attention Awareness Scale (MAAS)
To assess individual differences in the frequency of attention to and awareness of present-moment experience, we used the Chinese version of MAAS [32] translated and revised from the scale of Brown and Ryan (2003). This scale consists of 15 items (e.g., “I find it difficult to stay focused on what is happening”). The participants rated each item on a 6-point scale ranging from 1 = almost always to 6 = almost never, with higher scores reflecting more mindfulness. For this study, the measure demonstrated high reliability (Cronbach’s α=.91).

2.2.2 Profile of Mood States (POMS)
To assess transient and distinct mood states, we used the Chinese version of POMS [33] translated and revised from the scale of McNair [34]. This 65-item scale evaluates six mood factors: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Fatigue-Inertia, Vigor-Activity and Confusion-Bewilderment. Participants rated each item on a 5-point scale ranging from 0 = not at all to 4 = extremely. The total mood disturbance (TMD) score is calculated by adding the scores for five mood factors (Tension-Anxiety, Depression-Dejection, Anger-Hostility, Fatigue-Inertia and Confusion-Bewilderment.) and subtracting the score for Vigor-Activity then adding 100. The TMD score is a summary measure of negative emotion with higher scores reflecting worse mood states [33]. For this study, the measure showed high reliability (Cronbach’s α=0.95).

2.2.3 Symptom Checklist 90 (SCL-90)
SCL-90 [35] is designed to assess individual mental health symptoms. It consists of 90 items and 9 subscales. One of these, a nine-item (e.g., "feeling ununderstood or unsympathetic") interpersonal sensitivity factor (IPS), was used to assess an individual's discomfort and inferiority in interpersonal communication, especially when compared with others. Participants rated each item on a scale of five, with one indicating "perceived absence of the problem" and five indicating "perceived severity and frequency of the symptoms". This research uses Wang's revised edition [36]. For this study, the measure displayed high reliability (Cronbach’s $\alpha=0.85$).

2.2.4 Emotional Creativity Inventory (ECI)
ECI is a self-report questionnaire, which consists of 30 questions and is divided into three subscales [29]. The effectiveness/authenticity subscale (e.g., "sometimes my emotional experience and emotional expression can help me improve my interpersonal relationship") was used to assess participants' self-perception of validity/authenticity. Participants rated each item on a 5-point scale, with 1 indicating total nonconformity and 5 indicating total conformity. This research uses Wang's revised edition [37]. In this study, high reliability of the validity/authenticity subscale was measured (Cronbach’s $\alpha=0.81$).

2.3 Procedure
All materials and procedures were approved by the Ethics in Human Research Committee of the first author's university. The simple random sampling was applied to select the target university. The data were collected online through the psychological test system for college students in October 2019. Importantly, the authenticity, independence, and integral nature of all answers were emphasized to the participants. Informed consent was obtained from the participants. All participants received a gift as compensation for their time.

2.4 Statistical analyses
First, the descriptive information and correlation matrix were calculated. Second, we followed MacKinnon’s (2008) four-step procedure [38] to establish a mediation effect. Third, we examined whether the mediation process was moderated by effectiveness/authenticity. Moderated mediation is often applied to test whether the magnitude of a mediation effect is conditional on the value of a moderator [39]. The analyses of moderated mediation were constructed using Hayes’s (2013) PROCESS macro (Model 59). All continuous variables were standardized and the interaction terms were computed from these standardized scores. In addition, the bootstrapping method was applied to examine the significance of all the effects to obtain robust standard errors for parameter estimation [40]. The bootstrapping method produces 95% bias-corrected confidence intervals of these effects from 1,000 resamples of the data. Confidence intervals that do not include zero indicate effects that are significant.

3 RESULTS
The purposes of this study were to explore whether negative emotions would mediate the relation between trait mindfulness and interpersonal sensitivity, and whether the indirect path between trait mindfulness and interpersonal sensitivity would be moderated by effectiveness/authenticity. These research questions were tested in three steps.

### 3.1 Preliminary analysis

Correlation analysis was performed on trait mindfulness, negative emotions, interpersonal sensitivity and effectiveness/authenticity. Means, standard deviations, and zero-order correlations for all study variables are presented in Table 1. As expected, college students with better trait mindfulness were less likely to get interpersonal sensitivity, which is also true for college students with higher levels of negative emotions. Besides, college students with better trait mindfulness were more likely to have lower levels of negative emotions. In addition, college students with higher levels of effectiveness/authenticity are less likely to get interpersonal sensitivity; they may have lower levels of negative emotions and better trait mindfulness as well.

#### Table 1. Descriptive statistics and related analysis results of each variable

| Variables                                | M   | SD  | 1  | 2  | 3  | 4   |
|------------------------------------------|-----|-----|----|----|----|-----|
| 1. Trait mindfulness (MAAS)              | 62.38| 13.533| 1  |    |    |     |
| 2. Negative emotions (POMS)              | 140.43| 33.615| -0.426** | 1  |    |     |
| 3. Effectiveness/authenticity (ECI)      | 26.78| 4.972| 0.289** | -0.206** | 1  |     |
| 4. Interpersonal sensitivity (SCL-90)    | 13.90| 5.339| -0.233** | 0.314** | -0.151** | 1  |

Note. N=1419. SD: standard deviation; M: mean. **p<.01.

### 3.2 Testing for mediation effect

In Hypothesis 1, this study assumed that negative emotions would mediate the link between trait mindfulness and interpersonal sensitivity. To examine this hypothesis, this study followed MacKinnon’s (2008) four-step procedure to establish the mediation effect, which requires (a) a significant relation between trait mindfulness and interpersonal sensitivity, (b) a significant association between trait mindfulness and negative emotions, (c) a significant association between negative emotions and interpersonal sensitivity while controlling for trait mindfulness, and (d) a significant coefficient for the indirect path between trait mindfulness and interpersonal sensitivity through negative emotions. The bias-corrected percentile bootstrap method determines whether the last condition is satisfied.

Multiple regression analysis showed that, in the first step, mindfulness was significantly associated with interpersonal sensitivity, $b=-0.23$, $p<.001$ (see Model 1 of Table 2). In the second step, mindfulness was significantly associated with negative emotions, $b=-0.43$, $p<.001$ (see Model 2 of Table 2). In the third step, when this study controlled for mindfulness, negative emotions was significantly associated with interpersonal sensitivity, $b=0.26$, $p<.001$ (see Model 3 of Table 2). Finally, the
bias–corrected percentile bootstrap method indicated that the indirect effect of mindfulness on interpersonal sensitivity through negative emotions was significantly, \( ab = -0.11, SE = 0.02, 95\% CI = [-0.15, -0.08] \). The mediation effect accounted for 48% of the total effect. Overall, the four criteria for establishing mediation effect were totally satisfied. Therefore, Hypothesis 1 was supported.

\[ \text{Table 2. Testing the mediation effect of mindfulness on interpersonal sensitivity} \]

| Predictors               | Model 1 (interpersonal sensitivity) | Model 2 (negative emotions) | Model 3 (interpersonal sensitivity) |
|-------------------------|-------------------------------------|------------------------------|------------------------------------|
|                         | \( b \)   | \( t \) | \( b \) | \( t \) | \( b \) | \( t \) |
| Trait mindfulness       | -0.23     | -9.04*** | -0.43 | -17.73*** | -0.12 | -4.39*** |
| Negative emotions       |          |         | 0.26  |         | 9.48*** |       |
| \( R^2 \)               | 0.05      | 0.18    | 0.11  |         |        |       |
| \( F \)                 | 81.64***  | 314.37*** | 88.28*** |       |       |       |

Note. \( N=1419 \). Each column is a regression model that predicts the criterion at the top of the column.

\***p<.001.\)

3.2 Testing for moderated mediation
As noted, Hypothesis 2 predicted that effectiveness/authenticity would moderate the indirect associations between trait mindfulness and interpersonal sensitivity through negative emotions (Figure 1). To examine this moderated mediation hypothesis, we used the PROCESS macro (Model59) developed by Hayes (2013) to test for moderated mediation. Specially, we estimated parameters for three regression models. In Model 1, we estimated the moderating effect of effectiveness/authenticity on the relation between trait mindfulness and interpersonal sensitivity. In Model 2, we estimated the moderating effect of effectiveness/authenticity on the relation between trait mindfulness and interpersonal sensitivity. In Model 3, we estimated the moderating effect of effectiveness/authenticity on the relation between trait mindfulness and negative emotions, and on the relation between negative emotions and interpersonal sensitivity. The specifications of the three models can be seen in Table 3.

Moderated mediation was established if either or both patterns existed \([39, 40]\): (a) the path between trait mindfulness and negative emotions was moderated by effectiveness/authenticity (first-stage moderation), and/or (b) the path between negative emotions and interpersonal sensitivity was moderated by effectiveness/authenticity (second-stage moderation).

As Table 3 demonstrates, in Model 1, there was a main effect of trait mindfulness on interpersonal sensitivity, \( b = -0.21, p<.001 \), and this effect was not moderated by effectiveness/authenticity, \( b = 0.01, p>.05 \). In Model 2, there was a main effect of trait mindfulness on negative emotions, \( b = -0.41, p<.001 \), and this effect was moderated by the effectiveness/authenticity, \( b = -0.10, p<.001 \). Model 3 indicated that the effect of
negative emotions on interpersonal sensitivity was significant, \( b=0.26, p<.001 \), and this effect was moderated by effectiveness/authenticity, \( b=-0.06, p<.01 \).

**Table 3. Testing the moderated mediation effect of trait mindfulness on interpersonal sensitivity**

| Predictors                              | Model1 (interpersonal sensitivity) | Model1 (negative emotions) | Model2 (interpersonal sensitivity) |
|-----------------------------------------|------------------------------------|-----------------------------|------------------------------------|
|                                        | \( b \)    | \( t \)          | \( b \)    | \( t \)          | \( b \)    | \( t \)          |
| Trait mindfulness                      | -0.21      | -7.74***         | -0.41      | -16.60***        | -0.11      | -3.88***         |
| Effectiveness/authenticity             | -0.09      | -3.44***         | -0.11      | -4.39***         | -0.07      | -2.50*           |
| Trait mindfulness × effectiveness/authenticity | -0.01      | -0.74           | -0.10      | -5.89***         | 0.00       | 0.02             |
| Negative emotions                      |            |                 | 0.26       | 9.12***          |            |                 |
| Negative emotions × effectiveness/authenticity |          |                 | -0.06      | -2.68**          |            |                 |
| \( R^2 \)                               | 0.06       | 0.21            | 0.12       |                 |            |                 |
| \( F \)                                 | 31.38***   | 124.21***       | 38.43***   |                 |            |                 |

Note. \( N=1419 \). Each column is a regression model that predicts the criterion at the top of the column.

*\( p<.05 \), **\( p<.01 \), ***\( p<.001 \).

For descriptive purposes, this study plotted predicted negative emotions against trait mindfulness (Figure 2) and interpersonal sensitivity against negative emotions (Figure 3), separately for low and high levels of the effectiveness/authenticity (one SD below the mean and one SD above the mean, respectively). For negative emotions against trait mindfulness, simple slope tests demonstrated that for college students with high levels of effectiveness/authenticity, trait mindfulness was significantly associated with negative emotions, \( b_{\text{simple}} = -0.52, p<.001 \), as was for college students with lower levels of effectiveness/authenticity, \( b_{\text{simple}} = -0.31, p<.001 \). But as the level of trait mindfulness increased, the trend of effectiveness/authenticity in the high levels group decreased more steeply (Figure 3). In other words, compared with the low-effectiveness/authenticity college students, the effect of the high-effectiveness/authenticity college students' trait mindfulness on the negative emotion was greater. For interpersonal sensitivity against negative emotions, simple slope tests demonstrated that for college students with high levels of effectiveness/authenticity, negative emotions was significantly associated with interpersonal sensitivity, \( b_{\text{simple}} = 0.24, p<.001 \), as was for college students with lower levels of effectiveness/authenticity, \( b_{\text{simple}} = 0.35, p<.001 \). But as the level of negative emotions increased, the trend of effectiveness/authenticity in the high levels group decreased more slowly (Figure 3). In other words, compared with the low-effectiveness/authenticity college students, the high-effectiveness/authenticity college students' trait mindfulness had less effect on the negative emotions.
Figure 2. Effects of trait mindfulness and effectiveness/authenticity on negative emotions. Functions are graphed for two levels of the effectiveness/authenticity; one standard deviation above the mean and one standard deviation below the mean. Note that the graph is for descriptive purpose only. All inferential analyses maintained the continuous values of trait mindfulness and the effectiveness/authenticity.

Figure 3. Effects of negative emotions and effectiveness/authenticity on interpersonal sensitivity. Functions are graphed for two levels of the effectiveness/authenticity; one standard deviation above the mean and one standard deviation below the mean. Note that the graph is for descriptive purpose only. All inferential analyses maintained the continuous values of negative emotions and the effectiveness/authenticity.

4 DISCUSSION
The influence of trait mindfulness on interpersonal sensitivity may be derived from studies related to interpersonal communication, such as coworker trust, interpersonal citizenship behavior, interpersonal acceptance, and cooperative behavior [16,41].
However, questions concerning the underlying mediating and moderating mechanisms of the relationship between trait mindfulness and interpersonal sensitivity stay largely unanswered. This study established a moderated mediation model to test whether trait mindfulness would be indirectly associated with interpersonal sensitivity through negative emotions, and whether this direct and indirect relationship between trait mindfulness and interpersonal sensitivity was moderated by effectiveness/authenticity. The results indicated that the impact of trait mindfulness on interpersonal sensitivity could be partially explained by negative emotions. That is trait mindfulness would negatively predict negative emotions, and in turn, negative emotions could positively predict interpersonal sensitivity. Furthermore, this indirect relation was moderated by effectiveness/authenticity in the two stage of the mediation process, such that the path from trait mindfulness was stronger in the context of higher effectiveness/authenticity and the path from negative emotions was weaker in the context of higher effectiveness/authenticity. In other words, low level of negative emotions is a protective factor against interpersonal sensitivity for college students with an increased effectiveness/authenticity, whereas the protective role was not so strong in college students with low level of effectiveness/authenticity. The following sections will discuss each of the research hypothesis in light of this moderated mediation model of trait mindfulness and interpersonal sensitivity.

4.1. The mediating role of negative emotions
This study found that trait mindfulness decreased negative emotions, which in turn was positively related to interpersonal sensitivity. That is, negative emotions mediated the relation between trait mindfulness and interpersonal sensitivity. Therefore, low level negative emotions can be one of the explanatory mechanisms for why those college students with good trait mindfulness are less likely to get sensitive to interpersonal relationships. As far as we know, this is the first study to report such results in the literature. The current study is the first to document the mediating role of negative emotions between trait mindfulness and interpersonal sensitivity. These findings reveal why trait mindfulness reduces interpersonal sensitivity among college students. We considered the potential link between trait mindfulness and tested the mediating role of negative emotions in this relationship. These findings provide theoretical support for mindfulness training in reducing interpersonal sensitivity [16,17].

In addition to the overall mediation result, each of the separate associations in the mediation model is noteworthy. For the first stage of the mediation process (i.e. trait mindfulness $\rightarrow$ negative emotions), our findings support the notion that good trait mindfulness is related to decreased negative emotions. This finding is consistent with previous results [23,24,26], which indicate that good trait mindfulness plays a vital role in emotions. For college students with good trait mindfulness, they are more likely to be people with less negative emotions, which in turn could prevent them from becoming sensitive to interpersonal relationships. For the second stage of the mediation model (i.e. negative emotions $\rightarrow$ interpersonal sensitivity), this study
revealed that negative emotions were positively associated with interpersonal sensitivity, consistent with previous evidence that individuals with a higher degree of negative emotions are more likely to be interpersonal sensitivity [19].

4.2. The moderating role of effectiveness/authenticity

The second goal of this study was to examine whether effectiveness/authenticity could predict interpersonal sensitivity, and more importantly, whether effectiveness/authenticity would moderate the indirect link between trait mindfulness and interpersonal sensitivity. The result revealed that effectiveness/authenticity could predict interpersonal sensitivity, for college students with lower levels of effectiveness/authenticity, they are more likely to get sensitive to interpersonal relationships.

Moreover, the results revealed that effectiveness/authenticity moderated both the path between trait mindfulness and negative emotions (first-stage moderation) and the path between negative emotions and interpersonal sensitivity (second-stage moderation). The relationship between trait mindfulness and negative emotions was more significant for college students with high level of effectiveness/authenticity; however, the relationship between negative emotions and interpersonal sensitivity was more significant for college students with low level of effectiveness/authenticity.

Altogether, by integrating the effectiveness/authenticity as a moderator into the model, this study revealed effects that have been overlooked without the moderation analysis. The moderated mediation model in this study is conceptually more sophisticated and provides greater predictive power than the mediation model alone.

4.3. Limitations and practical implications

Several limitations of this study should be addressed. First of all, the design of this study is horizontal. The reader should be wary of causal inference. Second, the data were collected only by self-reported measurement, and the majority of the samples were female, which may affect the validity of this study. Other information providers may add a unique perspective to the research and help reduce the subjectivity of the results. Finally, the model was tested on a community sample of young adults, rather than on a clinical sample. Therefore, our findings should not be generalized to other populations.

Despite these limitations, the findings of this study have important practical implications. Understanding the protective factors and risk factors of interpersonal sensitivity person is important for developing prevention and intervention plans to reduce interpersonal sensitivity. On the one hand, the findings highlight mindfulness training and emotional regulation as potential targets for intervention in young adults with high levels of interpersonal sensitivity. Therefore, mindfulness training may help reduce interpersonal sensitivity in young adults. On the other hand, our findings could
help practitioners understand the link between trait mindfulness and interpersonal sensitivity, providing a possible venue for targeted intervention. For example, reducing negative emotions may aggravate some of the beneficial effects of trait mindfulness on interpersonal sensitivity.

5 CONCLUSIONS
In summary, this study indicates that trait mindfulness could be a protective factor in interpersonal sensitivity. Furthermore, the mediation analysis shows that negative emotions could be one possible mechanism underlying this relation. Moreover, low levels of effectiveness/authenticity can be a predictor of interpersonal sensitivity, and moderated mediation reveals that effectiveness/authenticity moderates the relationship between trait mindfulness and negative emotions, with the relation being more significant for college students with high level of effectiveness/authenticity; besides, effectiveness/authenticity moderated the relationship between negative emotions and interpersonal sensitivity, with the relation being more significant for college students with low level of effectiveness/authenticity. Specifically, when college students have strong effectiveness/authenticity, lower negative emotions may be a protective factor to prevent interpersonal sensitivity.

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**ABBREVIATION**
CVD: cardiovascular diseases; MAAS: Mindful Attention Awareness Scale; POMS: Profile of Mood States; SCL-90: Symptom Checklist 90; ECI: Emotional Creativity Inventory.

**ETHICS APPROVAL AND CONSENT TO PARTICIPATE**
All materials and procedures were approved by the Ethics in Human Research Committee of Liaoning Normal University (LL2020003). Informed consent was obtained from the participants.

**CONSENT FOR PUBLICATION**
All authors grant BMC Behavioral and Brain Functions consent for the publication of the present article.

**AVAILABILITY OF DATA AND MATERIALS**
The datasets during and/or analysed during the current study available from the corresponding author on reasonable request.

**COMPETING INTERESTS**
The authors declare that they have no competing interests.

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**AUTHORS’ CONTRIBUTIONS**
XD designed the study, collected the data, analyzed and interpreted data, and participated in writing up the manuscript. TZ analyzed data and drafted the manuscript. XL and ZY collected the data and assisted paper writing. YYT conceived the idea, and participated in writing up and revising the manuscript. All authors read and approved the final manuscript.

**AUTHOR DETAILS**
1College of Psychology, Liaoning Normal University, Dalian, Liaoning, 116024, China,
2Mental Health Education Center for College Students, Dalian University of Foreign Languages, Dalian, Liaoning, 116044, China,
3Department of Gastroenterology, Affiliated Zhongshan Hospital of Dalian University, Dalian, Liaoning, 116001, China,
4Department of Psychological Sciences, Texas Tech University, Lubbock, TX 79409, United States.