Current Psychology
https://doi.org/10.1007/s12144-022-03229-1

How negative automatic thoughts trigger Chinese adolescents' social anxiety: The mediation effect of meta-worry

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Accepted: 13 May 2022

Abstract
Theoretical and empirical evidence has found that negative automatic thoughts (ATs) are vital in the occurrence of social anxiety in youth population; however, the mechanism is rarely investigated in Chinese adolescents. This study aimed to discover the mediating mechanism of meta-worry (including meta-worry belief and frequency) on negative automatic thoughts and social anxiety in Chinese adolescents. Cross-sectional research design was used. Three hundred and fifty-seven adolescents were recruited to complete measures of meta-worry, social anxiety, negative automatic thoughts, depression, and demographic information. After controlling for depression, we found that meta-worry frequency mediated partially the relation between negative automatic thoughts and social anxiety in adolescents. In addition, participants' age moderated the relation between negative automatic thoughts and meta-worry frequency. Our results shed the light on the metacognitive therapy in adolescents. Results are informative for metacognitive therapy suggesting that it could be more effective by targeting changes in the frequency of thoughts rather than changes in meta-worry beliefs.

Keywords Chinese adolescents · Meta-worry · Negative automatic thoughts · Moderated mediation analyses · Social anxiety

Introduction

Social anxiety disorder (SAD) involves an intense fear of negative evaluations from others and avoidance of interpersonal situations, which would lead to significant distress and would interfere with daily life (DSM-5; American Psychiatric Association, 2013). Previous studies suggested that social anxiety exists on a continuum from the absence of social fear, through ordinary fear, to more intense and dysfunctional social anxiety in childhood (Benedetto et al., 2014). Prevalence studies in both European and U.S. communities showed that SAD is one of the most prevalent categories of youth psychopathology (Fehm et al., 2008; Merikangas et al., 2010; Ruscio et al., 2008). Specifically, SAD affects 9% of American children, making it the highest lifetime-prevalence anxiety disorder (Gross & Hen, 2004; Knappe et al., 2015).

High level of social anxiety among adolescents would possibly lead to other disorders, such as, mood and substance use disorders, and also would be associated with impaired psychosocial functioning (Aderka et al., 2012). As teenagers become more self-conscious (Westenberg et al., 2007) and are expected to manage increased social interactions, they are increasingly at risk of being affected by social anxiety. Thus, as the increases of social consciousness and emotion, individuals during adolescence might be greatly affected by social anxiety (Alfano et al., 2002; Westenberg et al., 2004). In addition, evidence indicated that there is a cultural discrepancy in social anxiety among adolescents. Previous research has revealed that, compared to adolescents from Western culture, Eastern adolescents, including those from China, would demonstrate higher level of social anxiety, including in subclinical and typically developing adolescents (e.g., Loscalzo et al., 2017; Miers et al., 2008; Yu et al., 2020; Zhou et al., 2008). Hence, it would be interesting to lift more facets of veil of Chinese adolescents' social anxiety.

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Published online: 30 May 2022

The understanding of SAD has been advanced by cognitive models framing effective conceptualization as well as treatment (e.g., Clark & Wells 1995; Rapee & Heimberg, 1997). One similarity among these cognitive models is the primary focus on cognitive aspects, such as, negative automatic thoughts (Normann et al., 2016). Negative automatic thoughts represent "what just ran through one's mind" and could be defined as spontaneous, evaluative cognitions about oneself, the future and the world (Beck, 2011; Iancu Iulian et al., 2015).

In adaptation of Clark and Wells' (1995) cognitive model of SAD in adolescents (Hodson et al., 2008), socially anxious youth would perceive ambiguous social stimulus as danger. Then negative automatic thoughts about social threat appear, and the socially anxious individuals would in turn biasedly interpret the social clues, leading to a vicious cycle of negative thoughts and psychological distress (Leigh & Clark, 2018). Results from Yu et al. (2017) confirmed the cognitive content-specificity hypothesis among Chinese adolescents by pointing out that automatic thought towards social threat was the best predictor of anxiety, especially social anxiety. More importantly, researchers found that SAD group displayed more negative and less positive automatic thoughts as compared to healthy controls (Iancu Iulian et al., 2015). The above-referred empirical evidence has indicated how automatic negative thoughts impact on adolescents' social anxiety. However, a firm empirical base of mediators between negative automatic thoughts and social anxiety is still lacking and sparse in Chinese adolescents' sample. To date, only a few studies have investigated whether specific metacognitive processes (i.e., metacognitive appraisals of thoughts and awareness of thoughts) were linked to anxiety and other affective disorders in children and adolescents (e.g., Bacow et al., 2009). One research conducted in Denmark demonstrated that metacognitive processes would partially mediate the relationship between negative automatic thoughts and anxiety (Normann et al., 2016). They further found that the effective therapy did not necessarily decrease the frequency of individuals' negative thoughts, but changed the metacognitions toward them. Albeit this study did not explain the change mechanism in detail, it still notably illuminated a possible mechanism of metacognitions between negative automatic thoughts and social anxiety in adolescents.

Among those vast kinds of metacognitions, a closely-related variable drew our attention: meta-worry. Meta-worry, also known as "Type II worry" (Wells, 1994, 1995) was derived from the description about metacognition. Generally, meta-cognition would be divided into two classifications: positive and negative belief about worry. The negative belief and appraisal about worry is defined meta-worry. More specifically, meta-worry includes two components, namely frequency and beliefs. As for meta-worry frequency, it was viewed as a kind of issue which represented the frequency of worry about certain thoughts (Wells, 2005). Meta-worry belief was defined as the extent to which the person believes the meta-worry at its time of occurrence and its level (Wells, 2005). The occurrence and content of meta-worry closely associate with underlying negative beliefs that individuals have about the nature and consequences of worrying (Wells, 2008).

A body of research has clarified the association between meta-cognition (including meta-worry) and generalized anxiety symptoms (e.g., Wells 2005; Ryum et al., 2017). Although the direct evidence for the link between meta-cognition and social anxiety was rare, Papageorgiou and Wells (1999) still pointed out that anxious and depressive thoughts have a high degree of similarity in measuring metacognitive dimensions. Furthermore, GAD has been shown to comorbid with mood and anxiety disorders such as social anxiety and panic disorder (Simon, 2009). The above-mentioned evidence suggested an analogy of meta-worry between SAD and GAD.

Meta-worry, theoretically, might be prominent at a later developmental stage of anxiety (Wells & Matthews, 1994; Wells, 2008). Previous studies have indicated that negative meta-beliefs about worry would be a better predictor of anxiety, including social anxiety, than worry itself (Ryum et al., 2017). Not only that, Wells had specifically noted that meta-worry frequency was directly linked with generalized anxiety symptoms and the relation between meta-worry belief and anxiety was mediated by meta-worry frequency (Wells, 2005). These results also supported the important role of meta-worry frequency in anxiety. Additionally, in line with the Clark and Wells (1995)'s model, findings suggested that negative social beliefs were positively correlated with social anxiety (Heeren et al., 2014; Holzman et al., 2014) and would further predict social anxiety (Wong & Moulds, 2011). Although no finding in the available literature has investigated the direct association between meta-worry, especially meta-worry frequency and belief, and social anxiety, the analogy between GAD and SAD and the research with negative meta-beliefs would help us potentially identify the association between meta-worry and social anxiety among Chinese adolescents in the present study.

For anxious individuals, their negative thoughts and anxiety level were found to be correlated with meta-worry (Wells, 2002). Similarly, researchers found a moderate correlation between automatic thoughts and meta-worry among reactive obsession patients (Keles Altun et al., 2017). In addition, as Wells (2008) summarized, it was important to distinguish automatic and involuntary intrusive thoughts, as automatic thoughts may trigger sustained worry. This showed a potential intimate relationship between negative automatic thoughts and meta-worry. To sum up, meta-worry is a secondary evaluation, normally occurring after

negative automatic thoughts. Hence, we hypothesized that meta-worry could mediate the relationship between negative automatic thoughts and social anxiety.

Previous literature has also focused on the effect of age on treatment outcomes for social anxiety symptoms. For instance, researchers demonstrated that, by recruiting teen participants (7 to 17 years old), age was found to be positively correlated with pre-to-post reductions in worry frequency after receiving CBT (Payne et al., 2011). In addition, Dush et al. (1989) reported that self-statement modification was associated with age, indicating that older children benefited more from this approach than the younger. These findings shed the lights on a possible hypothesis that age would play an important role during treatment. In China, specifically, Kang (2005) as well as Cheng and Wang (2007) found that as age increased, adolescents' metacognition capacity improved as well, especially in the dimension of planning and evaluating. Meanwhile, research in Western samples in a variety of areas (e.g., intellect, memory, self- concept, scientific thinking) has suggested that children and adolescents were increasingly capable of metacognitive thinking with the increase of age (Kuhn, 1999, 2000a, b, c; Vasey & Daleiden, 1994). Furthermore, previous research demonstrated that adolescents' metacognitive abilities tended to be more advanced than younger children (Flavell et al., 1998). Due to the fact that the effect of age on negative automatic thoughts as well as meta-worry is plausible, we assumed that age might moderate the relationship between negative automatic thoughts and meta-worry.

To conclude, the primary purpose of this study was to investigate whether meta-worry (frequency and belief) would mediate the relation between negative automatic thoughts and social anxiety among Chinese adolescents. Second, we would like to examine whether the path of negative automatic thoughts and meta-worry (frequency and belief) and social anxiety, would be moderated by age.

Thus, in the Current study, we hypothesized (a) Negative automatic thoughts was positively related with social anxiety, (b) Meta-worry frequency mediated the association between negative automatic thoughts and social anxiety, (c) Meta-worry beliefs would mediate the association between negative automatic thoughts and social anxiety, and (d) Age moderated the relationship between negative automatic thoughts and meta-worry frequency and belief.

Method

Participants

Three hundred and fifty-seven adolescents (193 girls and 164 boys) were recruited from one public middle school in a city from Shanxi Province in China. Participants' age ranged from 11 to 17 years with the average of 14.65 ($SD = 1.54$). Specifically, there were 89 junior high school boys, 142 junior high school girls, 75 high school boys and 51 high school girls in this study.

Design & Procedures

This study was approved by the Institutional Review Board at first author's affiliation. First, researchers contacted the potential middle schools to collaborate. Then, one public middle school from Shanxi province agreed to participate in data collection. Once informed written consents were obtained from adolescents and at least one parent, participants were asked to complete a pack of questionnaires, including demographic information, Social Anxiety Scale for Adolescents, Children's Automatic Thoughts Scale, Meta-Worry Questionnaire and Children' s Depression Inventory. All the responses were collected anonymously and participants were informed that they could withdraw from the study at any point. The data-collection procedure was conducted in the classroom by a research assistant, with the assistance of a head teacher.The research assistant ensured that the students understood clearly the instruction before the test, responded independently. After completing the questionnaires, the researcher thanked the adolescents for their participation.

Measures

Social Anxiety Scale for Adolescents (SAS-A; La Greca et al., 1988) The SAS-A is a 5-point Likert self-report measurement tool with 18 items (e.g., I worry that others don't like me") and is used to assess adolescents' social anxiety level. It has demonstrated adequate reliability and validity in Chinese adolescents (Zhou et al., 2008) and the Cronbach's alpha coefficient in the present study was .88.

Children's Automatic Thoughts Scale (CATS; Schniering & Rapee, 2002) CATS is a 40-item self-report questionnaire with 5-point Likert scoring and is designed to measure children and adolescent's negative thoughts. It consists of four subscales: Personal Failure (e.g., ''I am worthless''), Physical Threat (e.g., I'm scared of losing control), Social Threat (e.g., ''People are thinking bad things about me'') and Hostility (e.g., ''Most people are against me'') and showed adequate reliability and validity in Chinese youth (Sun et al., 2015). The Cronbach's alpha coefficient of the present study was .93.

Meta-Worry Questionnaire (MWQ; Wells, 2005) The MWQ is designed to assess negative appraisals of worry activity. The scale consists of 7 items, and for each item participants are asked to indicate degree of belief and the frequency

with which they experience the belief. Consequently, the MWQ consists of two subscales: (1) MWQ-Belief, which measures degree of belief in particular metacognitions from 0 to 100 points, and (2) MWQ-Frequency, which measures frequency of occurred meta-worries with 4-point Likert scoring (Fisak et al., 2014). In order to assure the convergent validity of MWQ among Chinese adolescents, we conducted a pilot survey with 592 participants ranging from 11 to 18 years old and found that Cronbach's alpha for MWQ-Belief was 0.90, 0.85 for MWQ-Frequency. Furthermore, two subscales were significantly correlated with CATS ($r_{frequency}$=0.61, $p<.001$; r_{belief}=0.41, $p<.001$), meta cognitions ($r_{frequency}$=0.54, $p<.001$; r_{belief}=0.35, $p<.001$) and social anxiety ($r_{frequency}$=0.55, $p<.001$; r_{belief}=0.33, $p<.001$). This re-demonstrated a plausible reliability and validity of MWQ. In the current study, Cronbach's alpha coefficients were as follows: 0.89 for MWQ-Belief and 0.82 for MWQ-Frequency, separately.

Children' s Depression Inventory (CDI; Kovacs, 1992) CDI includes 27 items and is a 3-points Likert scale. It was designed to provide a valid way to assess the severity of depressive symptoms among children and adolescents aged from 7 to 17 years old. The Chinese version of CDI showed good reliability and validity (Yu & Li, 2000). The internal consistency coefficient of the present study was .80.

Data Analyses

The missing values of each participant's data in our study was less than 5%, so none data was deleted. As for the missing values, expectation-maximization algorithm was used to finish the imputation. Descriptive analyses and Pearson correlation analyses were computed to report means, standard deviations, and correlations of study variables. In order to examine the mediation effect, we followed Zhao et al. (2010)'s four-step procedure: the bootstrap test of the indirect effect. Specifically, negative automatic thought was viewed as independent variable, meta-worry frequency and meta-worry belief as mediators, and finally socially anxiety as dependent variable. The reason we used the procedure by Zhao and colleagues (2010) was due to their improvement of the classic Baron-Kenny procedure (Baron & Kenny, 1986), which paid attention first to the significance of the direct effect that may gloss over the existing mediation effects. However, Zhao and colleagues formulated a more precise decision tree in mediation analysis. First, the procedure focused on testing the mediation effect. Second, the Sobel test used in Baron-Kenny procedure was not as powerful as the Sobel test used by Zhao and colleagues. In addition, to examine the moderation effect of age on the mediation path, we used SPSS 22 and PROCESS macro (model 7) developed by Hayes (2013). For mediation and moderated mediation analyses, as the high comorbidity between social anxiety and depression among adolescents (Cummings et al., 2014), depression was controlled as covariate in the present study.

Results

Descriptive Statistics

Means, standard deviations, and zero-order correlations for all study variables are presented in Table 1. As expected, adolescents' meta-worry (including frequency and belief) was positively correlated with social anxiety. Meanwhile, adolescents with greater meta-worry frequency were more likely to have higher meta-worry belief.

Testing for Mediation Effect

As shown in Table 2 and 3, multiple regression analyses results demonstrated that, in the first step, the regression coefficient of negative automatic thoughts on social anxiety was significant, $\beta=0.66$, $p<.001$. In the second step, the regression coefficient of negative automatic thoughts on meta-worry frequency after controlling for depression was significant, $\beta=0.47$, $p<.001$. As for the regression coefficient of meta-worry belief on social anxiety, when depression was controlled, was also found significant, $\beta=0.20$, $p<.001$. In the third step, we tested the relationship between meta-worry frequency and social anxiety after controlling for depression and the test result was shown to be promising ($\beta=0.11$, $p=.011$) (See Fig. 1). However, the path coefficient between meta-worry belief and social anxiety after controlling for

Table 1 Descriptive statistics and correlations of the main study variables

Variable	*M*	*SD*	1	2	3	4	5
1. NAT	89.77	24.33	-				
2. Social anxiety	44.67	12.34	0.65**	-			
3. Depression	52.30	4.94	−0.08	0.09**	-		
4. Meta-worry frequency	11.13	3.89	0.46**	0.41**	0.11*	-	
5. Meta-worry belief	211.18	216.44	0.19**	0.19**	0.12*	0.47**	-

NAT: negative automatic thoughts

* $p<.05$ ** $p<.01$

Table 2 Testing the mediation effect of meta-worry frequency on adolescent social anxiety(Normalized)

Independent variables	Model 1(SA)		Model 2(MWF)		Model 3(SA)	
	β	*t*	*β*	*T*	*β*	*t*
Depression	0.14	3.46**	0.15	3.25**	0.12	3.00**
NAT	0.66	16.54**	0.47	10.13**	0.61	13.47**
MWF					0.11	2.55*
R^2	0.44		0.23		0.45	
F	139.15**		54.28**		96.37**	

Each column is a regression model. SA: Social Anxiety; MWF: Meta-Worry Frequency; NAT: negative automatic thoughts

* $p < .05$ ** $p < .01$

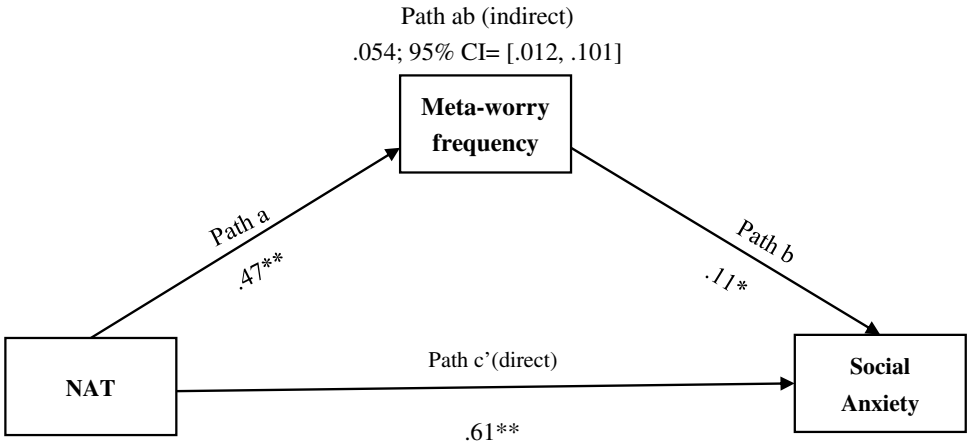

Fig. 1 The mediation model of Meta-worry frequency. NAT: negative automatic thoughts. * $p < .05$ ** $p < .01$

Table 3 Testing the mediation effect of meta-worry belief on adolescent social anxiety(Normalized)

Independent variables	Model 1(SA)		Model 2(MWB)		Model 3(SA)	
	β	*t*	*β*	*T*	*β*	*t*
Depression	0.14	3.46**	0.13	2.52*	0.13	3.26**
NAT	0.66	16.54**	0.20	3.77**	0.65	15.98**
MWB					0.05	1.32
R^2	0.44		0.05		0.44	
F	139.15**		9.56**		93.54**	

Each column is a regression model. SA: Social Anxiety; MWB: Meta-worry belief; NAT: negative automatic thoughts. * $p < .05$ ** $p < .01$

depression showed no significance ($\beta = 0.05$, $p = .19$) (See Fig. 2). In the final step, the bias–corrected percentile bootstrap test showed that the indirect effect of negative automatic thoughts on social anxiety through meta-worry frequency was significant, $ab = 0.054$, SE = 0.022, 95% CI = [0.012, 0.101]. The mediation effect accounted for 8.1% of the total effect, and statistic power was 0.688.

As concluded, the relation between negative automatic thoughts and meta-worry frequency as well as social anxiety was a mediation. For the relation between meta-worry belief and social anxiety, there was no mediation effect (See Table 2 and 3).

Testing for Moderated Mediation

As shown in Table 4; Fig. 3, the main effect of negative automatic thoughts on meta-worry frequency was significant, $\beta = 0.48$, $p < .001$, and this effect was moderated by age when controlling for depression, $\beta = -0.14$, $p = .002$. The index of moderated mediation (with normalized) was −0.017 (Boots CI = [-0.03, −0.003]). For descriptive purposes, our study plotted the relationship between age and negative automatic thoughts, separately for low and high levels of age (one SD below and above the mean score, respectively) (See Fig. 4). Simple slope tests demonstrated that, compared with older

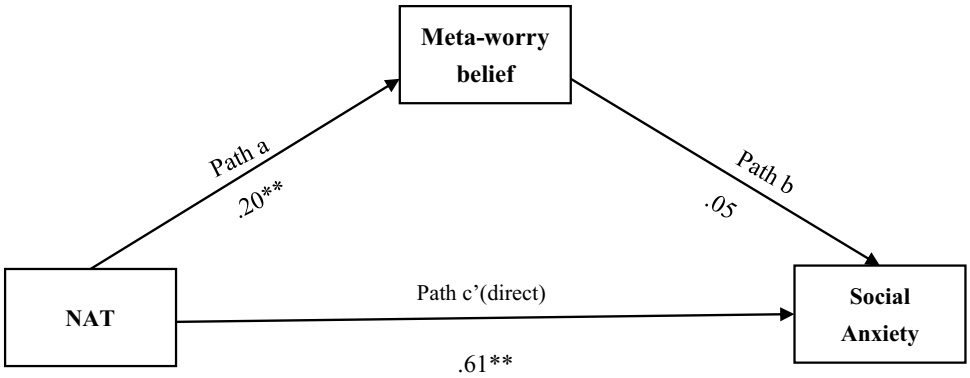

Fig. 2 The mediation model of Meta-worry belief. NAT: negative automatic thoughts. * $p < .05$ ** $p < .01$

adolescents ($\beta = 0.34$, $p < .001$), the younger participants ($\beta = 0.63$, $p < .001$) had a stronger effect of negative automatic thoughts on meta-worry frequency.

Discussion

Referred from model of meta-worry in GAD and the cognitive model of SAD, the present study primarily examined the mediation effect of meta-worry frequency and meta-worry belief, respectively, between negative automatic thoughts and social anxiety among Chinese adolescents, and then the moderation effect of age on the negative automatic thoughts and meta-worry. To conclude, for the mediation analyses, results revealed that only meta-worry frequency, not meta-worry belief, partially mediated the association between negative automatic thoughts and social anxiety. Furthermore, with a moderated mediation model, we found out that age did moderate the relation between negative automatic thoughts and meta-worry frequency among Chinese adolescents.

In the current study, only meta-worry frequency was found to be the significant mediator between negative automatic thoughts and social anxiety among Chinese adolescents. Meta-worry frequency represented the frequency of worry about certain thoughts (Wells, 2005). It was plausible that social anxiety symptoms would be more severer when negative automatic thoughts are constantly evaluated in passive dimensions. Additionally, our results might suggest rumination, as a frequency-related behavior which we mentioned before, also played a pivotal role at the metacognitive level. More importantly, this result was in line with Wells' model (2005), which indicated that meta-worry frequency would be more closely associated with anxiety. As frequency represented the number of conscious activations of negative beliefs and each occurrence was linked to the elevated distress and unhelpful coping strategies.

Although meta-worry belief was not a significant mediator in the present study, it still was in accordance with the findings from Fisak et al. (2014) which demonstrated that MWQ-Belief was not significantly related with social anxiety when MWQ-Frequency was entered simultaneously into the regression equation. A possible explanation would be that meta-worry belief was more likely to be representative of the underlying schema of emotional disorders. Instead of directly impacting on social anxiety, meta-worry belief would be mediated by meta-worry frequency (Wells, 2005). The research illustrated that meta-worry belief might be a deeper level of cognition, rather than just the superficial occurrence at meta-cognition level.

The finding that meta-worry frequency mediated the relation between negative automatic thoughts and adolescents' social anxiety still showed clinical and practical implication with the perspective of metacognition therapy. Specially, as the complicatedness, intensity, longer process of formation of meta-worry belief, and its effect acting on social anxiety, it would be more effective in targeting meta-worry frequency rather than belief directly when targeting anxious emotions. Namely, to some extent only a certain number of practice time was conducted, a qualitative change (i.e., meta-worry belief) would happen.

With regard to the age-based differences in cognitive monitoring, with older children and adolescents scoring higher (Ellis & Hudson, 2010), the findings from the present

Table 4 Testing the moderated mediation effect of age on adolescent social anxiety(Normalized)

	Variable: SA		Variable: MWF	
Independent variables	β	t	β	t
NAT	0.61	13.47**	0.48	10.50**
Depression	0.12	3.00**	0.14	3.09*
Age			−0.11	-2.35*
NAT x Age			−0.14	-3.10**
MWF	0.11	2.54*		
R^2	0.45		0.27	
F	96.37**		32.60**	

Each column is a regression model. SA: social anxiety; NAT: negative automatic thoughts; MWF: meta-worry frequency

* $p < .05$ ** $p < .01$

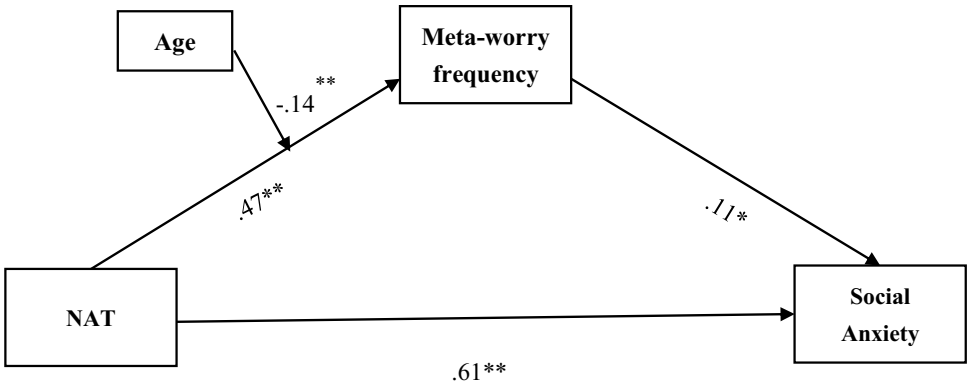

Fig. 3 The moderated mediation model of age. NAT: negative automatic thoughts. * $p < .05$ ** $p < .01$

study indicated that age significantly and negatively moderated the association between negative automatic thoughts and meta-worry frequency would be explainable. As previously indicated, results showed the elevation of metacognition capacity in Chinese adolescents could lead to a better control for the negative appraisals about their thoughts. Hence, with the increase of age, the negative effect of biased automatic cognitions on meta-worry might be lessened. This finding would suggest that more attention should be paid to developmental factors, such as age, in the development of children and adolescents' social anxiety. Age-specific intervention techniques would be strongly recommended in future research.

Several limitations should be considered when interpreting the results. First, most of the participants were from urban district, which limits the generalizability of our findings to the adolescents from suburban or less developed areas. Second, social anxiety is likely to be initiated in a complex and dynamic way and may change in different contexts. Hence, it's vital to conduct a multiple-social-situation-contained experiment for consolidating our findings in future research. It should be noted that the relationship with social-anxiety-specific metacognitive beliefs may be enhanced due to criterion overlap in measuring social anxiety. Such criterion overlap may also enhance the relation between social cognition and social anxiety (Gkika et al., 2017). Another limitation of the present study was its reliance on a cross-sectional rather than a longitudinal research design. Finally, the lack of clinical or subclinical samples limits the generalizability and interpretation of the results of this study.

Albeit the above-mentioned limitations, the present study indeed proved that meta-worry, especially the component meta-worry frequency, has a broad effect on social anxiety in Chinese adolescents. The finding about meta-worry frequency and social anxiety would greatly improve our understanding of social anxiety and this would probably explain the developmental trends in worry and anxiety prevalence. Secondly, the findings from the present study would point out towards the shared mechanisms with other anxiety disorders,

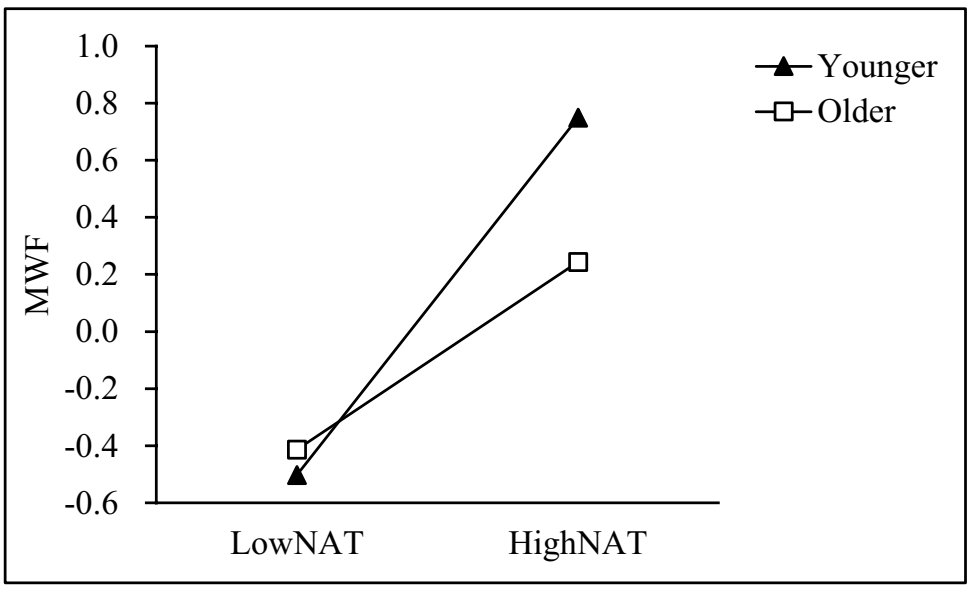

Fig. 4 Meta-worry frequency among adolescents as a function of negative automatic thoughts and age. Results are graphed for two levels of age; one standard deviation above the mean and one standard deviation below the mean

e.g., generalized anxiety disorder, illustrating the probability to further investigate and conduct more research in social anxiety (disorder), especially from the perspective of MCT. The findings indicated that negative automatic thinking triggers social anxiety in adolescents, where meta-worry frequency, rather than meta-worry beliefs, could mediate the relationship. Therefore, individuals' meta-worry frequency can be reduced to alleviate social anxiety in adolescents. The present results are informative for metacognitive therapy suggesting that it could be more effective by targeting changes in the frequency of thoughts rather than changes in meta-worry beliefs. In summary, the present study extends the existing literature of meta-worry and social anxiety as well as negative automatic thoughts in Chinese adolescents by examining a moderated mediation model.

Funding This research was supported by the National Science Foundation of China [Grant No. 32171073], Humanities and Social Science Fundation of Ministry of Education of China [No. 21YJC190020], and China Postdoctoral Science Foundation [Grant No. 2020M672919].

Declarations

Conflict of Interest My coauthors and I do not have any conflicts of interest with regard to this manuscript.

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