

Relationship Between Father-Child Attachment and Adolescents' Anxiety: The Bidirectional Chain Mediating Roles of Neuroticism and Peer Attachment

Cong Peng¹, Yan Liu², Yuqin Zhou³, Zhenyun Zhang⁴

¹School of Education and Psychology, Hubei Engineering University, Xiaogan, 432000, People's Republic of China; ²School of Education, Hunan University of Science and Technology, Xiangtan, 411201, People's Republic of China; ³School of Foreign Languages, Hubei Engineering University, Xiaogan, 432000, People's Republic of China; ⁴School of Computer and Information Science, Hubei Engineering University, Xiaogan, 432000, People's Republic of China

Correspondence: Cong Peng; Zhenyun Zhang, Email pengcong2023@hbeu.edu.cn; 3132980866@qq.com

Background: Adolescent anxiety is closely associated with the quality of parent-child attachment. However, previous studies have predominantly focused on the impact of mother-child attachment. Little is known about the direct and indirect associations of father-child attachment on adolescent anxiety.

Purpose: This study aims to investigate the association and underlying mechanisms that link father-child attachment and adolescent anxiety. A bidirectional chain mediating model was constructed to test whether neuroticism and peer attachment play bidirectional mediating roles in father-child attachment and adolescent anxiety.

Methods: The proposed model was examined among 763 adolescents aged 11–16 years (male 53.1%) from four middle schools in Central China. Students completed questionnaires on father-child attachment, anxiety, neuroticism and peer attachment. The correlation and bidirectional chain mediating effect analyses were conducted using SPSS Process.

Results: (1) Father-child attachment negatively correlated with adolescent anxiety and neuroticism, and positively correlated with peer attachment; (2) Father-child attachment had an indirect association on adolescent anxiety through three pathways: a partial mediating effect on neuroticism, a partial mediating effect on peer attachment, and a bidirectional chain mediating effect involving both neuroticism and peer attachment.

Conclusion: This study revealed father-child attachment has an indirect association with adolescent anxiety through the bidirectional chain mediation of neuroticism and peer attachment. These empirical findings shed light on the intricate dynamic between father-child attachment and anxiety among Chinese adolescents, highlighting the crucial role of fathers in the prevention and reduction of adolescent anxiety from the perspectives of father-child dynamics, personal traits, and interpersonal relationships.

Keywords: father-child attachment, adolescent anxiety, neuroticism, peer attachment, bidirectional chain mediating effect

Introduction

Anxiety is characterized by feelings of pain, uneasiness, apprehension, or worry, and is commonly understood as a group of emotional disorders involving excessive fear and worry.¹ If left untreated, anxiety can develop into a chronic condition.² Among adolescents, anxiety is a prevalent psychological disorder. In a large-scale national comorbidity survey of 10,123 American adolescents, it was found that up to 31.9% of them suffered from anxiety disorders, making it the psychological disorder with the highest detection rate.³ Transnational studies have also demonstrated that Chinese adolescents experience higher levels of anxiety compared to their counterparts in Italy and the Netherlands.^{4,5} Moreover, previous research has shown that persistent anxiety in adolescents is closely associated with low social and learning abilities,⁶ sleep disorders,⁷ and alcohol use.⁸ Hence, addressing anxiety among Chinese adolescents is of utmost

importance. Consequently, it is crucial to conduct in-depth research on the risk and protective factors that influence anxiety in this population.

Attachment refers to the enduring and stable emotional connection between an individual and a significant caregiver, typically parents.⁹ Based on attachment theory, children may feel anxious when they question the availability and ability of their attachment figure to provide comfort and support, especially during difficult or unsettling situations.¹⁰ Previous study has demonstrated a close relationship between the quality of parent-child attachment and adolescent anxiety.¹¹ A positive parent-child attachment helps children develop a sense of security and self-confidence, which facilitates their exploration of the unknown and alleviates anxiety and tension in uncertain situations. However, early studies primarily focused on the role of mother-child attachment.¹² Researchers reviewed 19 studies conducted in Western countries from 1985 to 2007 on the relationship between parent-child attachment and internalizing problems (anxiety and depression) in children, which found that father-child and mother-child attachments have a comparable impact, although there were relatively few studies on father-child attachment.¹³

Over the past decade, the uniqueness and importance of father-child attachment has been specifically explored in the academic field,^{14,15} confirming the significant influence of paternal attachment on children's emotional and social development.^{16,17} An increasing number of studies have shown that the attachment figure extends beyond the mother, and fathers can also serve as important attachment figures for children. Recent research suggests that there is no primacy or dominance of mother-child attachment in children's development.^{18,19} Some studies even indicate that father-child attachment plays a more significant role than mother-child attachment in individual development. For instance, only father secure base support (an indicator of attachment security) uniquely predicted positive emotion,²⁰ and the predictive power of father-child attachment for adolescents' mental health is stronger than that of mother-child attachment and peer attachment.^{21,22} However, previous research on the impact of father-child attachment on children's emotional health (including anxiety) has typically focused on infancy and childhood.^{23–25} There is currently a lack of studies specifically examining the impact of father-child attachment on anxiety in adolescence.

Although anxiety symptoms in childhood and adolescence overlap, the nature of anxiety may differ between these stages, leading to potentially different impacts of paternal and maternal attachment on adolescent anxiety. Childhood anxiety often relates to changes in basic needs, sense of security, and parent-child relationships.²⁶ For example, separation anxiety, one of the most common types of childhood anxiety, manifests as intense distress and anxiety upon separation from parents.²⁷ Upon entering adolescence, teenagers begin to explore externally and develop a sense of self, and are more likely to experience anxiety due to discordant peer relationships, academic pressure, and career decision-making difficulties.^{28–30} According to the Secure Base Hypothesis of Father-child Attachment,³¹ mothers primarily fulfill the role of a safe haven, providing comfort and alleviating doubts when children are stressed or upset. In contrast, fathers mainly function as a secure base, offering support and encouragement as children explore unfamiliar environments. Thus, the role of father-child attachment in adolescence may be relatively more important than that of mother-child attachment as physical care-taking declines in prominence.³² Fathers can have a greater impact than mothers on certain aspects of adolescent development, such as peer communication, engaging in new experiences, and encouraging the pursuit of goals and plans.¹⁶ Therefore, empirical research on Chinese adolescents, who exhibit relatively high levels of anxiety, can enrich our understanding of how father-child attachment affects anxiety during adolescence.

Despite few previous studies analyzing the impact of father-child attachment on adolescent anxiety,^{33,34} these studies predominantly involve samples of Western adolescents, and seldom explore the pathway through which father-child attachment influences adolescent anxiety. There is a lack of research on the direct and indirect impacts of the father-child relationship on Chinese adolescents' anxiety. Since fathering and the father-child relationship are profoundly influenced by culture,³⁵ the impact of father-child attachment on Chinese adolescents' emotional health needs to be further explored in the context of Chinese culture. It is worth investigating whether father-child attachment significantly influences anxiety among Chinese adolescents and the pathways through which this influence occurs.

In summary, there are still certain limitations and gaps in the existing literature. First, most studies examining parent-adolescent relationships have primarily focused on the relationship between mothers and adolescents, neglecting the impact of the father-child relationship. Second, there is a dearth of theoretical and empirical research investigating the

impact of the father-child relationship on Chinese adolescents' anxiety. In addition, ecological systems theory suggests that the micro systems, including external family and school factors as well as individual internal factors, collectively influence individual development.³⁶ Therefore, focusing solely on the family factor of father-child attachment to explain adolescent anxiety cannot fully reveal the underlying mechanisms. It is essential to consider the simultaneous effects of both adolescent personality (the individual internal factor) and external school factors such as peer attachment.

Based on the above argument, this study aims to investigate the impact of father-child attachment on Chinese adolescent anxiety and comprehensively explore the bidirectional chain mediating roles of adolescent's personality and peer attachment underlying this relationship. This not only deepens our understanding of the importance of father-child attachment among Chinese adolescents but also reveals the internal mechanisms through which fathers influence the emotional health of their children.

Father-Child Attachment and Adolescent Anxiety

Based on attachment theory,¹⁰ when adolescents have a close relationship with their parents, they show a positive developmental trend and experience less anxiety. Conversely, when the parent-child relationship is poor, adolescents are prone to anxiety due to a lack of emotional support from their parents in times of distress. A cross-sectional study has found that fathers have a significant association with adolescent anxiety.¹⁹ Additionally, a longitudinal study showed that father-child attachment has both simultaneous and sequential effects on children's anxiety, meaning that father-child attachment at time T1 not only predicts children's anxiety at time T1 but also predicts their anxiety at time T2. On the other hand, mother-child attachment only has a simultaneous effect.³⁷ Based on the above research, this study proposes Hypothesis 1: Father-child attachment is significantly and negatively associated with adolescent anxiety.

Although there is limited evidence regarding the association between father-child attachment and adolescent anxiety, it is not yet known through which pathway father-child attachment affects adolescent anxiety. Therefore, this study aims to reveal the intermediate mechanisms through which father-child attachment influences adolescent anxiety, in order to clarify the possible impact mechanisms of father-child attachment on adolescent anxiety.

The Mediating Role of Neuroticism

Neuroticism is considered one of the personality characteristics most related to psychopathology.³⁸ Longitudinal studies have shown that neuroticism significantly predicts individual anxiety in adolescent students.³⁹ Furthermore, the parent-child relationship is an important environmental factor that affects adolescent growth. Previous study has revealed a close relationship between attachment style and neuroticism. Individuals with early secure attachment scored higher in agreeableness and conscientiousness and lower in emotional stability in adulthood, while those with insecure attachment showed the opposite pattern, with higher neuroticism, lower agreeableness and conscientiousness.⁴⁰

Researchers proposed a Personality-Relationship Transactions Model of the association between personality and relationships, suggesting that the direction and magnitude of the influence between personality and relationships depend on the nature of an individual's life transition.⁴¹ If the life transition has normative characteristics, such as a positive change in the adolescent parent-child relationship, it can promote adolescents' self-differentiation and the development of a healthy personality. In this case, the relationship has a greater impact on personality development. Conversely, personality effects on social relationships are likely to emerge in the context of less normative life experiences. For example, neurotic individuals tend to interpret their partner's behaviors in a relatively threatening way during communication, leading to decreased satisfaction in the romantic relationship and affecting their stability. This reflects the neurotic individuals' styles of relationship regulation throughout their lives. In such cases, personality has a greater impact on relationships. Based on this model, two indirect effect paths were proposed between personality-relationship transactions and health outcomes: one is the path of "relationship → personality → health" (more common in normative life transitions), and the other is the path of "personality → relationship → health" (more common in non-normative life transitions).⁴² However, this hypothesis needs verification among different age groups and stages of development. As this study focuses on the impact of father-child relationships (a normative life transition) on adolescents' emotional health, we predict that the path "father-child relationship → neuroticism → anxiety" can be established and propose Hypothesis 2: Neuroticism plays a mediating role between father-child attachment and adolescent anxiety.

The Mediating Role of Peer Attachment

Based on the developmental systems theory,⁴³ individual development is not solely determined by the independent influence of different factors but rather the result of multiple interactions among situational variables, such as family and peers, throughout development. In addition to parent-child attachment, adolescents also develop important peer attachment relationships and seek emotional support from their peers to fulfill their need for belonging and intimacy, and to cope with various anxiety-inducing situations in daily life, such as parent-child conflicts and academic failure.⁴⁴ A longitudinal study indicated that attachment to best friends was one of the most robust predictors of adolescent anxiety.⁴⁵ Research even showed that peer attachment played a more important role in adolescent development than parent-child attachment.⁴⁶ However, after controlling for the influence of parental attachment, peer attachment has no significant effect on adolescents' adaptation.⁴⁷ In short, both parent-child attachment and peer attachment are important factors affecting adolescents' emotional health, however, they may have impact in different paths.

According to attachment theory, individuals construct internal working models (IWM) about themselves, others, and interpersonal relationships from early attachment-relevant experiences with parents.¹⁰ The IWM established through early social interactions naturally extends to an individual's other interpersonal relationships, including peer relationships, and indirectly affects their emotional adaptation.⁴⁸ Empirical research revealed that the attachment security of adolescents and fathers was closely related to the attachment security of adolescents with their best friends.⁴⁹ Father-child conflict was negatively linked to children's peer acceptance.⁵⁰ Father-child attachment can positively predict adolescents' peer attachment and negatively predict their negative emotions.⁵¹ The relationship between family function and social anxiety among adolescents was fully mediated by peer attachment and self-esteem.⁵² Recent research has found that parent-child attachment can influence adolescent emotional and school adaptation through the mediating role of peer attachment.^{53,54} Based on the aforementioned theoretical and empirical evidence, this study proposes Hypothesis 3: Peer attachment plays a mediating role between father-child attachment and adolescent anxiety.

The Bidirectional Chain Mediating Role of Neuroticism and Peer Attachment

Previous studies have discussed that father-child attachment affects adolescent neuroticism or how it influences peer attachment among adolescents. However, few have investigated the simultaneous influence of internal factors such as personality traits and external factors like peer relationships on the link between father-child attachment and adolescent anxiety. Therefore, this study aims to deeply analyze the mechanism of the influence of neuroticism and peer relationship caused by father-child attachment on adolescents' anxiety. According to the Personality-Relationship Transactions Model, personality traits (such as neuroticism and agreeableness) and social relationships (including friendships and romantic relationships) are not isolated and static, but interact and influence an individual's health.^{42,55} Consequently, if adolescents have isolated relationships with their fathers, changes in the emotional stability of their personality will interact with discordant peer relationship, potentially affecting their anxiety levels.

On the one hand, neuroticism has been found to be a favorable predictor of peer attachment. The results of an 8-year longitudinal study revealed that individual differences in neuroticism were closely related to changes in peer relationships.⁵⁶ Adolescents' level of neuroticism predicted self-and other-perceived conflict frequency in peer relationships.⁵⁷ The quality of peer relationships reflects an individual's interaction strategies and preferences. Individuals with high levels of neuroticism may pay excessive attention to their relationships and have a high demand for recognition from their peers, tending to interpret their peers' specific behaviors in a relatively threatening way.⁴² Consequently, neurotic adolescents may experience reduced relationship satisfaction, which undoubtedly affects the stability of the relationship. This unsuitable pattern of interpersonal interaction further affects their peer relationships and mental health. Recent research found that neuroticism could affect adolescent emotional health through the mediating role of secure peer attachment.⁵⁸ On the other hand, peer relationships play a crucial role in an individual's emotional stability. When adolescents experience disharmonious peer relationships and limited support from their social enthrone-ment, it inevitably impacts their emotional stability, which in turn may lead to the occurrence of anxiety. A longitudinal study showed that peer relationships significantly influence adolescent personality, with a lasting impact on their emotions.⁵⁹

Since peer relationships are based on the negotiation of equality and require mutual adaptation,⁵⁶ the interaction of selection and socialization should manifest in a reciprocal dynamic of personality-relationship transaction within the context of friendship.⁵⁵ Based on the above analysis, we propose research Hypothesis 4: Father-child attachment has an indirect association with adolescent anxiety through the bidirectional chain mediating effects of neuroticism and peer attachment.

The Present Study

In summary, the relationship between father-child attachment, neuroticism, peer attachment, and anxiety is closely intertwined. Nevertheless, there is still a paucity of research investigating the mechanisms through which father-child attachment, neuroticism, and peer attachment impact adolescent anxiety. Therefore, this study proposes a bidirectional chain mediating model to examine the mediating roles of neuroticism and peer attachment in the association between father-child attachment and adolescent anxiety. Figure 1 depicts the proposed research model.

Materials and Method

Participants

The participants in this study were 763 adolescents recruited from four middle schools in Xiaogan city, Hubei Province, Central China. In order to improve the representativeness and balance of the sample, two middle schools from the city and two from the suburbs were selected. From each school, two classes in Grade One, and one each class in Grade Two and Grade Three, were randomly selected. A group test was conducted, and all participants completed anonymous questionnaires. The age of the subjects ranged from 11 to 16 years, with an average age of 13.17 ± 0.96 . Of the participants (7 individuals missing gender information), 405 were male students (53.1%), and 351 were female students (46.0%). The distribution across grades was as follows: 370 (48.5%) in Grade One, 184 (24.1%) in Grade Two, and 209 (27.4%) in Grade Three. 680 adolescents were intact family (89.1%), 58 from single-parent family (7.6%), and 25 were from reconstituted family (3.3%).

Measures

Father-Child Attachment Scale and Peer Attachment Scale

Measurement for father-child attachment and peer attachment utilized the respective subscales of the Chinese version of the Inventory of Parent and Peer Attachment (IPPA).^{60,61} These subscales consisted of 25 questions, assessing dimensions of trust, communication, and alienation (eg, “My Dad respects my feelings” and “I tell my friends about my problems and troubles”). Participants rated their responses on a 5-point Likert scale, ranging from 1 (almost never) to 5 (almost always). Higher total scores indicated a higher level of attachment to fathers or peers. The Cronbach’s α coefficients for the two scales were 0.902 and 0.869, respectively.

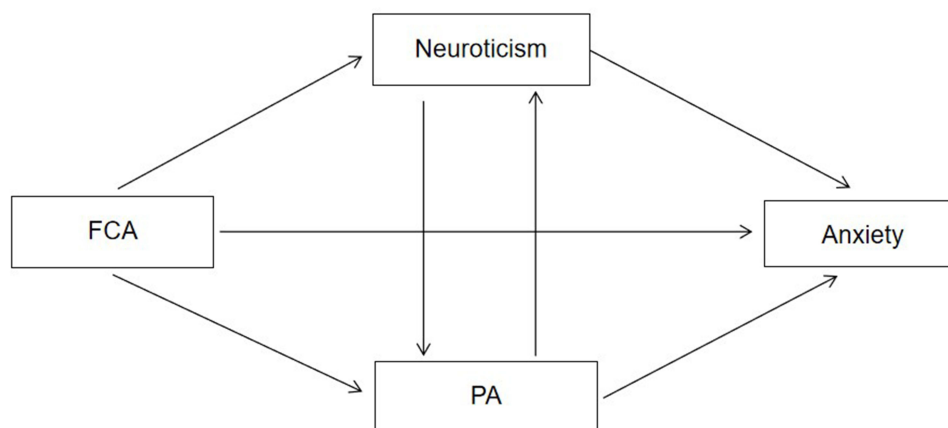


Figure 1 The proposed bidirectional chain mediating model.

Abbreviations: FCA, father-child attachment; PA, peer attachment.

Five-Factor Personality Questionnaire for Middle School Students

The neuroticism subscale of the five-factor personality questionnaire for middle school students was employed.⁶² This subscale comprises 9 items measuring neurotic tendencies (eg, “I often feel worried about things that I should be confident about”). Participants rated each item on a 5-point Likert scale, with responses ranging from 1 (very unlike me) to 5 (very like me). Higher scores indicated a higher level of unstable mood. The Cronbach’s α coefficient for this scale was 0.779.

Self-Rating Anxiety Scale

The Self-Rating Anxiety Scale (SAS) was utilized to assess anxiety levels.⁶³ This scale consists of 20 items that reflect subjective feelings of anxiety (eg, “I feel more nervous and anxious than usual”). Participants rated the frequency of symptoms on a 4-point Likert scale, ranging from 1 (little time) to 4 (most of the time). The Cronbach’s α coefficient for this scale was 0.839.

Control Variables

In addition to the main variables of interest, gender, grade, and family structure were included as control variables to account for their potential influence. The impact of father-child attachment on children may vary depending on their age, gender, and developmental stage.¹⁶ Similarly, the correlation between the quality of the father-child relationship and adolescent emotional outcomes can vary based on family structures.⁶⁴

Procedure

Data collection took place in middle-school classrooms without the presence of teachers. Written informed consent was obtained from the legal guardians/next of kin of the participants. The research protocol received approval from the Ethical Committee of the School of Education and Psychology, Hubei Engineering University. Prior to the survey, students were informed about the voluntary nature of their participation and were given the option to withdraw at any time. Trained postgraduate students followed standard procedures for distributing and collecting questionnaires, while also addressing any questions from the students.

Data Analysis

Descriptive statistics and correlation analyses were conducted using SPSS version 22.0. The Pearson correlation was used to analyze the correlation coefficient of each variable. The independent variables, mediating variables and the dependent variable were significantly associated with each other and met the conditions of a mediating effect test, then the PROCESS macro program was employed to test the bidirectional chain mediating effects.⁶⁵ Model 6, which is a chain mediating model, was used within the PROCESS macro program for SPSS to examine the bidirectional chain mediating effect of neuroticism and peer attachment between father-child attachment and adolescent anxiety. The bias-adjusted percentile bootstrap method was used to test for the bidirectional chain mediating effect. Five thousand samples were selected to estimate the 95% confidence interval of the chain mediating effect.

Common-Method Bias Test

Considering that all data in this study were derived from self-report measures completed by adolescents, concerns about common-method bias were addressed. To assess this, Harman’s single factor test was conducted. The results of non-rotating principal component factor analysis indicated the presence of 16 factors with eigenvalues greater than 1. The first factor accounted for 17.23% of the variance, which was lower than the critical value of 40%. This finding suggests that there was no serious common-method bias in this study.⁶⁶

Results

Preliminary Analysis

The mean and standard deviation of father-child attachment, neuroticism, peer attachment and adolescent anxiety are listed in Table 1. The results showed that father-child attachment is significantly negatively correlated with neuroticism and anxiety ($P_s < 0.01$), and positively correlated with peer attachment ($P < 0.01$); Neuroticism was negatively correlated

Table 1 The Correlation of the Main Study Variables (N=763)

Variables	M±SD	1	2	3	4	5
1 FCA	3.25±0.72	1				
2 Neuroticism	3.32±0.82	-0.31**	1			
3 PA	3.53±0.63	0.38**	-0.20**	1		
4 Anxiety	1.97±0.51	-0.32**	0.42**	-0.41**	1	
5 Age	13.2±0.96	-0.09*	0.04	-0.12**	0.10**	1

Notes: *p<0.05; **p<0.01.

Abbreviations: FCA, father-child attachment; PA, peer attachment.

with peer attachment ($P < 0.01$), and positively correlated with anxiety ($P < 0.01$); Peer attachment was negatively correlated with anxiety ($P < 0.01$).

Testing for the Bidirectional Chain Mediating Effect

It can be seen from Table 1 that father-child attachment, neuroticism, peer attachment and anxiety are significantly correlated with each other. Independent variables are significantly associated with mediators and meet the conditions of a chain mediating effect test. In this study, the bias adjusted percentile bootstrap method was used to test the chain mediating effect. Five thousand samples were selected to estimate the 95% confidence interval of mediating effect, and model 6 (a chain mediating model) in SPSS macro was used to test the bidirectional chain mediating effect.

First, a chain mediating test was conducted to analysis the mediated model of neuroticism and peer attachment (Model 1). Under the condition of controlling for gender, age, grade and family structure, the results of chain mediating regression analysis (see Table 2 and Figure 2) showed that father-child attachment is significantly associated with neuroticism ($B = -0.34, t = -8.59, P < 0.001$); Neuroticism ($B = -0.08, t = -2.84, P < 0.01$) and father-child attachment

Table 2 Testing for the Chain Mediating Effects of Neuroticism and Peer Attachment (Model 1)

Regression Equation (N=756)		Fitting Indicators			Coefficient Significance	
Outcomes	Predictors	R	R ²	F	β	t
Neuroticism	Gender	0.33	0.11	18.49***	0.15	2.59**
	Age				0.02	0.37
	Grade				-0.01	-0.17
	Family structure				0.01	0.16
	Father-child attachment				-0.34	-8.59***
Peer attachment	Gender	0.41	0.16	24.54***	0.09	2.17*
	Age				-0.04	-1.22
	Grade				-0.01	-0.28
	Family structure				0.06	1.20
	Neuroticism				-0.08	-2.84**
Anxiety	Father-child attachment	0.55	0.30	45.28***	0.31	9.89***
	Gender				0.03	0.85
	Age				0.02	0.58
	Grade				0.01	0.24
	Family structure				-0.02	-0.48
	Neuroticism				0.20	9.61***
	Peer attachment				-0.24	-8.98***
Father-child attachment	-0.08	-3.19**				

Notes: *p<0.05, **p<0.01, ***p<0.001; Family structure was a category variable (1 = intact family; 2 = single-parent family; 3 = reconstituted family). As seven participants missed gender information, 756 samples were in the testing of chain mediating model.

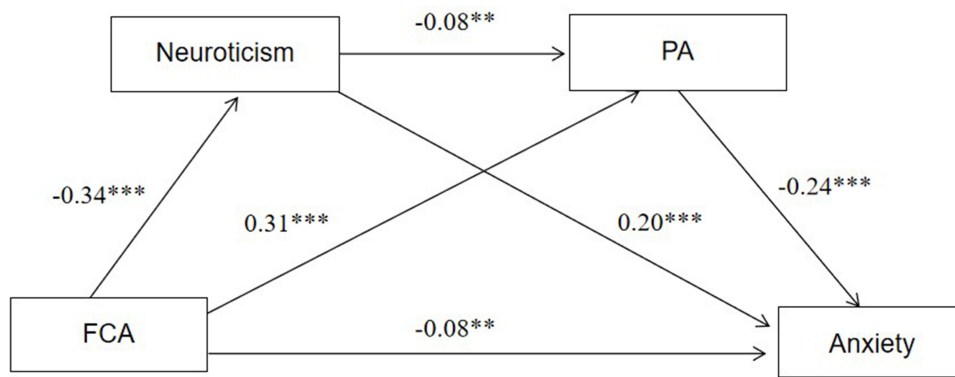


Figure 2 The chain mediating effects of neuroticism and peer attachment (Model 1).

Notes: ** $p < 0.01$, *** $p < 0.001$.

Abbreviations: FCA, father-child attachment; PA, peer attachment.

($B = 0.31, t = 9.89, P < 0.001$) are significantly associated with peer attachment; Neuroticism ($B = 0.20, t = 9.61, P < 0.001$), peer attachment ($B = -0.24, t = -8.98, P < 0.001$) and father-child attachment ($B = -0.08, t = -3.19, P < 0.01$) are significantly associated with adolescent anxiety.

The direct effect of father-child attachment on adolescent anxiety is -0.079 ($t = -3.19, P < 0.01, LLCI = -0.128, ULCI = -0.030$), accounting for 34.6% of the total effect (-0.228), and the total indirect effect of neuroticism and peer attachment between father-child attachment and adolescent anxiety is -0.149 ($LLCI = -0.185, ULCI = -0.116$), accounting for 65.4% of the total effect (see Table 3). The mediating effect of neuroticism between father-child attachment and adolescent anxiety is -0.067 , 95% $[-0.089, -0.046]$, accounting for 29.4% of the total effect (-0.228). The mediating effect of peer attachment between father-child attachment and adolescent anxiety is -0.075 , 95% $[-0.103, -0.052]$, accounting for 32.9% of the total effect (-0.228). The chain mediating effect of neuroticism and peer attachment between father-child attachment and adolescent anxiety is -0.007 , 95% $[-0.012, -0.002]$, accounting for 3.07% of the total effect (-0.228). The Bootstrap 95% confidence intervals of three indirect effects did not contain Zero (see Table 3). All standardized effects are statistically significant. This indicates that neuroticism and peer attachment have a chain mediating effect between father-child attachment and adolescent anxiety.

Second, a chain mediating test was conducted to analysis the mediated model of peer attachment and neuroticism (Model 2). Under the condition of controlling for gender, age, grade and family structure, the results of chain mediating regression analysis (see Table 4 and Figure 3) showed that father-child attachment is significantly associated with peer attachment ($B = 0.34, t = 11.20, P < 0.001$); Peer attachment ($B = -0.14, t = -2.84, P < 0.01$) and father-child attachment ($B = -0.30, t = -6.91, P < 0.001$) are significantly associated with neuroticism; Neuroticism ($B = 0.20, t = 9.61, P < 0.001$), peer attachment ($B = -0.24, t = -8.98, P < 0.001$) and father-child attachment ($B = -0.08, t = -3.19, P < 0.01$) are significantly associated with adolescent anxiety.

The direct effect of father-child attachment on adolescent anxiety is -0.079 ($t = -3.19, P < 0.01, LLCI = -0.128, ULCI = -0.030$), accounting for 34.6% of the total effect (-0.228), and the total indirect effect of peer attachment and neuroticism between father-child attachment and adolescent anxiety is -0.149 ($LLCI = -0.184, ULCI = -0.116$), accounting for 65.4% of the total effect (see Table 5). The mediating effect of peer attachment between father-child attachment

Table 3 The Total, Direct and Indirect Effects of the Chain Mediation Model of Neuroticism and Peer Attachment

	Indirect Effect	Boot SE	Boot LLCI	Boot ULCI	Relative Mediating Effect
Total indirect effect	-0.149	0.017	-0.185	-0.116	65.4%
FCA→Neuroticism→Anxiety	-0.067	0.011	-0.089	-0.046	29.4%
FCA→PA→Anxiety	-0.075	0.013	-0.103	-0.052	32.9%
FCA→Neuroticism→PA→Anxiety	-0.007	0.003	-0.012	-0.002	3.07%

Abbreviations: FCA, father-child attachment; PA, peer attachment.

Table 4 Testing for the Chain Mediating Effects of Peer Attachment and Neuroticism (Model 2)

Regression Equation (N=756)		Fitting Indicators			Coefficient Significance	
Outcomes	Predictors	R	R ²	F	β	t
Peer attachment	Gender	0.39	0.16	27.57***	0.08	1.90
	Age				-0.05	-1.25
	Grade				-0.01	-0.26
	Family structure				0.06	1.17
	Father-child attachment				0.34	11.20***
Neuroticism	Gender	0.35	0.12	16.89***	0.16	2.79**
	Age				0.01	0.24
	Grade				-0.01	-0.20
	Family structure				0.02	0.28
	Peer attachment				-0.14	-2.84**
Anxiety	Father-child attachment	0.55	0.30	45.28***	-0.30	-6.91***
	Gender				0.03	0.85
	Age				0.02	0.58
	Grade				0.01	0.24
	Family structure				-0.02	-0.48
Peer attachment	-0.24	-8.98***				
Neuroticism	0.20	9.61***				
Father-child attachment	-0.08	-3.19**				

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Family structure was a category variable (1 = intact family; 2 = single-parent family; 3 = reconstituted family). As seven participants missed gender information, 756 samples were in the testing of chain mediating model.

and adolescent anxiety is -0.082 , 95% $[-0.110, -0.057]$, accounting for 36.0% of the total effect (-0.228). The mediating effect of neuroticism between father-child attachment and adolescent anxiety is -0.058 , 95% $[-0.079, -0.039]$, accounting for 25.4% of the total effect (-0.228). The chain mediating effect of peer attachment and neuroticism between father-child attachment and adolescent anxiety is -0.009 , 95% $[-0.017, -0.002]$, accounting for 3.95% of the total effect (-0.228). The Bootstrap 95% confidence intervals of three indirect effects did not contain Zero (see Table 5). All standardized effects are statistically significant. This indicates that peer attachment and neuroticism also have a chain mediating effect between father-child attachment and adolescent anxiety.

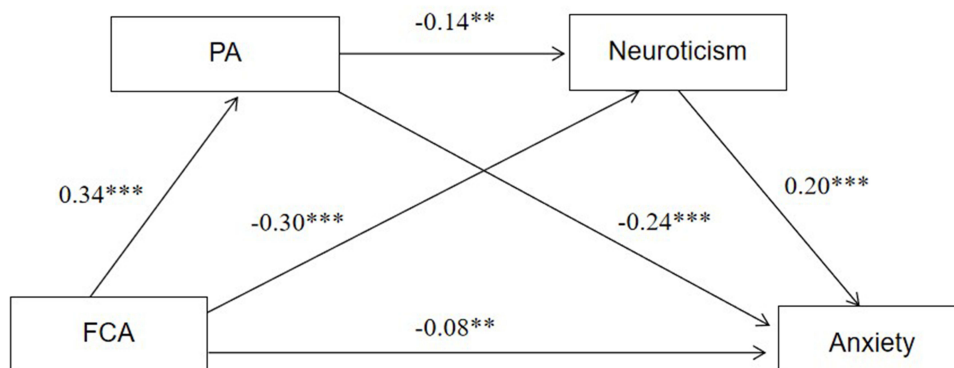


Figure 3 The chain mediation effects of peer attachment and neuroticism (Model 2).

Note: ** $p < 0.01$, *** $p < 0.001$.

Abbreviations: FCA, father-child attachment; PA, peer attachment.

Table 5 The Total, Direct and Indirect Effects of the Chain Mediation Model of Peer Attachment and Neuroticism

	Indirect Effect	Boot SE	Boot LLCI	Boot ULCI	Relative Mediating Effect
Total indirect effect	-0.149	0.017	-0.184	-0.116	65.4%
FCA→PA→Anxiety	-0.082	0.013	-0.110	-0.057	36.0%
FCA→Neuroticism→Anxiety	-0.058	0.011	-0.079	-0.039	25.4%
FCA→PA→Neuroticism→Anxiety	-0.009	0.004	-0.017	-0.002	3.95%

Abbreviations: FCA, father-child attachment; PA, peer attachment.

A comparison is made between the two chain mediation models. First, both models are fully saturated. Second, the total indirect effect sizes of the two chain mediating models are identical, suggesting that the two models have equivalent explanatory power. Third, the mediating effects of three pathways in Model 1 are comparable to those in Model 2.

Discussion

Adolescent anxiety is closely associated with the quality of parent-child attachment. However, previous studies have predominantly focused on the impact of mother-child attachment and its effects on Western adolescents, leaving a gap in understanding the direct and indirect associations of father-child attachment on Chinese adolescent anxiety. To address this gap, the current study endeavored to explore the association between father-child attachment and adolescent anxiety, examining how adolescent neuroticism and peer attachment serve as bidirectional chain mediating factors in this relationship. The results not only illuminate the potential mediating mechanisms between father-child attachment and anxiety among Chinese adolescents, but also underscore the importance of fathers in the prevention and reduction of adolescent anxiety from the perspective of father-child dynamics, personal traits, and interpersonal relationship.

The Direct Association of Father-Child Attachment on Adolescent Anxiety

First and foremost, this study indicates that father-child attachment is directly and negatively associated with adolescent anxiety, thus verifying Hypothesis 1 and aligning with previous study.^{11,12} According to attachment theory,¹⁰ contact with an attachment figure who provides a secure base and a secure haven reduces an individual's anxiety. As adolescents enter puberty, they become less dependent on their mothers in daily life. In contrast, father's inputs are so correlated with their children's development indices.⁶⁷ It is not difficult to understand that a high level of father-child attachment can provide adolescents with confidence, courage, and strength to cope with difficulties and challenges in academic or interpersonal communication, ultimately alleviating their anxiety. Fathers play an irreplaceable role in the healthy emotional development of adolescents.⁶⁸ Therefore, the results of this study have practical implications, suggesting that good father-child attachment is an important protective factor against adolescent anxiety.

The Mediating Role of Neuroticism

Secondly, this study found that adolescent neuroticism played a mediating role between father-child attachment and adolescent anxiety, thus verifying Hypothesis 2 and the indirect influence path of "relationship → personality → health". This study confirmed that father-child attachment is an important environmental factor affecting adolescents' personality. Based on life history theory,⁶⁹ although personality is greatly influenced by genetic inheritance, the influence of the environment induces the dominant expression of personality characteristics. Environmental factors can be used as the starting mechanism of development plasticity to affect the growth path of individuals, so as to shape their different personality characteristics. Good father-child attachment can negatively predict the level of neuroticism among adolescents.⁷⁰ Additionally, a longitudinal study showed that neuroticism is a strong predictor of developing anxiety among teenagers.³⁹ Therefore, father-child attachment could influence adolescent anxiety through the pathway of neuroticism.

The Mediating Role of Peer Attachment

Thirdly, this study found that peer attachment could play a mediating role between father-child attachment and adolescent anxiety, thus verifying Hypothesis 3. Based on the internal working models (IWM) of attachment, IWM has a significant and lasting impact on the external interpersonal relationships of individuals in the later stages.⁷¹ Research indicates that peer relationships begin later and have poorer stability compared to family relationships.⁵⁶ The early parent-child attachment relationship influences their later peer attachment. An empirical study has confirmed that adolescents' attachment experience with parents directly influenced the quality of their extra-familial relationships, particularly with peers.⁹ Another possible reason why the father-child relationship model naturally extends to peer relationships is that fathers allow their children to open up to the social world.⁷² Father-child relationships focus on the social sphere and are closely related to the subsequent mutually beneficial peer relationships.⁷³ Peer relationships are an important source of social support for adolescent mental health. This demonstrated that adolescents with high levels of father-child attachment are more likely to establish close emotional connections with their peers, and experience lower levels of anxiety. Therefore, peer attachment could play a mediating role between father-child attachment and adolescent anxiety.

The Bidirectional Chain Mediating Roles of Neuroticism and Peer Attachment

Lastly, this study identified the bidirectional chain mediating effects of neuroticism and peer attachment between father-child attachment and adolescent anxiety, thus confirming Hypothesis 4. This finding aligns with the ecological systems theory,³⁶ which posits that father-child attachment, as a critical proximal environmental factor, influences individual development. Micro systems such as peer relationships (external school factor) and personality traits (individual internal factor) also concurrently affect individual development. Additionally, the quality of father-child attachment can indirectly influence adolescent anxiety by triggering the interaction between adolescents social relationships and self-traits.

On one hand, adolescents with good father-child attachment exhibit lower levels of neuroticism.⁷⁰ Having a stable mood is helpful for adolescents to develop a positive perception of others during interpersonal interactions and maintain high-quality bonds with peers, leading to decreased anxiety. During adolescence, high-quality peer attachment fosters positive psychological adjustment.⁷⁴ This result indicated that individuals with high levels of neuroticism may excessively focus on others' views of themselves and have an unreasonable need for recognition. This heightened sensitivity and expectation can reduce interpersonal relationship satisfaction,⁷⁵ which in turn affects the quality of peer relationships, ultimately increasing anxiety among adolescents.

On the other hand, father-child attachment positively shapes peer relationships among adolescents,⁵⁸ which enhances their ability to manage negative emotions and coping with stress in social context, thereby alleviating anxiety. The quality of the father-child relationship directly affects the quality of adolescents' external interpersonal relationships, as explained by the father-child activation theory.⁷⁶ When there is low paternal accessibility, poor communication, and mutual distrust between father and child, fathers cannot help adolescents cope with stress, provide psychological support in the face of setbacks and difficulties, or aid in the development of general social skills. Research indicates that poor parent-child attachment predicts low levels of intimacy and social competence with peers during adolescence.⁷⁷ When adolescents' ability to establish harmonious relationships with peers is impaired, they typically encounter social problems and struggle to handle school interpersonal issues effectively, thus affecting their emotional stability, which in turn leads to anxiety. Adolescence is characterized by personality instability and high plasticity.⁷⁸ When adolescents experience discordant peer relationships, it inevitably impacts the emotional stability. Studies have shown that peer relationships significantly influence adolescent personality, with a lasting impact on their emotions.⁵⁹ Besides, personality has been viewed as a causal risk factor for adolescents' internalizing problems.⁷⁹ A six-year longitudinal study indicated that neuroticism confers substantial risk for the maintenance of anxiety symptoms in adolescence.⁸⁰ The results of this study points out the hypothesis of the interaction between peer relationships and personality traits in the relationship between father-child attachment and adolescent anxiety.

Based on the previous research,^{41,42} this study explored two new indirect effect paths of "parent-child relationship (longer history and higher level of closeness)→ adolescent personality→ peer relationship (starts later and has poorer stability)→ health" and "parent-child relationship → peer relationship→ adolescent personality→health". Therefore, the

findings further enriched the scope of the Personality-Relationship Transactions Model and revealed the process through which adolescent anxiety develops.

Limitations and Implications

Based on attachment theory and Personality-Relationship Transactions Model, this study explored the impact of father-child attachment on adolescent anxiety and its influencing mechanism through the bidirectional chain mediating roles of neuroticism and peer attachment. Furthermore, the total indirect effect between the quality of father-child attachment and adolescent anxiety was found to be higher than the direct effect, shedding light on the uniqueness of father-child attachment in terms of father-child interaction and indirect influence. This is the first study to construct a bidirectional chain mediation model from an integrated perspective of father-child dynamics, personal traits, and interpersonal relationship, further enriching and advancing the theoretical research on adolescent anxiety.

However, this study also has some limitations. First, adolescent anxiety is the result of the interaction of multiple factors, including physiological changes, psychological development, and changes in relationships. It is a continuous and dynamic developmental process. The cross-sectional method used in this study may not fully capture its dynamics. Therefore, future studies should employ longitudinal designs to further explore and establish the causal relationship and dynamic changes among the variables.⁸¹ Second, the self-report method used in this study is susceptible to social desirability bias. Behavioral observation and experimental methods could be employed to further verify the relationships between the variables. Third, in addition to parents and peers, the attachment between teachers and students should also be investigated. Future research could comprehensively examine the impact of father-child attachment, mother-child attachment, sibling attachment, peer attachment, and teacher-student attachment on the emotional and social adaptation of adolescents from the perspective of the family system and ecosystem theory. By controlling of mother-child attachment, teacher-student attachment and peer attachment, the results demonstrating the unique role of father-child attachment in child development will be more convincing.

Despite the aforementioned limitations, this study has important implications for the prevention and intervention of anxiety in adolescents. Firstly, the results revealed a significantly negative association between father-child attachment and anxiety in Chinese adolescents, indicating that those with a low level of father-child attachment are more likely to experience anxiety. Clinical practitioners should pay special attention to the quality of father-child relationships in adolescents with high levels of anxiety and prioritize repairing father-child relationships in cases of alienation. Secondly, the bidirectional chain mediating effect of neuroticism and peer attachment suggests that father-child attachment affects anxiety in adolescents through individual and interpersonal factors. Therefore, it would be beneficial for fathers to actively participate in their children's upbringing and help them maintain stable moods. Additionally, fathers should provide positive guidance in developing peer relationships and fostering high levels of peer attachment. Taking an integrated perspective on adolescent anxiety and incorporating family, individual, and interpersonal factors into the micro-environmental systems of adolescent development can enhance the effectiveness of clinical interventions.

Conclusion

This study firstly demonstrates both the direct and indirect associations between father-child attachment and adolescent anxiety. Specifically, adolescents who have a more distant relationship with their fathers are more likely to experience higher levels of anxiety. Additionally, the current study identifies neuroticism and peer attachment as significant bidirectional chain mediating factors influencing adolescent anxiety. Poor father-child relationships not only undermine adolescents' emotional stability but also influence their peer relationships, leading directly or indirectly to increased anxiety. These empirical findings shed light on the intricate dynamic between father-child attachment and anxiety among Chinese adolescents and highlight the crucial role of fathers in the prevention and reduction of adolescent anxiety. Therefore, future interventions targeting adolescent anxiety should not only focus on the quality of father-child relationships but also consider adolescents' emotional stability and peer relationships. Clinicians should adopt an integrated perspective in their therapeutic work.

Data Sharing Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval

The study is in accordance with the Declaration of Helsinki, and this research involving human participants was reviewed and approved by the the Ethical Committee of the School of Education and Psychology, Hubei Engineering University.

Informed Consent

Written informed consent to participate in this study was provided by all individual participants' legal guardian/next of kin.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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