

Personality traits and subjective well-being among Chinese adolescents: A moderated mediation model of interpersonal relationships and empathy

Xi Chen^{a,1}, Azlina Mohd Khir^{a,1}, Yong Yang^{b,2}, Boon Yew Wong^{c,*}

^a Faculty of Human Ecology, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

^b Faculty of Educational Studies, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

^c School of Nursing, Shandong Xiehe University, Jinan, Shandong, China

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ABSTRACT

Promoting subjective well-being (SWB) has emerged as a central priority in adolescent mental health research. However, how personality traits are associated with SWB via interpersonal pathways, and whether empathy moderates these processes, remain underexplored among Chinese adolescents. Using multi-stage stratified probability sampling, this study tested a moderated mediation model among 601 Chinese adolescents (aged 15–18 years; 42.93% male) from six schools in Henan Province. Participants completed the NEO Five-Factor Inventory, the Interpersonal Relationship Scale, the Interpersonal Reactivity Index, and the General Well-Being Schedule. Confirmatory factor analysis demonstrated good model fit ($\chi^2/df = 3.32$; CFI = 0.98; TLI = 0.96; RMSEA = 0.07), with satisfactory convergent and discriminant validity and adequate composite reliability. Mediation was tested using structural equation modeling in AMOS 29.0, and moderated mediation was examined using PROCESS Model 7. Results indicated that: (1) Neuroticism was negatively associated with SWB, while extraversion and conscientiousness were positively associated; openness and agreeableness showed no significant direct effects; (2) Interpersonal relationships mediated the associations of neuroticism, extraversion, and openness with SWB, but not those of agreeableness or conscientiousness. Openness exhibited indirect-only mediation, with a negative indirect effect despite no significant direct effect on SWB; (3) Empathy selectively moderated the association between extraversion and interpersonal relationships, a pattern confirmed after controlling for shared variance among the Big Five dimensions. These findings suggest that personality traits are associated with adolescent SWB via culturally salient interpersonal pathways, and that empathy may function as a selective, modest moderator for adolescents with less socially facilitative personality profiles.

1. Introduction

Adolescence represents a critical developmental period characterized by profound biological, cognitive, and psychological transformations, during which individuals navigate complex identity formation processes while exhibiting diverse personality configurations including extraversion, neuroticism, openness, agreeableness, and conscientiousness (Bleidorn et al., 2020; Dahl et al., 2018). These personality traits undergo significant consolidation during adolescence and demonstrate considerable stability, while remaining susceptible to environmental influences. Simultaneously, this developmental stage

encompasses intensive socioemotional growth that is substantially associated with long-term psychological adjustment and well-being trajectories (Caspi et al., 2020; Kim-Cohen et al., 2003).

Recent epidemiological data reveal an alarming increase in mental health concerns among Chinese adolescents, which warrants urgent attention. According to the “Report on the Development of China's National Mental Health,” screening detection rates for depression among Chinese adolescents have reached 24.6%, with 7.4% experiencing severe depression (Fu et al., 2023). Given that subjective well-being is inversely associated with depression and other internalizing symptoms among adolescents (Anglim et al., 2020; Winzer et al., 2021), these

* Corresponding author at: School of Nursing, Shandong Xiehe University, 250109, Jinan, Shandong, China.

E-mail addresses: chenxi88517@gmail.com (X. Chen), m.azlina@upm.edu.my (A.M. Khir), yangyong202305@163.com (Y. Yang), boonyew1234@gmail.com (B.Y. Wong).

¹ Department of Social and Development Sciences, Faculty of Human Ecology, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia.

² Department of Science and Technical Education, Faculty of Educational Studies, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia.

statistics underscore the critical need to investigate protective factors that may enhance subjective well-being within this vulnerable population.

Research on personality and well-being among Chinese adolescents necessitates a culturally situated perspective. Chinese society emphasizes interdependence and social harmony (Gelfand et al., 2017; Vignoles et al., 2016), where “guanxi” (relationship networks) functions as a fundamental organizing principle (Li & Bian, 2024). This cultural framework may shape trait expression; for instance, extraversion may manifest differently due to cultural values of modesty and emotional restraint (Shi et al., 2021). In such contexts, interpersonal relationships carry particular weight for psychological adjustment, and empathy, which in collectivist settings is oriented toward maintaining in-group relational harmony (Trommsdorff et al., 2007), may play a distinctive role in how personality traits are linked to social outcomes. Supporting this cultural perspective, cross-cultural research has demonstrated that, among Chinese adults, personality traits are associated with well-being through relationally oriented pathways, in contrast to the individual affective mechanisms observed in Western samples (Lun & Yeung, 2019). Furthermore, a meta-analysis of Chinese studies confirmed that Big Five-well-being associations, while broadly consistent with Western patterns, show attenuated effect sizes and significant age-related variation (Zheng et al., 2023). Together, these findings underscore the need to examine personality-well-being associations through culturally salient interpersonal pathways specifically within Chinese adolescent populations.

Subjective well-being represents an individual's multidimensional assessment of life experiences, encompassing both cognitive judgments and emotional responses (Diener et al., 2018). While influenced by various factors, personality traits and interpersonal relationships have been consistently identified among its strongest correlates (Andretta & McKay, 2020; Gold et al., 2023). The Big Five personality dimensions exhibit robust associations with well-being outcomes across diverse populations (Anglim et al., 2020; Steel et al., 2008). Beyond these direct associations, personality traits are also associated with the quality of interpersonal relationships (Asendorpf & Wilpers, 1998), which serves as a proximal correlate of psychological adjustment (Segrin & Taylor, 2007), suggesting that interpersonal relationships may mediate personality-well-being associations. Moreover, empathy, a social-cognitive capacity associated with interpersonal functioning (Davis, 1983; Verhofstadt et al., 2016), may moderate the strength of personality-relationship associations. However, an integrated model examining interpersonal relationships as a mediating mechanism and empathy as a boundary condition within personality-well-being associations remains largely untested, particularly among Chinese adolescents.

1.1. Personality traits and subjective well-being

The Big Five personality model, encompassing openness, conscientiousness, extraversion, agreeableness, and neuroticism, represents the dominant paradigm in personality psychology (Costa & McCrae, 1992). Extensive meta-analytic research has documented significant associations between all five traits and subjective well-being, with varying effect sizes across traits and cultural contexts (Anglim et al., 2020; Yu et al., 2020).

Adolescence represents a critical developmental window for trait consolidation, during which personality traits are salient correlates of subjective well-being and, while demonstrating increasing stability, remain susceptible to environmental and interpersonal influences (Soto & Tackett, 2015). The pathways through which specific traits are associated with well-being vary systematically. Neuroticism and extraversion demonstrate the strongest associations with well-being, potentially through affective regulatory pathways (Lucas & Diener, 2015), whereas agreeableness is indirectly linked to well-being through social harmony and prosocial engagement (Steel et al., 2008), and conscientiousness is

indirectly linked through self-regulatory capacities (Bogg & Roberts, 2013). Recent longitudinal research within adolescent populations corroborates these patterns, demonstrating that personality traits are associated with SWB trajectories across adolescence (Winzer et al., 2021). Nevertheless, the strength of these associations may vary across cultural contexts, particularly in collectivist settings where social conformity is emphasized (Zheng et al., 2023).

Given this theoretical foundation and empirical evidence, we hypothesize that extraversion, openness, agreeableness, and conscientiousness will be positively associated with subjective well-being, whereas neuroticism will be negatively associated with it.

1.2. The mediating role of interpersonal relationships

Interpersonal relationships are defined as social phenomena of interconnection between individuals across family, peer, and broader social contexts (Berscheid & Reis, 1998), representing a critical developmental domain during adolescence. Longitudinal research demonstrates that personality traits stabilize relatively early in development (Roberts & DelVecchio, 2000) and are substantially associated with social behavior and relationship quality (Asendorpf & Wilpers, 1998). Specifically, extraversion and agreeableness are associated with positive interpersonal functioning, potentially through social engagement and prosocial behaviors, and are linked to higher relationship quality and satisfaction (Dyrenforth et al., 2010; Yu et al., 2020). Meta-analytic evidence further corroborates these patterns, confirming robust associations between Big Five traits and relationship quality (Esplin et al., 2025).

Empirical evidence increasingly supports interpersonal relationships as a key pathway linking personality to well-being. While interpersonal difficulties represent a significant source of psychological distress among adolescents and emerging adults, high-quality relationships are consistently associated with enhanced subjective well-being (Chen et al., 2024; Segrin & Taylor, 2007; Zhang et al., 2024). This pattern appears particularly pronounced in collectivist cultures such as China, where interpersonal harmony is central to self-definition and life satisfaction (Markus & Kitayama, 1991). For instance, extraverted adolescents tend to have more supportive peer networks, which are associated with a stronger sense of belonging and psychological well-being (Soto & Tackett, 2015). Similarly, agreeable individuals tend to experience better relationship outcomes, which may relate to reduced interpersonal conflict and greater social support (Steel et al., 2008).

Despite robust evidence linking personality traits to both interpersonal relationships and subjective well-being separately, research examining interpersonal relationships as a mediating mechanism among Chinese adolescents remains limited. Preliminary evidence from adult populations suggests that interpersonal functioning mediates personality-well-being associations (Fors Connolly & Johansson Sevä, 2021), yet this pathway has not been tested in Chinese adolescent samples. Given the cultural salience of relational harmony and the developmental importance of peer relationships during adolescence, we hypothesize that interpersonal relationships will mediate the associations between personality traits and subjective well-being in this population.

1.3. The moderating role of empathy

Empathy, conceptualized as the capacity to understand and vicariously experience others' emotional states, represents a fundamental socio-cognitive ability associated with interpersonal functioning and social cohesion (Decety & Jackson, 2004; Rieffe et al., 2010). While empathy demonstrates correlations with certain personality traits (Melchers et al., 2016), it represents a distinct and malleable social-cognitive capacity rather than a fixed dispositional tendency (Davis, 1983).

In the present study, we propose that empathy functions as a

protective-compensatory resource within the personality-interpersonal relationship pathway. Drawing on the resilience framework (Fergus & Zimmerman, 2005; Zimmerman et al., 2013), empathy is theorized as a cultivable social-cognitive asset that provides an alternative input to relationship-building, independent of dispositional advantages. Where personality traits such as extraversion or agreeableness automatically channel adolescents into rewarding social interactions, empathy may enable adolescents who lack such trait-based facilitation to nonetheless engage in attuned, perspective-taking, and emotionally responsive social behavior.

Empirical work supports this dual nature of empathy as both a relationship-promoting resource and a cultivable competency. Multi-level meta-analytic evidence confirms robust associations between empathy and relationship quality during adolescence (Boele et al., 2019), while longitudinal research indicates that empathy development predicts later social competencies (Allemand et al., 2015) and that targeted school-based programs can effectively enhance adolescent empathy and downstream prosocial outcomes (Silke et al., 2024). At the interactional level, recent ecological momentary assessment work demonstrates that empathic individuals select more relationship-oriented regulatory strategies in everyday social encounters, supporting the view that empathy is linked to proximal interpersonal processes rather than functioning as a generalized affective tendency (Geiger et al., 2025; Main et al., 2017).

Based on this foundation, we hypothesize that empathy moderates the personality–interpersonal relationship pathway, such that adolescents with higher empathic capacity may achieve favorable interpersonal outcomes even when their personality profiles are less socially facilitative.

1.4. Integrated theoretical framework

The proposed model integrates two theoretical frameworks that together specify the mechanism and the boundary condition of the personality–well-being pathway. Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2017) grounds the mediating mechanism, while the protective-compensatory framework from resilience theory (Fergus & Zimmerman, 2005; Zimmerman et al., 2013) defines the boundary condition under which this mechanism can be modified.

Self-Determination Theory provides a framework for understanding how personality traits may be linked to well-being. Traits are theorized to be associated with the quality of interpersonal relationships, which in turn may contribute to relatedness need satisfaction and thereby to well-being (Reis et al., 2000; Sheldon & Niemiec, 2006). This relational pathway is theoretically expected to operate most strongly for traits that directly govern positive social engagement (Dyrenforth et al., 2010), and to carry particular weight in Chinese collectivist contexts, where interpersonal relationships are central to self-definition and well-being (Lu & Gilmour, 2004; Markus & Kitayama, 1991).

Building on this relational mechanism, the protective-compensatory framework (Fergus & Zimmerman, 2005; Zimmerman et al., 2013) specifies the boundary condition under which this relational pathway varies. Because empathy operates as a cultivable social-cognitive asset rather than a fixed trait (Davis, 1983; van der Graaff et al., 2014), the boundary condition of the personality–relationship pathway is itself amenable to intervention. Therefore, whereas Self-Determination Theory specifies how personality traits may relate to well-being through interpersonal relatedness, the protective-compensatory framework specifies for whom this relational pathway operates most strongly, depending on empathic capacity. This positioning departs from prior conceptualizations that treat empathy primarily as a personality correlate (Melchers et al., 2016) or as an outcome of trait-based socialization, and instead establishes empathy as a moderator of the personality–relationship pathway. By integrating these two frameworks, the proposed model offers a more comprehensive theoretical account that not only elucidates the relational pathway through which personality traits

may relate to well-being, but also identifies a modifiable social-cognitive boundary condition under which this pathway varies.

1.5. The current study

Despite extensive research on personality and well-being, three critical gaps remain. First, while personality–well-being associations are well-established in Western populations, it remains unclear how these operate among Chinese adolescents, particularly through culturally salient interpersonal pathways. Second, empathy has predominantly been conceptualized as a mediator or as an outcome of personality, rather than as a protective-compensatory resource that may buffer the social consequences of less facilitative personality profiles. Third, prior research has examined these variables in fragmented streams, with no unified framework specifying how the relational mediating mechanism and the social-cognitive boundary condition jointly operate within the personality–well-being pathway in Chinese adolescent samples. Addressing these gaps, the present study examines how personality traits are associated with subjective well-being among Chinese adolescents, with interpersonal relationships as a potential mediator and empathy as a potential moderator. Drawing on this integrated framework, we test a moderated mediation model in which interpersonal relationships mediate the associations between personality traits and subjective well-being, and empathy moderates the personality–relationship pathway (Fig. 1).

Specifically, we propose the following hypotheses:

H1. Neuroticism will be negatively associated with adolescents' subjective well-being, while extraversion, openness, agreeableness, and conscientiousness will be positively associated with subjective well-being.

H2. Interpersonal relationships will mediate the associations between personality traits (neuroticism, extraversion, openness, agreeableness, and conscientiousness) and subjective well-being.

H3. The indirect effects of personality traits (neuroticism, extraversion, openness, agreeableness, and conscientiousness) on subjective well-being through interpersonal relationships will be moderated by empathy.

2. Methodology

2.1. Participants

This study employed a multi-stage stratified probability sampling strategy to obtain a representative sample of adolescents in Henan Province. In the first stage, schools were stratified by location (urban vs. rural), and three schools were randomly selected from each stratum, yielding a total of six schools. In the second stage, classes within each school were stratified by grade (10th, 11th, and 12th) and randomly selected. In the third stage, students were randomly selected from the class rosters of the chosen classes. Participants were eligible if they were enrolled in grades 10 through 12 and aged 15 to 18 years. Prior to data collection, written informed consent was obtained from both the participants and their legal guardians. Data were collected over a three-week period during the fall semester of 2025 using paper-based questionnaires administered in classroom settings. A total of 650 questionnaires were distributed. After excluding 49 invalid responses (e.g., incomplete data or patterned responding, defined as selecting the same response option for all consecutive items within a scale), the final analytical sample consisted of 601 adolescents ($M_{age} = 16.52$, $SD = 0.95$; effective response rate = 92.46%). Table 1 presents the demographic characteristics of the final sample ($N = 601$).

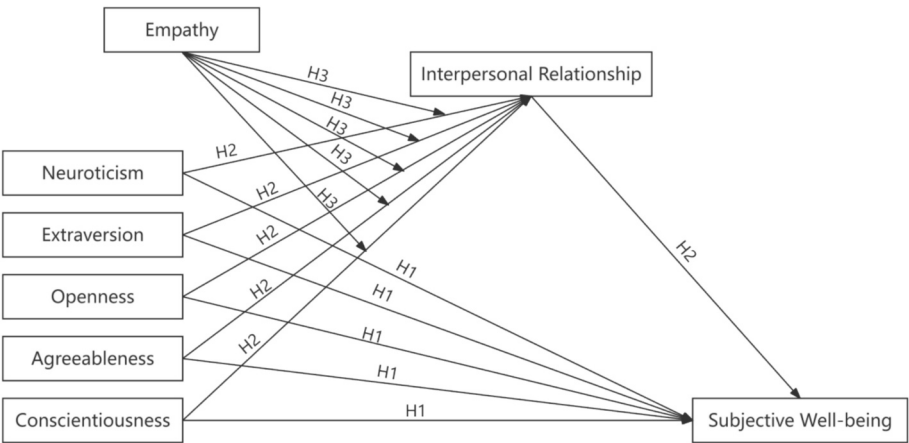


Fig. 1. The framework diagram of the moderated mediation model proposed in this study.

Table 1
Demographic characteristics of the sample (N = 601).

Characteristic	Category	Frequency	Percentage
Grade	10th	192	31.95%
	11th	210	34.94%
	12th	199	33.11%
Gender	Male	258	42.93%
	Female	343	57.07%
Hukou status	Urban	279	46.42%
	Rural	322	53.58%
Academic specialization	Humanities	301	50.08%
	STEM	300	49.92%

Note. Hukou status refers to the Chinese household registration system.

2.2. Research instruments

2.2.1. Personality traits

Personality traits were assessed using the Chinese version of the NEO Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992; Jin & Huang, 2019). This 25-item instrument measures five dimensions (neuroticism, extraversion, openness, agreeableness, and conscientiousness) using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Previous studies have confirmed its cross-cultural validity and internal consistency among Chinese students (Jin & Huang, 2019). In the present study, Cronbach's α coefficients for the five dimensions ranged from 0.79 to 0.81.

2.2.2. Subjective well-being

Subjective well-being was evaluated via the General Well-Being Schedule (GWB; Fazio, 1977), as adapted by Duan (1996). The scale comprises 18 items assessing six domains (e.g., tension-relaxation, energy) on a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree), with higher scores indicating higher levels of well-being. This scale has demonstrated good reliability and validity among Chinese youth (Kong et al., 2025). In the present study, Cronbach's α for the total scale was 0.84.

2.2.3. Empathy

Empathy was measured using the Chinese version of the Interpersonal Reactivity Index (IRI; Davis, 1983; Rong et al., 2010). The 28-item scale includes four subscales (perspective taking, empathic concern, fantasy, and personal distress), rated on a 5-point scale ranging from 1 (does not describe me well) to 5 (describes me very well). This scale has demonstrated good reliability and cultural applicability among Chinese adolescents (Zhang et al., 2020). In the present study, Cronbach's α for the total scale was 0.82.

2.2.4. Interpersonal relationships

Interpersonal relationship quality was assessed using the Comprehensive Diagnostic Scale for Interpersonal Relationships (Zheng, 1999). This 28-item instrument evaluates four dimensions of social interaction (conversational fluency, friendship development, behavioral tendencies, and opposite-sex interaction). Each item is answered on a dichotomous scale (0 = no, 1 = yes), with items reflecting interpersonal difficulties. Responses were reverse-coded so that higher total scores indicate better interpersonal relationship quality. This scale has been widely applied in studies of Chinese adolescents (Ma et al., 2024). In the present study, the Kuder-Richardson 20 (KR-20) reliability coefficient for the total scale was 0.81.

2.3. Data analysis

Data analyses were conducted using SPSS 25.0, AMOS 29.0, and the PROCESS macro (Hayes, 2017). First, preliminary analyses assessed measurement model fit via confirmatory factor analysis (CFA) in AMOS 29.0, with fit criteria following Hu and Bentler (1999): CFI > 0.90, TLI > 0.90, RMSEA < 0.08. Common method bias was evaluated by comparing the hypothesized measurement model with a single-factor alternative model. Bivariate relationships were examined using Pearson's correlation coefficients. Second, formal analyses proceeded in two steps. The hypothesized mediation model (H1 and H2) was tested using structural equation modeling in AMOS 29.0 with maximum likelihood estimation, in which all five personality dimensions simultaneously predicted interpersonal relationships and subjective well-being. Indirect effects were tested using bias-corrected bootstrap confidence intervals based on 5000 resamples. The moderated mediation model (H3) was tested using PROCESS Model 7 (Hayes, 2017) with 5000 bootstrap samples and 95% bias-corrected confidence intervals. PROCESS was selected for this step because it provides well-established procedures for estimating conditional indirect effects and the Index of Moderated Mediation (Hayes, 2015), and because the focal personality predictors were already specified as observed variables, limiting the added value of modeling latent interactions. All continuous variables were standardized prior to analysis (Aiken & West, 1991). Mediation was confirmed if indirect effect CIs excluded zero, and significant interactions were probed using simple slopes at ± 1 SD of empathy. Effect sizes for the interaction terms were estimated using Cohen's f^2 (Aiken & West, 1991), and the Index of Moderated Mediation (Hayes, 2015) was computed to formally test whether conditional indirect effects varied across levels of the moderator. To evaluate the robustness of the moderation findings against shared variance among the Big Five dimensions, each PROCESS Model 7 analysis was re-estimated with the remaining four personality traits included as covariates. Path diagrams for the structural equation model were generated using AMOS 29.0, and simple slope plots

illustrating moderation effects were created using Microsoft Excel 2019 based on conditional values from PROCESS outputs.

3. Results

3.1. Preliminary analyses

3.1.1. Measurement model fit

Confirmatory factor analysis (CFA) was conducted using AMOS 29.0 to validate the measurement model. The Big Five personality dimensions were modeled as observed variables using scale means, consistent with established practice in personality research employing structural equation modeling (e.g., Anglim et al., 2020; Steel et al., 2008). This specification is appropriate because Big Five dimensions are conceptualized as broad, higher-order constructs whose constituent items tap heterogeneous behavioral facets rather than reflecting a single narrow latent continuum (Costa & McCrae, 1992; John & Srivastava, 1999). Aggregating items into scale means effectively captures these broad constructs while reducing model complexity in structural models with multiple exogenous predictors (Hair et al., 2019; Kline, 2016). Interpersonal relationships, empathy, and subjective well-being were modeled as latent variables, with item parceling applied following the item-to-construct balance approach (Little et al., 2002). Each latent variable was represented by three parcels constructed from its respective item pool.

The measurement model specified three correlated latent factors (empathy, interpersonal relationships, and subjective well-being) and demonstrated good fit: $\chi^2/df = 3.32$; CFI = 0.98; TLI = 0.96; RMSEA = 0.07 (90% CI [0.06, 0.09]). All standardized factor loadings were statistically significant ($p < .001$) and exceeded the recommended threshold of 0.50 (Hair et al., 2019), ranging from 0.55 to 0.84 for empathy, 0.77 to 0.82 for interpersonal relationships, and 0.85 to 0.87 for subjective well-being. As shown in Table 2, convergent validity was supported by AVE values ranging from 0.56 to 0.72 (all ≥ 0.50) and CR values ranging from 0.79 to 0.88 (all ≥ 0.70), meeting established thresholds (Fornell & Larcker, 1981; Hair et al., 2019). Discriminant validity was evaluated using the heterotrait-monotrait ratio (HTMT; Henseler et al., 2015); all HTMT values were well below the recommended threshold of 0.85, supporting discriminant validity among the latent constructs. Because the Big Five dimensions were modeled as observed variables, HTMT was not applicable to these dimensions; discriminant concerns among personality predictors were instead addressed through multicollinearity diagnostics reported in the descriptive statistics section.

3.1.2. Assessment of common method bias

Given that all variables were assessed via self-report at a single time point, we conducted both procedural and statistical assessments of common method variance (CMV). Procedural remedies during data collection included assurances of anonymity and confidentiality, counterbalancing of measurement order, and separation of predictor and criterion variables within the questionnaire.

Statistically, we compared the hypothesized three-factor measurement model with an alternative single-factor model in which all parcels of empathy, interpersonal relationships, and subjective well-being were constrained to load on a single common factor. As shown in Table 3, the single-factor model demonstrated extremely poor fit across all indices,

Table 2
Convergent validity, composite reliability, and discriminant validity ($N = 601$).

Variable	AVE	CR	1	2	3
1. Empathy	0.56	0.79	–		
2. Interpersonal relationships	0.64	0.84	0.20	–	
3. Subjective well-being	0.72	0.88	0.14	0.68	–

Note. Values below the diagonal represent HTMT ratios. AVE = average variance extracted; CR = composite reliability; HTMT = heterotrait-monotrait ratio.

Table 3

Comparison of the three-factor measurement model and the single-factor model ($N = 601$).

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA [90% CI]
Three-factor model (hypothesized)	79.69	24	3.32	0.98	0.96	0.07 [0.06, 0.09]
Single-factor model	993.68	27	36.80	0.63	0.51	0.24 [0.23, 0.26]

falling far below accepted thresholds, whereas the three-factor model fit the data well. The substantial deterioration in fit when constraining indicators to a single factor ($\Delta\chi^2 = 913.99$, $\Delta df = 3$, $p < .001$) indicates that a single common factor cannot adequately account for the covariation among indicators. Together with the procedural remedies, these results suggest that common method variance is unlikely to substantially distort the substantive associations reported in this study.

3.2. Descriptive statistics and correlations

Table 4 presents descriptive statistics and bivariate correlations for all study variables. Examination of the distributions revealed that subjective well-being scores were moderately high ($M = 74.26$, $SD = 12.58$). Among personality dimensions, agreeableness demonstrated the highest mean score ($M = 16.55$, $SD = 2.80$), while openness exhibited the lowest ($M = 14.22$, $SD = 2.49$). Participants reported moderately high levels of empathy ($M = 93.62$, $SD = 15.34$) and moderately high levels of interpersonal relationship quality ($M = 18.06$, $SD = 5.26$).

Regarding distributional properties, all study variables approximated a normal distribution, with skewness values ranging from -0.40 to 1.10 and kurtosis values ranging from -0.23 to 1.03 (see Table 4). All values fell well within the thresholds recommended for parametric analyses ($|\text{skewness}| < 2$, $|\text{kurtosis}| < 7$; West et al., 1995), supporting the suitability of the data for subsequent confirmatory factor analysis, structural equation modeling, and bootstrap-based mediation and moderated mediation analyses.

Correlation analyses revealed patterns largely consistent with theoretical expectations. Neuroticism demonstrated a significant negative association with subjective well-being ($r = -0.49$, $p < .01$), representing the strongest personality–well-being relationship observed. Conversely, extraversion ($r = 0.33$, $p < .01$), agreeableness ($r = 0.19$, $p < .01$), and conscientiousness ($r = 0.20$, $p < .01$) were significantly positively associated with subjective well-being, aligning with previous meta-analytic findings (Steel et al., 2008). Notably, openness was not significantly correlated with subjective well-being ($r = -0.06$, $p > .05$), diverging somewhat from Western research but consistent with some findings in Chinese populations.

Empathy demonstrated significant positive correlations with both subjective well-being ($r = 0.20$, $p < .01$) and interpersonal relationship quality ($r = 0.10$, $p < .05$), though the latter association was relatively modest in magnitude. Interpersonal relationship quality exhibited a strong positive correlation with subjective well-being ($r = 0.58$, $p < .01$), representing the strongest bivariate relationship among study variables and highlighting the centrality of social relationships to adolescent psychological adjustment.

Examination of relationships among personality dimensions revealed expected patterns. Neuroticism was inversely related to extraversion ($r = -0.21$, $p < .01$), agreeableness ($r = -0.20$, $p < .01$), and conscientiousness ($r = -0.38$, $p < .01$). Extraversion and agreeableness were strongly positively correlated ($r = 0.50$, $p < .01$), while openness showed small negative correlations with extraversion ($r = -0.14$, $p < .05$), agreeableness ($r = -0.09$, $p < .05$), and conscientiousness ($r = -0.17$, $p < .01$).

Given the moderate-to-strong intercorrelations among several personality dimensions, particularly between extraversion and

Table 4Descriptive statistics and correlation coefficients of main variables ($N = 601$).

Variables	M	SD	Skew	Kurt	1	2	3	4	5	6	7	8
1. Neuroticism	15.50	2.94	0.10	0.84	1							
2. Extraversion	14.44	2.90	-0.01	0.14	-0.21**	1						
3. Openness	14.22	2.49	-0.07	1.03	0.06	-0.14*	1					
4. Agreeableness	16.55	2.80	0.04	0.20	-0.20**	0.50**	-0.09*	1				
5. Conscientiousness	16.00	2.86	-0.19	-0.19	-0.38**	-0.06	-0.17**	0.03	1			
6. Subjective well-being	74.26	12.58	-0.40	0.62	-0.49**	0.33**	-0.06	0.19**	0.20**	1		
7. Empathy	93.62	15.34	-0.31	0.81	-0.03	0.28**	-0.13**	0.37**	0.07	0.20**	1	
8. Interpersonal relationship	18.06	5.26	-0.29	-0.23	-0.51**	0.33**	-0.10*	0.22**	0.17**	0.58**	0.10*	1

Note. Skew = skewness; Kurt = kurtosis. * $p < .05$, ** $p < .01$, *** $p < .001$ (same applies hereafter).

agreeableness ($r = 0.50$), multicollinearity diagnostics were conducted. Variance inflation factor (VIF) values for the five personality predictors ranged from 1.04 to 1.38, and tolerance values ranged from 0.72 to 0.96, all well within acceptable thresholds ($VIF < 5$; Hair et al., 2019). These results indicate that multicollinearity does not pose a concern for the analyses employed in this study.

These patterns of associations provide preliminary support for the study's hypothesized relationships and establish the foundation for subsequent mediation and moderation analyses.

3.3. Mediating role of interpersonal relationships

To test the hypothesized mediation model (H1 and H2), structural equation modeling was conducted using AMOS 29.0 with maximum likelihood estimation. The model specified the Big Five personality dimensions as exogenous predictors, interpersonal relationships as the mediator, and subjective well-being as the outcome. The five personality dimensions were allowed to correlate, and both direct paths (personality $\rightarrow$ SWB) and indirect paths (personality $\rightarrow$ IR $\rightarrow$ SWB) were estimated simultaneously. Indirect effects were tested using bias-corrected bootstrap confidence intervals based on 5000 resamples.

The structural model demonstrated good fit to the data: $\chi^2/df = 3.93$; CFI = 0.97; TLI = 0.94; RMSEA = 0.07 (90% CI [0.06, 0.08]); SRMR =

0.01. The model explained 36.2% of the variance in interpersonal relationships ($R^2 = 0.36$, 95% CI [0.29, 0.43]) and 50.0% of the variance in subjective well-being ($R^2 = 0.50$, 95% CI [0.41, 0.57]). The structural model with standardized path coefficients is presented in Fig. 2.

Standardized path coefficients are reported in Table 5. Regarding the paths from personality traits to interpersonal relationships, neuroticism showed a significant negative association ($\beta = -0.45$, $p < .001$), while extraversion showed a significant positive association ($\beta = 0.23$, $p < .001$). Openness demonstrated an unexpected negative association with interpersonal relationships ($\beta = -0.11$, $p = .003$). Agreeableness ($\beta = 0.03$, $p = .473$) and conscientiousness ($\beta = 0.06$, $p = .167$) showed no significant associations with interpersonal relationships. Interpersonal relationships, in turn, showed a strong positive association with subjective well-being ($\beta = 0.49$, $p < .001$).

For direct paths to subjective well-being, neuroticism ($\beta = -0.14$, $p = .007$), extraversion ($\beta = 0.19$, $p = .001$), and conscientiousness ($\beta = 0.11$, $p = .015$) showed significant direct associations, whereas openness ($\beta = -0.04$, $p = .331$) and agreeableness ($\beta = -0.03$, $p = .422$) did not.

Bootstrap tests of indirect effects revealed that interpersonal relationships significantly mediated the associations between three personality traits and subjective well-being: neuroticism (indirect $\beta = -0.22$, 95% CI [-0.28, -0.17], $p < .001$), extraversion (indirect $\beta = 0.11$, 95% CI [0.07, 0.16], $p < .001$), and openness (indirect $\beta = -0.06$,

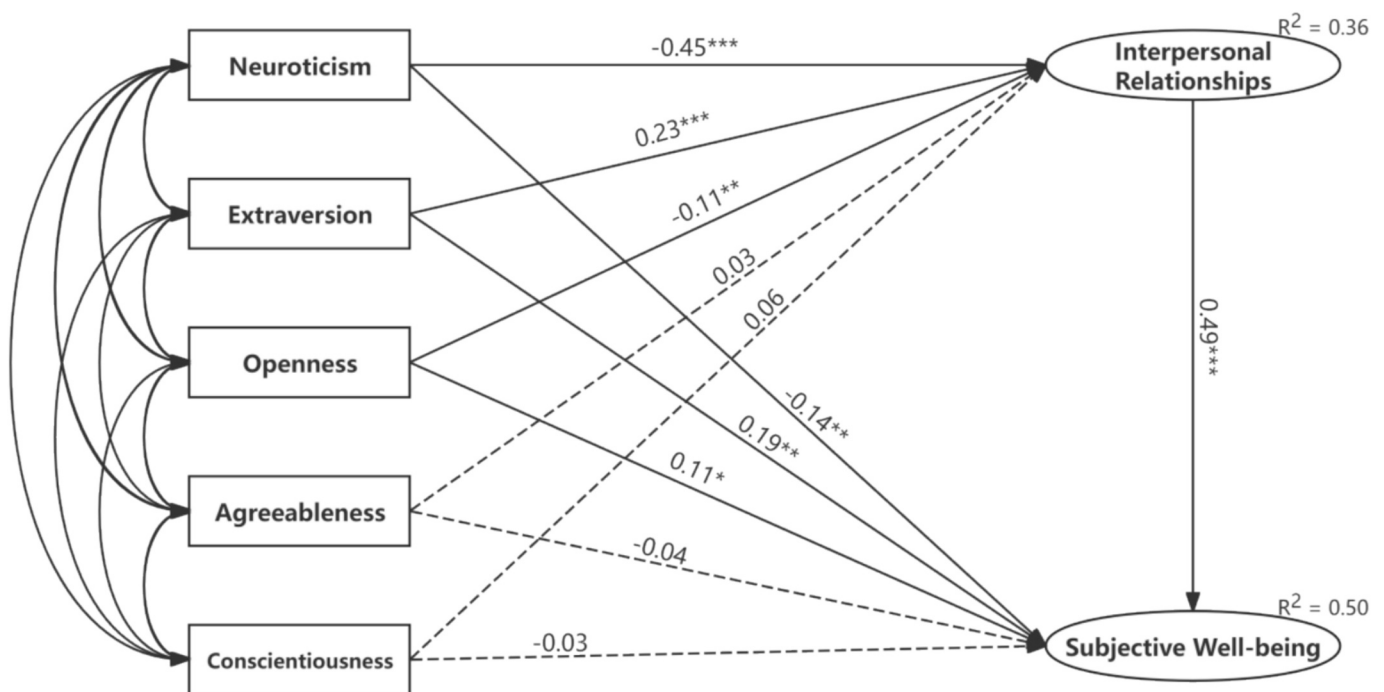


Fig. 2. Structural model with standardized path coefficients.

Note. Solid lines represent significant pathways; dashed lines represent nonsignificant pathways. Values on arrows are standardized path coefficients. R^2 indicates the proportion of variance explained.

Table 5SEM results for the mediation model ($N = 601$).

Path	β	95% CI	p
Direct paths to interpersonal relationships			
Neuroticism $\rightarrow$ IR	-0.45	[-0.53, -0.37]	<0.001
Extraversion $\rightarrow$ IR	0.23	[0.14, 0.31]	<0.001
Openness $\rightarrow$ IR	-0.11	[-0.19, -0.04]	0.003
Agreeableness $\rightarrow$ IR	0.03	[-0.06, 0.12]	0.473
Conscientiousness $\rightarrow$ IR	0.06	[-0.02, 0.14]	0.167
Direct path to subjective well-being			
IR $\rightarrow$ SWB	0.49	[0.40, 0.58]	<0.001
Direct paths to subjective well-being			
Neuroticism $\rightarrow$ SWB	-0.14	[-0.24, -0.04]	0.007
Extraversion $\rightarrow$ SWB	0.19	[0.10, 0.27]	0.001
Openness $\rightarrow$ SWB	-0.04	[-0.12, 0.04]	0.331
Agreeableness $\rightarrow$ SWB	-0.03	[-0.12, 0.05]	0.422
Conscientiousness $\rightarrow$ SWB	0.11	[0.02, 0.20]	0.015
Indirect effects through IR			
Neuroticism $\rightarrow$ IR $\rightarrow$ SWB	-0.22	[-0.28, -0.17]	<0.001
Extraversion $\rightarrow$ IR $\rightarrow$ SWB	0.11	[0.07, 0.16]	<0.001
Openness $\rightarrow$ IR $\rightarrow$ SWB	-0.06	[-0.10, -0.02]	0.002
Agreeableness $\rightarrow$ IR $\rightarrow$ SWB	0.02	[-0.03, 0.06]	0.464
Conscientiousness $\rightarrow$ IR $\rightarrow$ SWB	0.03	[-0.01, 0.07]	0.168

Note. β = standardized coefficient; CI = bias-corrected bootstrap confidence interval (5000 resamples); IR = interpersonal relationships; SWB = subjective well-being.

95% CI [-0.10, -0.02], $p = .002$). The indirect effects of agreeableness (indirect $\beta = 0.02$, 95% CI [-0.03, 0.06], $p = .464$) and conscientiousness (indirect $\beta = 0.03$, 95% CI [-0.01, 0.07], $p = .168$) were not significant.

These results partially support H2, as the mediational pathway was supported for neuroticism, extraversion, and openness, but not for agreeableness or conscientiousness. Notably, openness exhibited an indirect-only mediation pattern, in which its direct effect on subjective well-being was not significant but its indirect effect through interpersonal relationships was significant. Neuroticism and extraversion exhibited partial mediation, with both direct and indirect effects being significant. Conscientiousness showed only a significant direct effect, with no mediation through interpersonal relationships.

3.4. Analysis of moderated mediation

To examine the boundary conditions of the mediation model, we tested whether empathy moderated the indirect effects of personality traits on subjective well-being through interpersonal relationships. PROCESS Model 7 (Hayes, 2017) was applied to each personality dimension separately, with 5000 bootstrap samples and 95% bias-corrected confidence intervals. All variables were standardized prior to analysis. Effect sizes for the interaction terms were estimated using Cohen's f^2 (Aiken & West, 1991), interpreted against the empirically derived benchmarks for moderation in field research, in which f^2 values of approximately 0.005, 0.01, and 0.025 represent small, medium, and large effects, respectively (Aguinis et al., 2005).

Table 6 reports standardized path coefficients with 95% confidence intervals, model R^2 values, and f^2 effect sizes for the interaction terms across the five personality dimensions. Two of the five Trait $\times$ Empathy interactions reached statistical significance. The interaction between extraversion and empathy was negatively associated with interpersonal relationships ($\beta = -0.09$, 95% CI [-0.15, -0.03], $p = .007$), accounting for an additional 1.1% of variance in interpersonal relationships ($\Delta R^2 = 0.01$) with $f^2 = 0.01$, corresponding to a medium effect by Aguinis et al.'s (2005) benchmarks. The interaction between agreeableness and empathy was likewise significant ($\beta = -0.07$, 95% CI [-0.13, -0.01], $p = .019$), accounting for an additional 0.9% of variance ($\Delta R^2 = 0.01$) with $f^2 = 0.01$, a medium effect. Interactions involving neuroticism, openness, and conscientiousness did not reach statistical significance (all $ps > 0.05$), indicating that empathy's moderating function operates

Table 6Moderated mediation analyses: standardized coefficients with 95% CIs ($N = 601$).

Model/path	β	95% CI	p	R^2	ΔR^2	f^2
Neuroticism model						
Outcome: interpersonal relationships				0.27		
Neuroticism $\rightarrow$ IR	-0.51	[-0.57, -0.44]	<0.001			
Empathy $\rightarrow$ IR	0.08	[0.01, 0.15]	0.029			
Neuroticism $\times$ Empathy $\rightarrow$ IR	0.03	[-0.03, 0.09]	0.335		0.00	0.00
Outcome: subjective well-being				0.37		
Neuroticism $\rightarrow$ SWB	-0.22	[-0.30, -0.15]	<0.001			
IR $\rightarrow$ SWB	0.47	[0.39, 0.54]	<0.001			
Extraversion model						
Outcome: interpersonal relationships				0.12		
Extraversion $\rightarrow$ IR	0.33	[0.25, 0.41]	<0.001			
Empathy $\rightarrow$ IR	0.00	[-0.08, 0.08]	0.965			
Extraversion $\times$ Empathy $\rightarrow$ IR	-0.09	[-0.15, -0.03]	0.007		0.01	0.01
Outcome: subjective well-being				0.36		
Extraversion $\rightarrow$ SWB	0.15	[0.08, 0.22]	<0.001			
IR $\rightarrow$ SWB	0.53	[0.46, 0.60]	<0.001			
Openness model						
Outcome: interpersonal relationships				0.02		
Openness $\rightarrow$ IR	-0.09	[-0.17, -0.01]	0.032			
Empathy $\rightarrow$ IR	0.08	[0.00, 0.16]	0.046			
Openness $\times$ Empathy $\rightarrow$ IR	0.06	[-0.01, 0.13]	0.080		0.01	0.01
Outcome: subjective well-being				0.34		
Openness $\rightarrow$ SWB	0.00	[-0.07, 0.06]	0.954			
IR $\rightarrow$ SWB	0.58	[0.51, 0.64]	<0.001			
Agreeableness model						
Outcome: interpersonal relationships				0.06		
Agreeableness $\rightarrow$ IR	0.10	[0.02, 0.18]	0.022			
Empathy $\rightarrow$ IR	0.01	[-0.08, 0.09]	0.842			
Agreeableness $\times$ Empathy $\rightarrow$ IR	-0.07	[-0.13, -0.01]	0.019		0.01	0.01
Outcome: subjective well-being				0.34		
Agreeableness $\rightarrow$ SWB	-0.03	[-0.10, 0.05]	0.484			
IR $\rightarrow$ SWB	0.57	[0.50, 0.63]	<0.001			
Conscientiousness model						
Outcome: interpersonal relationships				0.04		
Conscientiousness $\rightarrow$ IR	0.17	[0.09, 0.25]	<0.001			
Empathy $\rightarrow$ IR	0.09	[0.01, 0.17]	0.030			

(continued on next page)

Table 6 (continued)

Model/path	β	95% CI	p	R ²	ΔR^2	f ²
Conscientiousness $\times$ Empathy $\rightarrow$ IR	−0.03	[−0.10, 0.04]	0.391		0.00	0.00
Outcome: subjective well-being				0.35		
Conscientiousness $\rightarrow$ SWB	0.11	[0.04, 0.17]	0.002			
IR $\rightarrow$ SWB	0.56	[0.49, 0.63]	<0.001			

Note. Each personality dimension was tested in a separate PROCESS Model 7 analysis (Hayes, 2017) with 5000 bootstrap samples and 95% bias-corrected confidence intervals. β = standardized coefficient; CI = confidence interval; R² = proportion of variance explained by the model; f² = effect size for the interaction term.

selectively rather than uniformly across personality domains. These findings offer partial support for Hypothesis 3.

To probe the two significant interactions, conditional effects of extraversion and agreeableness on interpersonal relationships were estimated at low (−1 SD), mean, and high (+1 SD) levels of empathy, following procedures recommended by Aiken and West (1991). Table 7 presents the conditional slopes with their 95% confidence intervals.

The simple slope analysis for extraversion (Fig. 3) revealed that the positive association between extraversion and interpersonal relationships was stronger among adolescents with lower empathic capacity (slope = 0.42, 95% CI [0.32, 0.52]) than among those with higher empathic capacity (slope = 0.24, 95% CI [0.14, 0.35]). A parallel pattern emerged for agreeableness (Fig. 4), with the conditional slope at low empathy (0.27, 95% CI [0.17, 0.37]) noticeably exceeding that at high empathy (0.13, 95% CI [0.02, 0.24]). Although the conditional effects remained statistically significant at all empathy levels, the magnitude of the slopes decreased notably from low to high empathy, and the significant interaction terms (see Table 6) confirm that these differences are statistically meaningful. These attenuated slopes at higher empathy suggest that empathic capacity partially buffers, but does not eliminate, the role of these dispositional tendencies in interpersonal outcomes.

To formally test the integrated moderated mediation pattern, the Index of Moderated Mediation (Hayes, 2015) was examined for each personality dimension. The index quantifies whether the conditional indirect effect varies significantly across levels of the moderator. As shown in Table 8, the index reached statistical significance only for extraversion (Index = −0.05, 95% Bootstrap CI [−0.09, −0.01]), indicating that the indirect effect of extraversion on subjective well-being through interpersonal relationships varied significantly across levels of empathy. For agreeableness, although the first-stage path (Trait $\rightarrow$ IR) was significantly moderated, the index of moderated mediation did not

Table 7
Conditional effects of extraversion and agreeableness on interpersonal relationships at different levels of empathy.

Predictor	Empathy level	Conditional slope	SE	95% CI	p
Extraversion	Low (−1 SD)	0.42	0.05	[0.32, 0.52]	<0.001
	Mean	0.33	0.04	[0.25, 0.41]	<0.001
	High (+1 SD)	0.24	0.05	[0.14, 0.35]	<0.001
Agreeableness	Low (−1 SD)	0.27	0.05	[0.17, 0.37]	<0.001
	Mean	0.20	0.04	[0.11, 0.28]	<0.001
	High (+1 SD)	0.13	0.06	[0.02, 0.24]	0.020

Note. CI = bias-corrected bootstrap confidence interval based on 5000 resamples.

reach significance (Index = −0.04, 95% Bootstrap CI [−0.08, 0.01]), reflecting that the moderation of the first-stage path did not propagate into a statistically significant difference in the conditional indirect effect on subjective well-being. Indices for the remaining traits were also non-significant. These results indicate that the full moderated mediation pattern is most clearly established for extraversion, while agreeableness demonstrates a more circumscribed pattern of first-stage moderation.

3.5. Robustness analysis

Because the Big Five dimensions are intercorrelated, particularly extraversion and agreeableness ($r = 0.50$), each PROCESS Model 7 analysis was re-estimated with the remaining four personality dimensions included as covariates to evaluate whether the observed moderation effects reflected trait-specific contributions or shared variance among predictors. When the other four dimensions were controlled, the Extraversion $\times$ Empathy interaction remained statistically significant ($\beta = -0.06$, 95% CI [−0.11, −0.01], $p = .045$, $f^2 = 0.01$), although attenuated relative to the primary analysis ($\beta = -0.09$, $p = .007$). The Agreeableness $\times$ Empathy interaction, however, was no longer statistically significant ($\beta = -0.03$, 95% CI [−0.08, 0.02], $p = .208$). Interactions involving neuroticism, openness, and conscientiousness remained non-significant in the covariate-adjusted models (all $ps > 0.05$). These results indicate that the moderating role of empathy in the extraversion–interpersonal relationship pathway represents a trait-specific contribution that is robust to mutual adjustment among the Big Five dimensions. The first-stage moderation observed for agreeableness in the primary analysis appears to have been partly attributable to its overlap with extraversion, consistent with the non-significant Index of Moderated Mediation reported for agreeableness in Table 8.

Taken together, the primary and robustness analyses converge on a selective compensatory role for empathy. The moderating effect of empathy on the extraversion–interpersonal relationship pathway remained significant after mutual adjustment among the Big Five dimensions, whereas the first-stage moderation for agreeableness did not survive this adjustment. Although the moderating effect is modest in absolute magnitude, the f^2 value falls within the medium range for moderation in field research (Aguinis et al., 2005), suggesting that empathic capacity may partially buffer the association between lower extraversion and interpersonal relationship quality (Eisenberg et al., 2010; Leng et al., 2020). Nevertheless, the substantial main effect of extraversion underscores the enduring role of this dispositional tendency in adolescent social development.

4. Discussion

The present investigation examined the complex network of associations between individual personality traits, interpersonal relationships, empathy, and subjective well-being in Chinese adolescents. The results revealed a nuanced pattern of associations: (1) neuroticism, extraversion, and conscientiousness demonstrated significant direct associations with subjective well-being, while openness and agreeableness showed no significant direct effects; (2) interpersonal relationships significantly mediated the associations of neuroticism, extraversion, and openness with subjective well-being, but not those of agreeableness or conscientiousness; and (3) empathy selectively moderated the association between extraversion and interpersonal relationships, with the moderating pattern confirmed by a robustness analysis controlling for shared personality variance. Collectively, these results deepen understanding of how dispositional characteristics relate to psychological adaptation among adolescents in Chinese cultural contexts.

4.1. Personality traits and subjective well-being

Partially consistent with Hypothesis 1, neuroticism demonstrated a significant negative direct association with subjective well-being, while

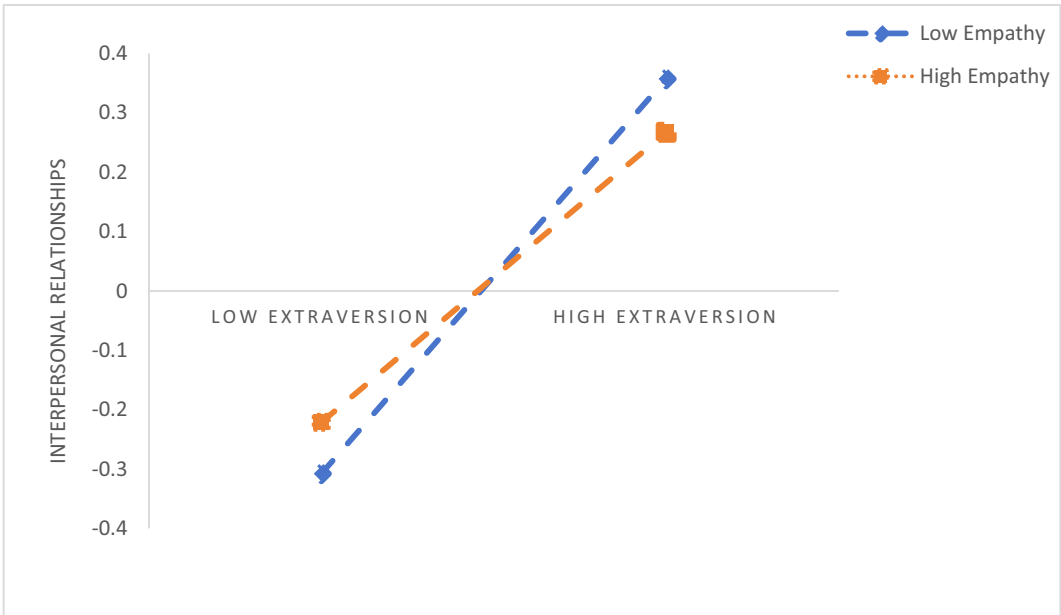


Fig. 3. The moderating effect of empathy on extraversion.
Note. Low empathy = Mean - 1SD; High empathy = Mean + 1SD.

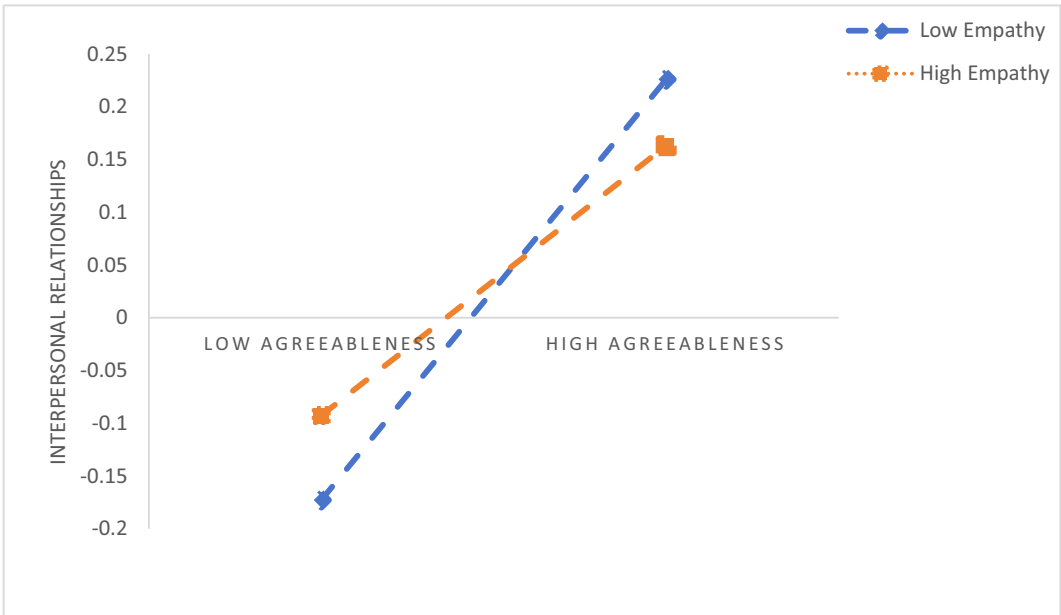


Fig. 4. The moderating effect of empathy on agreeableness.
Note. Low empathy = Mean - 1SD; High empathy = Mean + 1SD.

Table 8
Index of moderated mediation by personality dimension.

Personality trait	Index	BootSE	95% Bootstrap CI
Neuroticism	0.01	0.01	[-0.02, 0.04]
Extraversion	-0.05	0.02	[-0.09, -0.01]
Openness	0.04	0.03	[-0.02, 0.08]
Agreeableness	-0.04	0.02	[-0.08, 0.01]
Conscientiousness	-0.02	0.03	[-0.06, 0.04]

Note. Bootstrap CIs based on 5000 resamples.

extraversion and conscientiousness exhibited significant positive associations. However, openness and agreeableness did not show significant

direct effects. This pattern reveals selective convergence and divergence with the Western literature, in which all five dimensions typically show significant associations with well-being (Anglim et al., 2020; Steel et al., 2008). The associations for neuroticism and extraversion were consistent with cross-cultural patterns, suggesting that the affective regulatory pathways underlying these traits operate with relative universality. Neuroticism is associated with lower well-being, potentially through heightened emotional reactivity and sustained negative affectivity (Solmaz, 2025), while extraversion is associated with higher well-being, possibly via rewarding social interactions and heightened sensitivity to positive stimuli (Kroencke et al., 2023). Notably, although Chinese expressions of extraversion tend to be tempered by values of modesty and

emotional restraint compared to the assertiveness emphasized in Western conceptualizations (Shi et al., 2021), the trait nonetheless retained a robust association with well-being, suggesting that its association with well-being through social engagement may transcend cultural variation in trait expression. Conscientiousness also demonstrated a positive association with well-being, potentially linked to self-regulatory processes, which may be further reinforced by the strong emphasis on academic diligence and goal attainment in Chinese educational contexts (Bogg & Roberts, 2013).

In contrast, the absence of significant direct effects for openness and agreeableness diverges from the typical Western profile and aligns with a meta-analysis of Chinese studies reporting attenuated Big Five–well-being associations (Zheng et al., 2023). For openness, the null direct effect coupled with a significant negative indirect effect through interpersonal relationships suggests culturally specific processes. We propose two complementary explanations. First, developmentally, openness may not yet crystallize sufficiently during adolescence to show an independent association with life satisfaction (Brazil et al., 2025). Second, regarding Person-Environment Fit (van Vianen, 2018), Chinese classroom norms tend to prioritize behavioral compliance and group harmony over creative self-expression (Li, 2012), which may render high-openness dispositions socially costly rather than beneficial. This misfit is evidenced by the negative association between openness and relationship quality in the structural model, contrasting with the modest positive associations with well-being typically reported in Western samples (Anglim et al., 2020). Nevertheless, the possibility that measurement factors may partly contribute to the null direct effect cannot be entirely excluded, and this finding warrants replication across diverse assessment approaches.

For agreeableness, the absence of direct and indirect associations warrants alternative explanations. In Chinese educational contexts that emphasize collective harmony, cooperative and prosocial behaviors are normatively expected rather than uniquely attributable to individual dispositional tendencies (Chen, 2000; Markus & Kitayama, 1991). Relational obligations in such contexts may be driven more by social roles and filial duties than by individual dispositions, reducing the differentiating power of this trait for well-being outcomes, in contrast to Western individualist settings where agreeableness more clearly predicts well-being through individually distinctive prosocial behavior.

These cross-cultural contrasts underscore that personality–well-being associations vary across cultural contexts and developmental timing, and caution against assuming universal applicability of Western-derived models.

4.2. The mediating role of interpersonal relationships

The results partially support Hypothesis 2, demonstrating that interpersonal relationships significantly mediated the associations of neuroticism, extraversion, and openness with subjective well-being, but not those of agreeableness or conscientiousness. These findings partly extend the social investment perspective (Hang et al., 2023), suggesting that dispositional tendencies are associated with well-being partly through their connections to social relationship quality, although the strength of this mediational pathway varies markedly across personality dimensions.

For neuroticism and extraversion, interpersonal relationships emerged as significant partial mediators, operating alongside their direct effects on subjective well-being. For neuroticism, the substantial indirect association combined with a non-trivial direct association suggests that emotional reactivity is linked to lower well-being both through intrapsychic pathways and through its negative association with interpersonal functioning (Esplin et al., 2025). For extraversion, the indirect association supplements its direct association, suggesting that outgoing individuals may experience higher well-being both through positive affective dispositions and through higher-quality relationships (Fors Connolly & Johansson Sevä, 2021).

Openness exhibited a markedly different pattern of indirect-only mediation (Zhao et al., 2010), with a significant negative indirect effect through interpersonal relationships despite the absence of a significant direct effect. Specifically, openness was negatively associated with interpersonal relationships, potentially reflecting the social costs of non-conformity in Chinese educational contexts (Chen, 2000), and interpersonal relationships were in turn positively associated with well-being, together producing a negative indirect effect. Importantly, the SEM analysis, in which all five personality dimensions were entered simultaneously, confirmed that this indirect effect remained significant after controlling for the other four personality dimensions, supporting the robustness of this finding. In Chinese educational settings that emphasize behavioral conformity and group harmony, adolescents high in openness may encounter greater difficulties in peer integration, which in turn is associated with lower subjective well-being. This pattern underscores that meaningful indirect effects can emerge even when direct effects are absent (Hayes, 2009), although this culturally situated interpretation awaits confirmation from longitudinal and cross-cultural comparative research.

In contrast, agreeableness and conscientiousness did not show significant indirect effects through interpersonal relationships, albeit for different reasons. For agreeableness, neither its direct association with interpersonal relationships nor its indirect effect on subjective well-being reached statistical significance, consistent with the interpretation offered in Section 4.1 that dispositional agreeableness may exert limited differentiating influence in contexts where relational harmony is culturally prescribed. For conscientiousness, the significant direct effect on subjective well-being but non-significant indirect effect suggests that conscientiousness may relate to well-being in Chinese adolescents primarily through personal self-regulatory pathways (e.g., academic achievement, goal pursuit) rather than through enhanced interpersonal relationships. This pattern aligns with the strong emphasis on individual academic performance in Chinese adolescent development.

The predominance of interpersonal pathways observed for neuroticism, extraversion, and openness underscores the centrality of social relationship quality in linking certain dispositional tendencies to well-being outcomes among Chinese adolescents. This pattern is particularly meaningful given two contextual considerations. First, in the Chinese cultural context, where self-definition is closely tied to social roles and relationships (Lu & Gilmour, 2004; Markus & Kitayama, 1991), personality traits may be linked to well-being through their associations with interpersonal functioning, though the strength of this mediational pathway appears to vary across traits. Second, adolescence represents a developmental period when peer relationships assume heightened psychological significance, amplifying the relative importance of social pathways in determining adjustment outcomes (Brown & Larson, 2009). Together, these findings suggest that interpersonal relationship quality functions as a key proximal pathway through which certain distal personality characteristics are linked to subjective evaluations of life satisfaction. Importantly, this social pathway may represent a modifiable factor that complements the relative stability of personality traits, with particular relevance for adolescents high in neuroticism or openness within Chinese educational contexts, although its potential as an intervention target awaits longitudinal and experimental confirmation.

4.3. The moderating role of empathy

Our primary analyses revealed that empathy moderated the first-stage associations between extraversion/agreeableness and interpersonal relationships, with both interactions reaching statistical significance in trait-specific PROCESS models. A robustness analysis in which the remaining four Big Five dimensions were included as covariates, however, refined this picture. The Extraversion × Empathy interaction remained significant after mutual adjustment, whereas the Agreeableness × Empathy interaction was no longer significant, suggesting that the latter partly reflected shared variance with extraversion rather than

an independent moderating pathway. Combined with the Index of Moderated Mediation, which reached significance only for extraversion in the primary analysis, these converging lines of evidence reveal a graduated pattern in which extraversion demonstrates robust moderated mediation, agreeableness shows apparent but non-robust first-stage moderation, and the remaining three traits show no moderation. This differentiated pattern does not undermine the compensatory interpretation of empathy but sharpens it in theoretically meaningful ways that align with the cultural framework developed earlier.

For extraversion, the compensatory mechanism appears to operate coherently across the full mediation chain and to reflect a trait-specific contribution rather than shared personality variance. The positive association between extraversion and interpersonal relationships was substantially stronger at low levels of empathy than at high levels, the conditional indirect effect on well-being varied systematically across levels of empathy, and this moderating pattern survived mutual adjustment among the Big Five dimensions. Highly empathic adolescents who are low in extraversion may thus achieve more favorable interpersonal and well-being outcomes than would be expected from their dispositional profile alone, with perspective-taking and emotional attunement functioning as an additional route to social integration (Eisenberg et al., 2010; Leng et al., 2020). This pattern is consistent with a degree of psychological equifinality at the level of well-being outcomes, not merely at the level of social functioning.

For agreeableness, the picture is more circumscribed. Although the trait-specific model detected a significant Agreeableness $\times$ Empathy interaction, two subsequent analyses temper this finding. The Index of Moderated Mediation did not reach significance, indicating that the first-stage moderation did not propagate into a differential indirect effect on subjective well-being. Furthermore, the robustness analysis rendered the interaction non-significant when the remaining four Big Five dimensions were controlled, suggesting that the apparent moderation was partly attributable to the substantial overlap between agreeableness and extraversion rather than reflecting an independent compensatory pathway. This empirical pattern aligns with the cultural interpretation developed earlier. In Chinese educational settings where cooperative and prosocial behaviors are normatively prescribed rather than individually distinctive (Chen, 2000; Markus & Kitayama, 1991), dispositional agreeableness exerts limited differentiating influence on interpersonal relationships. When both the base association and the moderating effect are themselves attenuated by cultural normativity and shared trait variance, the conditions for a robust compensatory pathway are not met.

Empathy did not significantly moderate the associations involving neuroticism, openness, or conscientiousness. This selective pattern is consistent with the compensatory logic, as empathy's compensatory function most plausibly operates for traits that directly shape positive social engagement rather than traits operating through emotional reactivity (neuroticism), cognitive-aesthetic orientation (openness), or self-regulatory discipline (conscientiousness). For openness in particular, the non-significant moderation may reflect that its association with interpersonal functioning in Chinese educational contexts is shaped less by individual social-cognitive resources than by structural conformity pressures (van Vianen, 2018), a person-environment fit issue that empathy cannot directly redress.

Taken together, these findings indicate that empathy's compensatory function operates selectively rather than uniformly across the Big Five. Although the hypothesis was formulated as a general moderation prediction grounded in the protective-compensatory framework, the robust compensatory effect was confined to extraversion, the trait most directly governing positive social engagement. Empathy functions as a cultivable social-cognitive resource that buffers interpersonal risks associated with lower extraversion, yet its compensatory reach appears bounded by the nature of the dispositional risk involved and by the cultural conditions under which that trait operates. Importantly, even where moderation was statistically significant, the conditional associations remained

positive and meaningful at high empathy, indicating that empathy attenuates the dispositional association without eliminating it. Given that the interaction accounted for approximately 1% of additional variance, this pattern should be regarded as a preliminary directional insight warranting replication. Nonetheless, the finding suggests that multiple pathways to interpersonal success may coexist, with adolescents achieving positive social outcomes through dispositional advantages, through cultivated empathic competencies, or through their combination. This equifinality may inform future intervention research, particularly for adolescents whose personality profiles afford fewer automatic social advantages. At the same time, the non-robust finding for agreeableness and the null findings for the remaining traits caution against overestimating empathy's compensatory reach in contexts where cultural patterning and shared trait variance have already reshaped the trait-relationship architecture.

4.4. Theoretical implications

These findings advance the theory of personality and well-being in three respects. First, demonstrating that interpersonal relationships selectively mediate these associations refines the relational pathway proposed by Self-Determination Theory (Deci & Ryan, 2000). While prior applications often assume interpersonal relatedness functions as a uniform mediating mechanism across personality dimensions (Reis et al., 2000), our results indicate a trait-specific pathway. This relational mechanism appears to operate predominantly for traits with strong social or relational implications, such as neuroticism, extraversion, and openness in the present cultural context, whereas traits like conscientiousness may relate to well-being through the satisfaction of alternative basic psychological needs such as competence.

Second, the indirect-only mediation pattern observed for openness extends the understanding of personality in Chinese educational contexts. This pattern reveals that a trait may be linked to well-being primarily through its association with social functioning rather than through an independent direct pathway, and that such a social pathway can be negative when the trait generates interpersonal friction in conformity-oriented environments. Such evidence challenges the implicit assumption that traits exert uniformly positive or uniformly direct effects on well-being, highlighting the need for models that specify the social mechanisms through which traits are linked to well-being in specific cultural contexts.

Third, the selective moderation by empathy refines the protective-compensatory framework (Fergus & Zimmerman, 2005) as applied to interpersonal functioning. Rather than conceptualizing compensatory resources as universally protective, our findings suggest that the compensatory reach of a social-cognitive resource is constrained by two boundary conditions. Specifically, compensation depends first on the nature of the dispositional risk, with empathy's buffering reach appearing robust only for extraversion as the trait most directly governing positive social engagement, apparent but not robust to mutual adjustment for agreeableness, and undetectable for traits operating through affective, cognitive, or regulatory channels. Compensation depends second on the cultural context, as empathy cannot offset interpersonal costs imposed by structural conformity pressures. This preliminary dual-boundary observation suggests a direction for refining theoretical accounts of when compensatory resources are effective, and for integrating mediating pathways with their boundary conditions within a unified framework.

4.5. Practical implications

The present findings suggest three tentative directions for promoting adolescent well-being in Chinese educational contexts. First, personality assessment may complement existing screening approaches by providing information about individual differences relevant to adolescent well-being. Adolescents high in neuroticism may benefit from

emotion regulation training, while those low in extraversion may benefit from social skills support, consistent with the substantial association between extraversion and interpersonal relationship quality observed in the present study. Second, given the compensatory pattern observed for empathy, schools may consider incorporating empathy-enhancement activities such as perspective-taking exercises, role-playing, and cooperative learning. Such activities may be particularly beneficial for adolescents low in extraversion, for whom empathic capacity appears to provide an alternative pathway to positive interpersonal outcomes. Third, given the mediating role of interpersonal relationships observed in the present study, schools may consider fostering supportive peer environments through collaborative learning, peer mentoring, and class climate interventions emphasizing mutual respect. These tentative directions align with Chinese educational values emphasizing collective harmony while addressing individual differences in culturally responsive ways, and await empirical validation through intervention studies.

4.6. Limitations and future directions

This study has several limitations. First, the cross-sectional design precludes causal inferences, and all mediational and moderational pathways reported in this study are based on cross-sectional data that do not permit conclusions about causal direction. Future research employing longitudinal designs could better establish temporal precedence and clarify potential reciprocal effects among personality, interpersonal relationships, empathy, and well-being. Second, the sample was drawn from six schools in Henan Province and included only senior high school students aged 15 to 18 years, which may limit generalizability to other age groups and educational contexts. Moreover, considerable regional variation exists across China in educational environments, cultural climates, and exposure to individualistic values. Adolescents in different regions may therefore exhibit distinct personality–well-being patterns. Future research should employ geographically diverse samples spanning different regions and broader developmental stages. Third, all variables were assessed via self-report at a single time point, increasing the risk of common method variance. Although procedural remedies and confirmatory factor analytic comparisons suggested that common method variance did not substantially distort the findings, future research should incorporate multi-method approaches such as teacher ratings, peer nominations, and behavioral observations. Fourth, empathy's moderating function operated selectively in the present sample, suggesting that additional boundary conditions beyond empathic capacity warrant exploration in future research. Finally, potentially important contextual variables including academic pressure, family environment, and school climate were not examined. Future research should investigate how these contextual factors interact with personality traits and empathy in shaping adolescent well-being. More broadly, cross-cultural comparative studies employing longitudinal designs would help establish temporal ordering and differentiate universal processes from culturally specific patterns in personality–well-being associations.

5. Conclusion

This study examined how Big Five personality traits are associated with subjective well-being among Chinese adolescents, with interpersonal relationships as a mediator and empathy as a moderator. Three principal findings emerged. First, neuroticism, extraversion, and conscientiousness demonstrated significant direct associations with well-being, while openness and agreeableness did not, revealing a pattern that partially diverges from Western findings and underscores the culturally contingent nature of personality–well-being associations. Second, interpersonal relationships selectively mediated the associations of neuroticism, extraversion, and openness with well-being. Openness exhibited indirect-only mediation with a negative indirect effect, consistent with the social costs of non-conformity in Chinese

educational contexts, whereas conscientiousness was associated with well-being only directly, likely reflecting self-regulatory rather than interpersonal pathways. Third, empathy moderated the extraversion–interpersonal relationship association, with the full moderated mediation pattern significant only for extraversion and confirmed by a robustness analysis controlling for shared personality variance, supporting a circumscribed compensatory role for empathy.

These findings indicate that personality traits are associated with adolescent well-being through culturally embedded interpersonal pathways, and that empathy's compensatory function is consistent with psychological equifinality, whereby adolescents may achieve comparable outcomes through dispositional advantages, cultivated empathic competencies, or their combination. By identifying modifiable social and social-cognitive pathways that complement stable personality characteristics, this study highlights potential directions for culturally responsive approaches to promoting adolescent mental health in Chinese educational settings. Future longitudinal, cross-cultural, and intervention research is needed to validate these directions, establish the temporal ordering of these associations, and determine their generalizability beyond the present sample.

CRedit authorship contribution statement

Xi Chen: Writing – original draft, Validation, Software, Methodology, Investigation, Data curation, Conceptualization. **Azlin Mohd Khir:** Writing – review & editing, Validation, Supervision. **Yong Yang:** Visualization, Methodology, Data curation. **Boon Yew Wong:** Writing – review & editing, Supervision, Data curation.

Ethics approval

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Review Committee of Zhengzhou University (Approval No. ZZUIRB2025-146). Informed consent was obtained from all student participants and their legal guardians prior to data collection.

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Declaration of competing interest

The authors have no relevant financial or non-financial interests to disclose.

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Data availability

Data will be made available on request.

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