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ARTICLE

Longitudinal Association between Negative Family Representations and Depression in High School Students: The Mediating Role of Cognitive Failure and the Moderating Role of Self-Compassion

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ABSTRACT: Backgrounds: High school is a critical period for psychological development, during which mental health is vulnerable to family environment. According to attachment theory, adolescents exposed to conflicting family environments develop negative internal working models, characterized by doubts about the stability of parental relationships and family support (i.e., negative family representations). These negative representations constitute a cognitive basis for depression risk. However, the mediating and protective mechanisms remain unclear. Thus, the primary purpose of this study is to explore the potential effect of negative family representations on depression among high school students, focusing on the mediating role of cognitive failure and the moderating role of self-compassion. **Methods:** A longitudinal follow-up design included 770 high school students (342 males and 428 females) who completed two waves of questionnaires eight months apart. The measures included the security scale of parental relationship, the cognitive failures questionnaire, the self-compassion scale, and the center for epidemiologic studies depression scale. **Results:** (1) Negative family representations positively predicted depression eight months later. (2) Cognitive failure played a longitudinal mediating role between negative family representations and depression. (3) Self-compassion not only negatively predicted depression but also moderated the relationship between negative family representations and depression. Specifically, the higher the level of self-compassion, the weaker the impact of negative family representations on depression. **Conclusions:** Negative family representations significantly affect high school students' depression over eight months via cognitive failure. Self-compassion directly alleviates depression and buffers the negative impact of negative family representations on depression These findings have practical implications for improving adolescent mental health support systems and promoting positive development.

KEYWORDS: Negative family representations; cognitive failure; self-compassion; depression among high school students; moderated mediation model

1 Introduction

Since the 21st century, adolescent depression has become a global public health concern. Depression, a common emotional disorder among adolescents, is mainly manifested as typical emotional states such as persistent low mood, sadness, and loss of interest [1]. Research has found that the detection rate of depression among high school students is 45.00%, a rate higher than that among junior high school students (28.50%) and college students (37.30%) [2], which indicates that the status of depression among high school students urgently needs to be addressed. If not intervened in a timely manner, it will affect high school

students in many aspects, such as their academic performance and social adaptation [3], and may also cause long-term and cumulative harm [4]. Therefore, an in-depth exploration of the influencing factors and potential mechanisms of depression among high school students is of significant theoretical and practical significance for formulating scientifically effective intervention strategies.

The family environment, as the core ecosystem for adolescent growth, profoundly impacts mental health development [5]. Previous studies have mostly focused on family conflict behavior. It is widely acknowledged that conflicts between parents can have a negative impact on children [6] and significantly increase their risk of depression [7]. However, according to the stress-cognitive interaction theory [8], objective environmental events may not directly determine an individual's emotional responses but rather exert their effects through cognitive evaluation. This suggests that what truly has a lasting impact on adolescents may be the deep-seated perceptions left in their minds by the conflicts. The internal working model theory provides a framework for understanding this internal cognitive process. This theory posits that individuals form stable mental representations of themselves and others through interactions with caregivers, which continuously influence cognition, emotions, and behaviors [9]. When this theory is applied to specific family conflict situations, it gives rise to a more concrete concept: negative family representations. Negative family representations refer to the internal negative representations formed by adolescents exposed to parental conflict regarding the consequences of such conflicts [10], specifically manifested as negative expectations of the stability of the parental relationship and negative cognitions about whether parents can provide stable support [11]. If the internal working model explains "how negative representations operate", then the theory of emotional security [12] explains "how negative representations are formed". The theory of emotional security holds that adolescents repeatedly exposed to family conflicts experience continuous threats to their emotional security and gradually form negative internal representations of the stability of their family relationships [13]. This internalized cognitive-emotional structure may be more predictive of adolescents' long-term adaptability than the conflicts themselves [12] and thus can be regarded as a distal risk factor for adolescent depression.

High school is a critical and developmentally vulnerable period of psychological development, during which individuals are highly sensitive to the quality of their family relationships. However, there are at least two critical limitations in the existing literature. First, the specific pathways through which negative family representations, a distal risk factor, influence depression remain unclear. It may contribute to emotional problems by depleting individuals' daily cognitive functioning, manifested as "cognitive failure", yet this longitudinal mediation hypothesis remains untested. Second, research on which individual resources can buffer this risk pathway is particularly scarce. Self-compassion, as a positive disposition characterized by treating one's own difficulties with kindness and a sense of common humanity [14], is theoretically proposed to serve a protective function by providing an emotional buffer or modifying negative cognitions. However, its moderating effect in the aforementioned pathway remains to be empirically explored.

To explore these issues in depth, the present study integrates emotional security theory and attachment internal working model theory [9,15] to construct a moderated mediation model. This study aims to examine how negative family representations (distal risk factor) influence depression among high school students through cognitive failures (proximal cognitive mechanism) and to test the moderating role of self-compassion, so as to provide an evidence-based reference for the prevention practice of adolescent depression in high school settings.

1.1 Negative Family Representations and Depression in High School Students

Negative family representations are specifically defined as the internal negative representations of conflict consequences formed by adolescents exposed to interparental conflict [10]. They mainly consist of negative expectations regarding the stability of the parental relationship (e.g., "My parents may separate at any time") and negative cognitions about parents' inability to maintain stable supportive resources (e.g., "My parents may not have time for me or hold me accountable for the conflict") [11].

From the perspective of emotional security theory, children repeatedly exposed to destructive interparental conflict will have their core developmental task–maintaining emotional security–threatened. To cope with this threat, they gradually form negative internal representations of the stability of their family relationships [13]. Once formed, these representations become a relatively stable psychological structure and continuously exert an enduring effect on adolescents' emotional response. For instance, research has indicated that adolescents with negative family representations consistently navigate changes in family relationships negatively and overestimate the potential harm of interparental conflict. As a result, they experience more distress, perceive greater levels of self-blame [10], and subsequently have a higher risk of developing depression. Previous studies have also demonstrated that children with more negative family representations tend to cope with problems in more negative ways, making them more prone to psychological adjustment difficulties [16]. A study further confirmed that adolescents exposed to interparental conflict may be at an increased risk of developing depression by perceiving parents' negative emotions and forming negative family related cognitions [17]. Therefore, drawing on emotional security theory and the aforementioned empirical evidence, the present study proposes:

Hypothesis 1: *Negative family representations (Time 1, T1) positively predict depression among high school students (Time 2, T2).*

1.2 The Mediating Role of Cognitive Failure

Cognitive failure refers to lapses in an individual's attention, memory, and behavioral performance that impede the consistent completion of routine, simple daily tasks that would otherwise be executed without difficulty [18]. According to the internal working model theory of attachment [9,15], the stable mental representations of the self and others formed in early life continuously shape how individuals process daily social information, including proximal cognitive processes such as attention, memory, and attribution. After adolescents develop negative family representations, they maintain sustained vigilance toward family related information and interpret daily events with a negatively biased lens [15]. This sustained vigilance and negative information processing consume substantial amounts of cognitive resources.

Furthermore, cognitive load theory [19] and conservation of resources theory [20] together explain how this resource consumption leads to cognitive failure. When task demands exceed an individual's limited cognitive resource capacity or when resources are continuously invested without effective replenishment, cognitive overload and resource depletion occur, leading to cognitive failure. In the family context, adolescents with negative family representations must continuously invest substantial psychological resources to cope with the uncertainty arising from interparental conflict and maintain their emotional security. This process of resource depletion is highly likely to induce cognitive load, which in turn manifests as the classic symptoms of cognitive failure, including impaired attention and reduced memory function [21]. In addition, these adolescents often attribute interparental conflict to themselves, resulting in self-blame [22]. Over time, engaging in such self-blaming ruminative thoughts consumes cognitive resources, which in

turn impairs executive functioning [23], specifically selective attention and attentional switching, and may ultimately contribute to cognitive failure.

Once cognitive failure develops, it may become a proximal risk factor for depression. Repeated, perceived cognitive dysfunction (e.g., "I can't even do simple things well") activates and reinforces an individual's sense of worthlessness, forming a cognitive pathway to depression [24,25]. Empirical research has found that individuals with high levels of cognitive failure are often characterized by chronic self-denial and negative cognition and face a higher risk of developing depression [26]. Moreover, cognitive failure itself may reflect impairments in more fundamental cognitive control functions (e.g., difficulties in task switching). These deficits impair an individual's ability to effectively regulate negative emotions, disengage from negative thinking, and recover from experiences of failure [27], thereby increasing the risk of depression [28]. Related research has also found that negative family experiences exacerbate the risk of depression by comprehensively impairing adolescents' cognitive functioning [29]. Building on this integrated theoretical framework, the present study proposes:

Hypothesis 2: *Cognitive failure (T2) exerts a longitudinal mediating effect between negative family representations (T1) and depression (T2).*

1.3 The Moderating Role of Self-Compassion

Self-compassion, a positive adaptive strategy for coping with distress, refers to the practice of encouraging oneself to confront failures directly and view personal shortcomings positively when facing adversity [14]. It specifically comprises three core components: self-kindness, a sense of common humanity, and mindfulness. Grounded in Neff's theoretical framework [30], self-compassion is an inherently adaptive emotion regulation strategy. Individuals with high levels of self-compassion tend to face their adverse life experiences with a more forgiving attitude and are better able to openly accept the accompanying painful feelings without either avoiding or ruminating on negative emotions [31]. This characteristic may allow self-compassion to play a critical buffering role in the effects of negative family representations and cognitive failure on high school students. Specifically, existing research indicates that individuals with high self-compassion are more likely to employ the emotion regulation strategy of positive cognitive reappraisal, framing family conflict as a normal universal experience (e.g., all families experience conflict) rather than attributing it to internal personal causes [32]. This, in turn, reduces rumination about family conflict [33] and subsequently mitigates cognitive failure resulting from the sustained depletion of cognitive resources.

In addition, individuals with high self-compassion may demonstrate greater self-care and a more positive, objective coping attitude by replacing self-criticism with self-kindness, alleviating feelings of loneliness through a sense of common humanity, and accepting distress via mindfulness, thereby buffering the direct emotional impact of negative family representations. A large body of cross-sectional and longitudinal research has found that self-compassion significantly and negatively predicts negative psychological outcomes, including depression and anxiety [34,35], and that high self-compassion helps adolescents strengthen their use of positive emotion regulation strategies [36]. Nguyen et al. [37] further noted that when adolescents are exposed to stressors or emotionally evocative stimuli, self-compassion exerts a protective role in shaping socioemotional experiences, which in turn shapes their mental health outcomes. Collectively, this body of evidence indicates that as a positive psychological resource, self-compassion enables adolescents to cope in a healthier manner when faced with family-related stress, thus mitigating the adverse emotional effects of risk factors.

Furthermore, repeated experiences of cognitive failure may make adolescents more prone to internalizing failures as personal flaws, to developing a self-blaming attributional style [20], and to activating negative emotions such as helplessness and hopelessness. Individuals with high levels of self-compassion may directly counteract depression and other negative emotions elicited by negative attributional bias, through core processes including the self-kindness component of self-compassion and mindfulness (e.g., "making mistakes is a normal part of being human, and I can improve at my own pace"). For instance, research has documented that adolescents with higher levels of self-compassion exhibit significantly reduced self-blaming tendencies [38] and significantly elevated self-esteem [39] following experiences of cognitive failure, which may, in turn, effectively alleviate depression triggered by cognitive failure.

Taken together, the present study proposes:

Hypothesis 3: *Self-compassion (T1) moderates the relationship between negative family representations (T1) and depression (T2) through three specific pathways:*

H3a: *Self-compassion moderates the path from negative family representations (T1) to cognitive failure (T2).*

H3b: *Self-compassion moderates the path from negative family representations (T1) to depression (T2).*

H3c: *Self-compassion moderates the path from cognitive failure (T2) to depression (T2).*

Integrating the theories discussed above, this study proposes a moderated mediation model: negative family representations—a distal risk factor rooted in emotional security theory—deplete adolescents' cognitive resources over time (cognitive load theory, conservation of resources theory), leading to cognitive failure as a proximal cognitive mechanism. Self-compassion, drawn from positive psychology, is hypothesized to serve a protective function in this process, potentially buffering the direct impact of negative family representations on emotional distress and moderating the mediating pathways involving cognitive failure.

2 Methods

2.1 Participants

This study adopted a convenience sampling method and conducted two rounds of questionnaire surveys among students from 16 classes in two high schools. Given that the participants were minors, ethical approval for this study was obtained from the Academic Committee of Shenyang Normal University (No. 20240301). All procedures adhered to the ethical standards outlined in the declaration of helsinki. Researchers provided guardians with written statements in advance (detailing the research objectives, data usage, and confidentiality measures), and participants were enrolled only after the guardians signed the written informed consent forms. Before data collection, the researchers thoroughly explained the study content to the participants, ensuring that they comprehended the procedures and verbally confirmed their voluntary participation in the assessment. In May 2024, 900 questionnaires were distributed to the selected sample. After excluding questionnaires with straight-lining response patterns, invalid multiple responses, or missing items, 782 valid questionnaires were obtained, with a valid response rate of 86.89%. Among the participants, 346 were male (44.25%) and 436 were female (55.75%); 365 were grade 10 students (46.68%) and 417 were grade 11 students (53.32%); 95 were left-behind students (12.15%) and 687 were non-left-behind students (87.85%). All participants were aged between 14 and 19 years, with a mean age of 16.35 years (SD = 0.76).

Eight months later, a second questionnaire survey was conducted among the 782 high school students. During the interval between the two surveys, 12 participants were lost due to reasons such as sick leave, school transfer, or dropout, resulting in an attrition rate of 1.53%. After matching the data from the two measurements, 770 valid questionnaires were obtained. An independent samples t-test was performed on the T1 data of the lost participants (n = 12) and the valid participants (n = 782). The results showed no significant differences in T1 scores for negative family representations [$t(782) = 1.79$, $p > 0.05$], cognitive failure [$t(782) = -0.12$, $p > 0.05$], self-compassion [$t(782) = 0.04$, $p > 0.05$], or depression [$t(782) = -0.39$, $p > 0.05$] between the two groups. Chi-square tests on gender, grade, and age of participants who completed both surveys revealed no significant differences in gender [$\chi^2(1) = 0.11$, $p > 0.05$], grade [$\chi^2(1) = 3.79$, $p > 0.05$], or age [$\chi^2(5) = 5.96$, $p > 0.05$], indicating no structured attrition among participants. Ultimately, the valid sample consisted of 342 males (44.41%) and 428 females (55.58%), 358 Grade 10 students (46.49%) and 412 Grade 11 students (53.51%), 95 left-behind students (12.34%), and 675 non-left-behind students (87.66%). The participants were aged between 14 and 19 years, with a mean age of 16.36 years (SD = 0.67).

2.2 Instruments

2.2.1 Negative Family Representations Questionnaire

The negative representations questionnaire from the security scale of parental relationships, developed by Davies et al. [21] and translated and revised by Wang et al. [22], was adopted. The questionnaire consisted of eight items, including two dimensions: destructive representation and spreading representation. A 4-point Likert scale was used, ranging from 1 (completely inconsistent) to 4 (completely consistent), with higher scores indicating a higher level of negative family representations. The Cronbach's α coefficients of the scale in the two measurements were 0.85 and 0.88.

2.2.2 Cognitive Failure Questionnaire

The cognitive failure questionnaire (CFQ) developed by Broadbent et al. [18] and revised by Zhou et al. [40] was used. The questionnaire consisted of 25 items, including five dimensions: distraction, memory, interpersonal errors, motor coordination, and name memory. A 5-point Likert scale was used, ranging from 1 (never) to 5 (always). Higher scores indicate higher levels of cognitive failure. The Cronbach's α coefficients for the two measurements were 0.92 and 0.96, respectively.

2.2.3 Self-Compassion Scale

The self-compassion scale, revised by Chen et al. [41], was used. The scale consists of 26 items, including six dimensions: self-kindness, self-criticism, sense of common humanity, isolation, mindfulness, and overimmersion. A 5-point Likert scale was adopted, ranging from 1 (strongly inconsistent) to 5 (strongly consistent). Higher scores indicate higher self-compassion. The Cronbach's α coefficients for the two measurements were 0.91 and 0.93, respectively.

2.2.4 Center for Epidemiologic Studies Depression Scale

The center for epidemiologic studies depression scale (CES-D), revised by Zhang et al. [42], was used to measure depression. The scale consists of 20 items, including four dimensions: positive emotions, depressive emotions, somatic symptoms and psychomotor retardation, and interpersonal relationships. A 4-point Likert scale was used, ranging from 0 (rarely or none) to 3 (most of the time). Higher scores indicate more severe depression symptoms. The Cronbach's α coefficients for the two measurements were 0.89 and 0.91, respectively.

2.3 Analytical Strategy

Given that the present study employed a two-wave longitudinal design, in testing the hypothesized model, the independent variable (negative family representations) and the moderator (self-compassion) were measured at T1, whereas the mediator (cognitive failure) and the dependent variable (depression) were measured at T2, in accordance with methodological recommendations for longitudinal data analysis [43,44]. Furthermore, this measurement schedule is consistent with previous longitudinal studies in the field [45]. SPSS 27.0 software was used to perform descriptive statistics, correlation analysis, and common method bias testing on the data set. Mplus 8.3 was used to construct structural equation models to test the hypothesized mediation and moderation models.

2.4 Common Method Bias Testing

Harman's single-factor test was adopted in the present study to examine the common method bias in the research data. The results showed that a total of 31 factors had eigenvalues greater than 1, among which the first factor explained 21.21% of the total variance, which was below the critical threshold of 40%. Therefore, common method bias was not a significant concern in this study.

2.5 Measurement Invariance Testing of the Measurement Instruments

Multigroup confirmatory factor analysis (MCFA) was performed to test the longitudinal measurement invariance of the four core study scales (negative family representations, cognitive failure, self-compassion, depression) across Time 1 (T1) and Time 2 (T2), in accordance with standard longitudinal invariance testing guidelines [46]. Four nested hierarchical invariance models with progressively stricter equality constraints were tested sequentially: (1) configural invariance (baseline model with identical factor structure across time points); (2) metric invariance (equal factor loadings across time points); (3) scalar invariance (equal item intercepts across time points); and (4) strict invariance (equal item residual variances across time points). Invariance was evaluated following the multi-index joint judgment rule specified in Chen [47], in which noninvariance can only be concluded when both ΔCFI and supplementary fit indices simultaneously meet the noninvariance cutoff values, rather than relying on a single ΔCFI cutoff. Metric and scalar invariance are the necessary prerequisites for valid cross-time comparisons of latent variables, and both were fully supported for all scales in this study. As presented in Table 1, all four invariance models were fully supported overall. These results confirm that the four scales hold consistent measurement properties across the two time points. This consistency in turn supports the robustness and validity of our subsequent longitudinal mediation and moderation analyses.

2.6 Data Analysis

Data were analyzed using SPSS 27.0 (IBM Corporation, Armonk, NY, USA) and Mplus 8.3 (Muthén & Muthén, Los Angeles, CA, USA). Continuous variables are presented as mean ± standard deviation (*Mean* ± *SD*). Structural equation modeling was used to test the mediation and moderated mediation models. Indirect effects were tested using bootstrapping with 5000 resamples. The p value is defined as the probability of obtaining the observed results under the null hypothesis. All statistical tests were two-tailed, and a p value < 0.05 was considered statistically significant.

Table 1: Longitudinal invariance test of each variable.

Variable		χ^2	*df*	CFI	RMSEA	SRMR	$\Delta\chi^2$	Δdf	ΔCFI
Negative Family Representations	Configural invariance	580.39	94	0.92	0.08	0.06	–	–	–
	Metric invariance	600.39	102	0.92	0.08	0.06	20	8	0.00
	Scalar invariance	631.23	110	0.92	0.08	0.06	30.84	8	0.00
	Strict invariance	741.06	118	0.90	0.08	0.07	109.83	8	−0.02
Depression	Configural invariance	2018.44	718	0.91	0.05	0.06	–	–	–
	Metric invariance	2094.54	738	0.91	0.05	0.06	76.1	20	0.00
	Scalar invariance	2147.52	758	0.90	0.05	0.06	52.99	20	−0.01
	Strict invariance	2324.29	778	0.89	0.05	0.07	176.77	20	−0.01
Self-Compassion	Configural invariance	2294.44	446	0.86	0.07	0.09	–	–	–
	Metric invariance	2403.36	462	0.85	0.07	0.09	108.92	16	−0.01
	Scalar invariance	2464.67	478	0.85	0.07	0.09	61.31	16	0.00
	Strict invariance	2676.28	494	0.84	0.08	0.09	211.61	16	−0.01
Cognitive Failure	Configural invariance	2405.45	574	0.88	0.06	0.05	–	–	–
	Metric invariance	2473.50	592	0.87	0.06	0.07	68.05	18	−0.01
	Scalar invariance	2609.72	610	0.87	0.07	0.07	136.22	18	0.00
	Strict invariance	2786.11	628	0.85	0.07	0.07	176.39	18	−0.02

Note: χ^2 = Chi-square; *df* = Degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; $\Delta\chi^2$ = Change in Chi-square; Δdf = Change in Degrees of freedom; ΔCFI = Change in Comparative Fit Index. All invariance models were tested sequentially across the two time points (Time 1 and Time 2). Δvalues are reported to two decimal places; "0.00" indicates a value rounding to zero.

3 Results

3.1 Descriptive Statistics and Correlation Analysis of Variables

As shown in Table 2, correlation analyses revealed pairwise positive correlations among negative family representations, depression, and cognitive failure. Self-compassion was significantly and negatively correlated with negative family representations, cognitive failure, and depression. These findings indicate significant associations between the study variables, providing preliminary support for subsequent path model testing. In addition, grade was significantly and negatively correlated with the three variables, excluding self-compassion; thus, grade was included as a control variable in the subsequent model testing.

Table 2: Correlation analysis of main research variables. (n = 770).

Variable	*Mean* ± *SD*	1	2	3	4	5
1 Grade	–	1				
2 Negative Family RepresentationsT1	12.68 ± 4.88	−0.16***	1			
3 Cognitive FailureT2	59.35 ± 19.72	−0.13***	0.20***	1		
4 DepressionT2	13.93 ± 10.33	−0.16***	0.27***	0.56***	1	
5 Self-CompassionT1	82.85 ± 16.30	0.03	−0.31***	−0.33***	−0.51***	1

Note: ***p < 0.001, the same applies below. *SD* = Standard Deviation. T1: Time 1 (baseline); T2: Time 2 (eight months later).

3.2 Testing of the Mediating Effect of Cognitive Failure

First, this study adopted the balanced item parceling method [48] to generate item parcels for negative family representations, cognitive failures, self-compassion, and depression separately, with each set of parcels serving as the observed indicators for the corresponding latent variable (four latent variables in total). Next, grade was dummy-coded and included as a control variable to test the predictive effect of negative family representations on depression. The results showed that the model yielded good fit indices: χ^2/df = 2.57, CFI = 0.98, TLI = 0.97, RMSEA = 0.05, and SRMR = 0.05. Negative family representations

significantly and positively predicted depression (γ = 0.29, Z = 6.47, p < 0.001). Cognitive failure was incorporated into the structural model as a mediating variable. The results indicated that the model also exhibited excellent fit indices: χ^2/df = 2.23, CFI = 0.99, TLI = 0.98, RMSEA = 0.04, and SRMR = 0.05. As shown in Fig. 1, the mediating effect of T2 cognitive failure between T1 negative family representations and T2 depression was statistically significant (Effect = 0.12, 95% CI [0.07, 0.15]), with the mediating effect accounting for 41.14% of the total effect. Thus, Hypotheses 1 and 2 were confirmed.

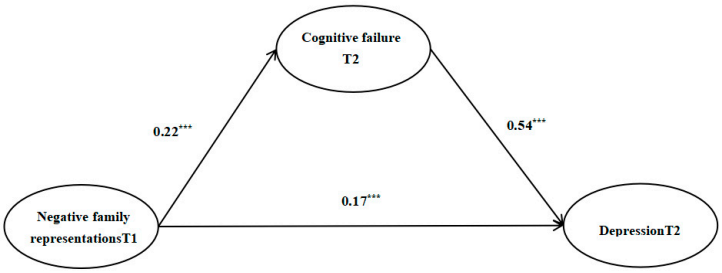

Figure 1: The Mediating Effect of Cognitive Failure. Note: ***p < 0.001; T1: Time 1 (baseline); T2: Time 2 (eight months later).

3.3 Testing of the Moderating Effect of Self-Compassion

Latent moderated structural equation (LMS) modeling was employed to examine the moderating effect of self-compassion. This method demonstrates robust statistical properties because it circumvents the issue of inconsistent parameter estimates arising from the specification of different product indicators [49]. However, this method does not generate conventional model fit indices such as the CFI and RMSEA. Accordingly, the AIC and log-likelihood values were used to evaluate the fit of the latent moderation model and quantify the improvement in the moderated mediation model fit relative to the baseline model.

First, the baseline structural equation model (SEM) without the latent moderation interaction term was tested, which yielded favorable fit indices: χ^2/df = 2.71, CFI = 0.97, TLI = 0.97, RMSEA = 0.05, SRMR = 0.07. Second, a model fit comparison was performed between the baseline model and the moderated mediation model, incorporating the latent moderation interaction term. The results revealed that the log likelihood value of the baseline model was −10,685.48, and the log likelihood value of the model with the interaction term added was −11,191.91, −2LL = 1012.86, Δdf = 5. The chi-square test of the −2ΔLL value was statistically significant (p < 0.001), indicating that the moderated mediation model exhibited a significantly better fit than the baseline model. Finally, the moderated mediation model with the latent moderation effect was formally tested, and the results are presented in Fig. 2. In Fig. 2, "X×U" denotes the interaction between negative family representations and self-compassion, and "M×U" denotes the interaction between cognitive failure and self-compassion.

Simple slope tests were conducted to unpack the moderating effect of self-compassion. As shown in Fig. 3, the results indicated that at low levels of self-compassion, negative family representations significantly predicted depression (γ = 0.10, Z = 2.19, p < 0.05). In contrast, at high levels of self-compassion, the predictive effect of negative family representations on depression was not statistically significant (γ = −0.07, Z = −1.40, p > 0.05). This pattern of results demonstrates that higher levels of self-compassion weaken the association between negative family representations and depression to the point where the effect is fully buffered.

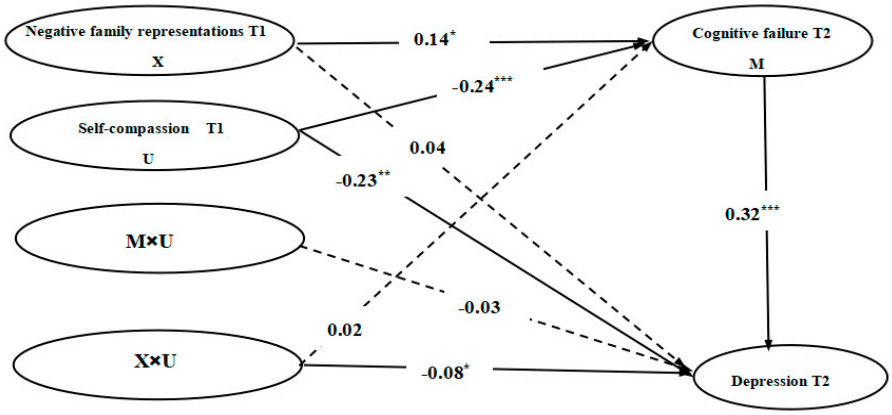

Figure 2: A moderated mediation model. Note: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$; grade as a control variable. "X×U" denotes the interaction between negative family representations and self-compassion, and "M×U" denotes the interaction between cognitive failure and self-compassion. T1: Time 1 (baseline); T2: Time 2 (eight months later).

The Johnson-Neyman technique was further applied to examine the moderating effect [50] and identify the critical values of self-compassion and the range of moderator values for which the moderating effect was statistically significant, as presented in Fig. 4. The results revealed that the moderating effect was significant when standardized self-compassion scores were below −0.7 or above 1.7, where the 95% *CI* of the simple slopes did not contain zero, indicating statistically significant simple slopes. In summary, self-compassion significantly moderated the direct path from negative family representations to depression (supporting H3b). However, self-compassion did not significantly moderate the path from negative family representations to cognitive failure (H3a not supported) nor the path from cognitive failure to depression (H3c not supported). Thus, H3b was supported, while H3a and H3c were not.

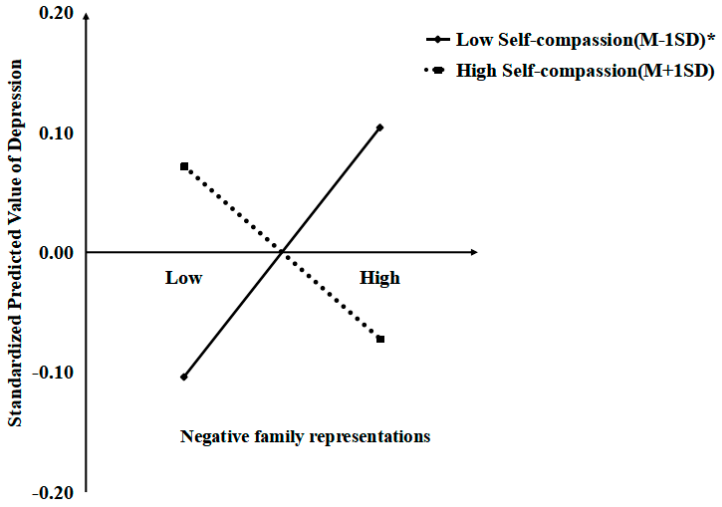

Figure 3: The moderating role of self-compassion in the relationship between negative family representations and depression. Note: M−1SD: mean minus one standard deviation (low self-compassion); M+1SD: mean plus one standard deviation (high self-compassion). * indicates that the simple slope for low self-compassion (M−1SD) is statistically significant ($p < 0.05$).

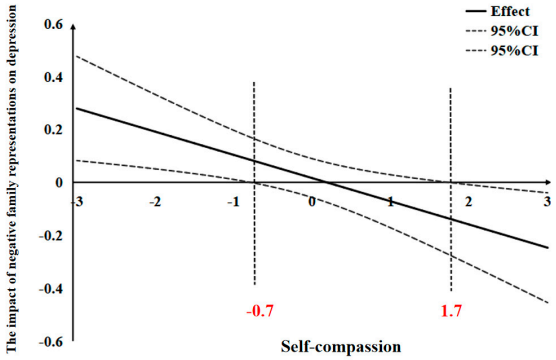

Figure 4: The moderating role of self-compassion in the relationship between negative family representations and depression (J-N). Note: 95% CI: 95% confidence interval.

4 Discussion

4.1 Association between Negative Family Representations and Depression

The present study found that negative family representations significantly and positively predicted depression levels among high school students at the 8-month follow-up, supporting Hypothesis 1 and aligning with findings from previous research [51]. This finding demonstrates that the family is an interconnected system, with interactions among family members exerting a profound impact on individual behavior and development [52]. Stable and harmonious family relationships promote the healthy development of adolescents [53]. In contrast, negative and conflict-ridden family relationships may lead adolescents to develop negative family representations, which ultimately trigger negative emotions such as depression [54]. From the perspective of emotional security theory [13], adolescents' negative representations of family conflict (e.g., negative expectations of the consequences of interparental conflict, doubts about the stability of family support) undermine their emotional security, leaving them under chronic stress, which in turn activates their depression vulnerability [22]. Furthermore, as an internalized product of interparental conflict, negative family representations will continuously give rise to adolescents' negative cognitions that their parents may separate at any time or hold them responsible for the conflict. If high school students perceive interparental conflict as a threat to their family system or feel unable to cope with it, they are likely to experience helplessness. If they attribute the conflict to themselves, they may feel guilt and sadness, which further contribute to the onset of depressive symptoms [55].

4.2 Mediating Role of Cognitive Failure

The present study also found that cognitive failure exerted a longitudinal mediating effect between negative family representations and depression among high school students, supporting Hypothesis 2. This finding provides new evidence for understanding the "cognitive pathway" through which family risk factors influence adolescent depression. Integrating cognitive load theory [19] and conservation of resources theory [20], this result can be explained from two aspects. On the one hand, to cope with the uncertainty of family relationships (e.g., persistent worry about the consequences of interparental conflict), adolescents need to invest substantial psychological resources to maintain emotional stability, which may lead to cognitive overload, manifested as cognitive failure symptoms such as inattention and memory lapses [21]. High school students are in a critical developmental stage with high emotional lability. If chronically exposed to interparental conflict, they are prone to developing negative cognitions of family instability and are more likely to attend to and absorb parents' negative emotions. This process consumes

a large amount of psychological resources, impairs their ability to focus on other tasks, and thus results in more frequent cognitive failure [56]. On the other hand, cognitive failure is not only an outcome of resource depletion but also a proximal risk factor for the development of depression. Frequent occurrences of cognitive failure (e.g., task errors, distractibility) may activate adolescents' sense of worthlessness; they may attribute these failures to their own deficits [25], which in turn generates feelings of helplessness and hopelessness and triggers depression. Adolescents face the dual challenges of academic tasks and family emotional stress. Sustained resource depletion is likely to lead to a gradual decline or even rigidity in their originally flexible cognitive processing mode [57]. This causes negative cognitive patterns to be repeated ineffectively, with no capacity to generate new and positive cognitions [58], which in turn places high school students at a high risk of developing depression over time.

4.3 Moderating Role of Self-Compassion

The results of the present study also revealed that self-compassion significantly predicted depression in the longitudinal analysis and moderated the association between negative family representations and depression. Specifically, higher levels of self-compassion were associated with a weaker, even fully buffered, effect of negative family representations on depression. Hypothesis 3b was supported, which is consistent with the findings of previous studies [59]. From a theoretical perspective, this result supports Neff's self-compassion theory [14,30]. This theory posits that the three core components of self-compassion—self-kindness, sense of common humanity, and mindfulness—can help individuals replace self-criticism with care, alleviate loneliness through a shared human perspective, and accept rather than avoid pain with mindfulness. This indicates that when adolescents with negative family representations face family stress, these psychological processes can effectively buffer the direct impact of risk factors on their emotions. A relevant study has shown that self-compassion can protect individuals from the deep activation of depression-related schemas [60]. Furthermore, the risk and protective factor model also notes that protective factors (e.g., self-compassion) and risk factors (e.g., negative family representations) interact synergistically in adolescent development [61]. Risk factors may push individuals toward negative developmental outcomes, whereas protective factors can buffer this trend. A recent intervention study provided evidence for this, finding that compassion-focused therapy (CFT) can significantly improve self-esteem and reduce cognitive vulnerability to depression by regulating emotion systems, enhancing mindfulness, and modifying cognitive patterns [62]. This suggests that for high school students trapped in negative family representations, those with high levels of self-compassion can indeed effectively buffer the impact of risk factors on depression through the three core components of self-compassion. Shenaar-Golan et al. [63] also found that individuals with high levels of self-compassion can maintain subjective well-being even when experiencing difficulties in emotion regulation, which further confirms the unique function of self-compassion as an "emotional buffering resource".

Notably, self-compassion did not moderate the effect of negative family representations on cognitive failure (H3a not supported), nor did it moderate the effect of cognitive failure on depression (H3c not supported). One possible explanation is that the protective effect of self-compassion is selective. First, the failure of self-compassion to moderate the effect of negative family representations on cognitive failure may stem from the automatic nature of cognitive processing. Gilbert systematically analyzed affect regulation systems from a biopsychosocial perspective, arguing that humans have evolved two different affect regulation systems [64]. The first is the threat-defense system, rooted in the sympathetic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis, which is primarily responsible for identifying threats, triggering fear and anger, and prompting individuals to enter a defensive state. The other is

the soothing system, rooted in the parasympathetic nervous system and mediated by oxytocin, which is mainly responsible for providing a sense of security, promoting caregiving behaviors, and calming negative emotions. These two systems operate in a mutually inhibitory manner; when the soothing system is activated, it effectively downregulates the threat system's hyperreactivity [64]. This indicates that negative family representations, as threat-related cognitions about the stability of family relationships, first activate the threat-defense system, triggering emotions such as self-blame and anxiety, which in turn directly increase the risk of depression. The three core components of self-compassion—self-kindness, sense of common humanity, and mindfulness—are effective ways to activate the soothing system. This is consistent with the review findings of Neuenschwander et al. [65]: when adolescents with high self-compassion face family stress, they can replace self-criticism with care, alleviate loneliness from the perspective of common humanity, and accept rather than avoid pain with mindfulness. These psychological processes can effectively inhibit the hyperactivation of the threat system at the emotional level, thereby directly buffering the effect of negative family representations on depression. However, the effect of negative family representations on cognitive failure may stem more from the depletion of cognitive resources caused by the sustained, automatic activation of the threat system. According to Dykas and Cassidy [15], the internal working model processes daily information in an automatic, unconscious manner. This means that even individuals with high self-compassion can calm emotional responses through the soothing system, but it is difficult for them to prevent negative family representations from continuously consuming attentional and memory resources in the background. Consequently, self-compassion fails to moderate the effect of negative family representations on cognitive failure.

Second, the failure of self-compassion to moderate the effect of cognitive failure on depression may stem from the direct impact of cognitive failure on self-attribution and self-efficacy. As an experience of daily cognitive lapses, cognitive failure may predict depression more through the self-attribution and diminished self-efficacy triggered by failure experiences (e.g., "I cannot do anything right") [25] than through pure emotional threat. Although self-compassion can activate the soothing system and calm emotional responses [65], this emotional buffering effect may be unlikely to reach deeper cognitive beliefs. Research has shown that self-compassion interventions may have difficulty altering individuals' attributions about failure experiences [66]. In other words, while self-compassion may help individuals feel better after experiencing cognitive failure, it does not readily change stable self-attributional patterns such as "my failure is due to my own incompetence", thereby making it difficult to reverse its impact on depression. Consequently, self-compassion fails to moderate the effect of cognitive failure on depression.

4.4 Research Significance and Limitations

The present study identified the longitudinal mechanism linking negative family representations to depression among high school students, as well as the roles of cognitive failure and self-compassion. These findings hold both theoretical and practical value. Theoretically, this study verified the longitudinal pathway of "negative family representations → cognitive failure → depression," addressing the limitation of previous studies that focused on interparental conflict behaviors while neglecting internal representations. It also integrated attachment theory, cognitive load theory, and self-compassion theory to construct a moderated mediation model, enriching the research framework for adolescent depression.

Practically, the findings offer concrete directions for prevention and intervention. First, interventions should target negative family representations. School mental health practitioners can help students identify and adjust negative cognitions about family conflict through family interviews, parent-child communication workshops, and psycho education, thereby reducing excessive concerns about family

stability. Second, cognitive training should address cognitive failure. The results indicate that cognitive failure serves as a key mediating mechanism linking negative family representations to depression. Schools may introduce cognitive intervention programs, such as attention training, memory strategy instruction, and executive function training, to help students reduce daily cognitive lapses and consequently lower depression risk. Third, self-compassion should be cultivated as an emotional buffering resource. Self-compassion effectively buffers the direct impact of negative family representations on depression. Schools can incorporate self-compassion training into mental health curricula through mindfulness exercises, self-kindness writing activities, and education on common humanity, helping students develop positive self-care capacities. For example, group counseling sessions focused on "being kind to oneself" can guide students to replace self-criticism with kindness and alleviate loneliness through a shared human perspective. Fourth, school-family collaborative interventions should be implemented. Given the significant influence of the family environment on adolescent mental health, schools should strengthen communication with parents, help them understand the potential impact of family conflict on their children's psychological well-being, and provide training in family communication skills to reduce the formation of negative family representations at the source.

However, this study also had several limitations. First, the data were collected from only two high schools in Shenyang, which may limit the generalizability of the findings. Given the Chinese cultural context that uniquely emphasizes filial piety [67], adolescents may be more prone to developing negative family representations and experiencing guilt in family conflicts, and the expression of self-compassion may also differ from that in other cultural contexts. Moreover, given China's vast geographic expanse, family culture and educational patterns vary across regions [68]. Additionally, the relatively high proportion of 11th-grade students in the present sample may limit representativeness for other grades. Therefore, future research should expand the sample coverage to include diverse cultural backgrounds and regions to enhance the generalizability of the findings. Second, the data in this study were primarily collected via self-reports, which may introduce subjective bias. Future research should incorporate multi-informant measures, such as teacher or parent ratings, to assess the core variables. Third, potential confounders such as prior mental health status and family socioeconomic status were not controlled for in this study. Research suggests that these variables may have significant effects on the core variables of interest [69,70]; thus, future studies should include them in the analysis. Fourth, this study only explored the mediating role of cognitive failure in the relationship between negative family representations and depression. However, other key variables may also play a role. Future research could incorporate variables such as emotion regulation and other social support factors to further investigate the underlying mechanisms. Finally, this study employed a two-wave longitudinal design with a limited time span. Although this design follows methodological recommendations for longitudinal research [43,44], the ideal temporal ordering of variables would be T1X $\rightarrow$ T2M $\rightarrow$ T3Y. Future studies could extend the follow-up period or adopt more sophisticated methods such as cross-lagged panel models or latent growth curve models to further explore the complex relationships and underlying mechanisms among the variables.

5 Conclusions

(1) Negative family representations exert a significant longitudinal predictive effect on depression among high school students; (2) Cognitive failure plays a longitudinal mediating role between negative family representations and depression; (3) Self-compassion significantly negatively predicts depression, and plays a moderating role between negative family representations and depression. Specifically, higher levels of self-compassion are associated with a weaker effect of negative family representations on depression.

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Ethics Approval: All the procedures of this study comply with the ethical standards stipulated in the "Ethical Review Measures for Human Life Sciences and Medical Research" issued by the National Health Commission of China, and has been approved by the Academic Committee of Shenyang Normal University (No.20240301). Given participants are minors, written informed consent was obtained from both students and their legal guardians prior to data collection. All procedures adhered to the ethical standards of the Declaration of Helsinki.

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