Joint Developmental Trajectories of Depression and Nonsuicidal Self-Injury in Early Adolescence: The Role of Interpersonal Factors

Authors: Huang Yuancheng, Zhao Qingling, Li Caina, Li Caina

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Abstract

Through three-wave longitudinal measurements over three years among 859 junior high school students, this study examined the independent and joint developmental trajectories of depression and self-injury, and tested the role of three important interpersonal relationships (parent-child relationship, peer relationship, teacher-student relationship) in their joint development. Results revealed that depression and self-injury in early adolescence exhibited four and three heterogeneous developmental trajectories, respectively; the joint developmental trajectories of the two comprised three categories: "low depression-low self-injury-stable," "low depression-low self-injury-increasing," and "moderate depression-moderate self-injury-decreasing." Parental psychological control and peer acceptance served as risk and protective factors, respectively, for depression and self-injury in early adolescence.

Full Text

Joint Developmental Trajectories of Depression and Non-Suicidal Self-Injury in Early Adolescence: The Role of Interpersonal Factors

HUANG Yuancheng[1], ZHAO Qingling[1], LI Caina[1]
([1] School of Psychology, Shaanxi Normal University; Shaanxi Provincial Key Research Center for Child and Adolescent Mental and Behavioral Health; Shaanxi Normal University Branch of Collaborative Innovation Center of Assessment toward Basic Education Quality at Beijing Normal University, Xi' an 710062, China)

ABSTRACT

This three-year longitudinal study tracked 859 junior high school students across three time points to examine the independent and joint developmental trajectories of depression and non-suicidal self-injury (NSSI), and to test the role of three important interpersonal relationships (parent-child, peer, and teacher-student relationships) in their co-development. Results revealed four heterogeneous developmental trajectories for depression and three for NSSI in early adolescence. The joint developmental trajectories comprised three classes: "low depression-low NSSI-stable," "low depression-low NSSI-increasing," and "moderate depression-moderate NSSI-decreasing." Parental psychological control and peer acceptance emerged as risk and protective factors, respectively, for the joint development of depression and NSSI in early adolescence.

Keywords: early adolescence, depression, non-suicidal self-injury, joint developmental trajectories, interpersonal relationships

1. Introduction

Adolescent social adjustment problems have long been a major concern for governments, researchers, and the public due to their prevalence and severity, with depression and NSSI representing particularly salient manifestations of maladjustment [**?**, **?**]. Extensive research demonstrates that both depression and NSSI severely impair adolescents' physical and psychological health, and more critically, both serve as significant predictors of suicidal behavior, with prevalence rates reaching or exceeding 20% in adolescent populations [**?**, **?**]. Given their high prevalence and detrimental impact, researchers have extensively investigated the association between depression and NSSI through theoretical and empirical work.

Early cross-sectional studies consistently found strong correlations and comorbidity between depression and NSSI [**?**, **?**]. Guerry and Prinstein [**?**] first examined the causal relationship between depression and NSSI longitudinally, identifying depression as a high-risk predictor of NSSI—a finding subsequently validated by numerous studies [**?**, **?**]. However, recent research suggests that NSSI may predict depression rather than the reverse [**?**]. Meta-analyses have also yielded inconsistent results; for instance, Fox et al. [**?**] proposed that depression might be a risk factor for NSSI, while domestic researchers Li and colleagues [**?**] found only a high correlation between depression and NSSI without establishing causal direction. Marshall et al. [**?**] earlier noted that the uncertain relationship pattern stems from traditional variable-centered approaches neglecting the heterogeneity in developmental patterns, meaning different adolescent subgroups may exhibit distinct developmental trajectories of depression and NSSI. Therefore, without accounting for this population heterogeneity, examining depression and NSSI at the variable level alone cannot clarify their precise relationship.

Person-centered approaches can identify subgroups of individuals with similar emotional and behavioral characteristics, recognize heterogeneous developmen-

tal trajectories of depression and NSSI across different adolescent groups [?, ?], and precisely depict typical within-person combinations of these developmental patterns—that is, joint developmental trajectories—thereby elucidating potential reasons for the high correlation and comorbidity between depression and NSSI at the individual level.

Researchers in psychotherapy also argue that the high correlation and comorbidity between depression and NSSI suggest shared developmental trajectories and etiological factors. Identifying high-risk groups and potential risk and protective factors would enable practitioners to develop more efficient prevention and intervention systems to reduce maladaptive outcomes [?]. Early adolescence marks a period when accelerated physiological development and increased cognitive complexity heighten the influence of interpersonal relationships—including family, peer, and teacher relationships—on emotions and behaviors [?, ?]. Therefore, this study targeted newly enrolled seventh-grade students, employing a person-centered design through three-year longitudinal research to investigate the joint developmental trajectories of depression and NSSI and their interpersonal risk and protective factors in early adolescence.

1.1 Independent Developmental Trajectories of Adolescent Depression and NSSI

Depression refers to a negative affective disorder arising from an individual' s inability to cope with stressful life events, often termed the "common cold" of the 21st century [?, ?]. Compared to other developmental periods, adolescents experience significant hormonal changes and accelerated physical development, resulting in marked heterogeneity and individual differences in depression trajectories [?]. Ellis et al. [?] reviewed 18 studies examining heterogeneity in adolescent depression development and found that all reported a "low-stable" trajectory, with most also identifying "increasing" and "decreasing" trajectories [?, ?]. Costello et al. [?] identified four heterogeneous depression trajectories in a large adolescent sample (N = 11,559) over six years: a minority belonged to a "no depression" group, while most followed "low-stable," "low-increasing," or "high-decreasing" trajectories. Recent studies have validated these findings [?]. For example, Vaillancourt and Haltigan [?] identified "low-stable," "low-increasing," and "high-decreasing" trajectories among 700 adolescents. Based on this literature, we propose that adolescent depression development comprises three basic patterns: "low-stable," "increasing," and "decreasing."

Non-suicidal self-injury (NSSI) refers to direct, deliberate harm to one' s body tissue without suicidal intent [?]. Research indicates that early adolescence represents a critical period for NSSI onset and development, with significant individual differences in NSSI frequency emerging from this stage [?, ?]. Barrocas et al. [?] first examined heterogeneity in adolescent NSSI trajectories, reporting three patterns: "low-decreasing," "moderate-decreasing," and "high-stable," findings subsequently supported by later research [?]. Wang et al. [?] validated these results in a large sample (N = 3,381), further noting that most adolescents

exhibited a "low-stable" trajectory, suggesting that "low-decreasing" represents a special case of the "low-stable" pattern. Additionally, Adrian et al. [?] found a "low-increasing" trajectory in a clinical adolescent sample. However, no study has identified an "increasing" trajectory in general adolescent populations, which this study will examine. In summary, adolescent NSSI likely exhibits two basic patterns ("low-stable" and "decreasing") and one potential pattern ("increasing").

1.2 Joint Developmental Trajectories of Adolescent Depression and NSSI

Integrating person-centered research reveals striking similarities in the number and shape of independent developmental trajectories for adolescent depression and NSSI. Most adolescents maintain low levels of both depression and NSSI long-term, while a minority exhibit "increasing" or "decreasing" trajectories [?, ?]. Variable-centered research also confirms stable high correlations and comorbidity between depression and NSSI [?, ?]. Do these findings suggest shared developmental trends?

The functional model of NSSI [?, ?] posits that NSSI provides "immediate relief" from negative emotional experiences (e.g., depression), indicating a highly symbiotic relationship and potentially shared developmental patterns. Specifically, adolescents with low-stable depression can manage emotional distress using general emotion regulation strategies (e.g., cognitive reappraisal) without NSSI or with minimal NSSI to maintain emotional harmony, resulting in low-stable NSSI (corresponding to the "low depression-low NSSI-stable" joint trajectory). For adolescents with increasing depression, existing emotion regulation strategies become inadequate; "occasional" NSSI effectively alleviates depression, and this "successful experience" creates dependency [?], leading to increased NSSI (corresponding to the "depression-NSSI-increasing" joint trajectory). For adolescents with decreasing depression, reduced depressive symptoms diminish the need for frequent NSSI, resulting in parallel decreases (corresponding to the "depression-NSSI-decreasing" joint trajectory). Thus, the high similarity in independent trajectories is not coincidental; shared developmental trajectories likely exist.

1.3 Interpersonal Factors in Adolescent Depression and NSSI

Interpersonal theories of depression [?] suggest that individuals experiencing more rejection, conflict, and negative interpersonal events develop more negative cognitive schemas and self-evaluations, with deteriorating self-perceptions that persistently increase depression risk. The functional model of NSSI [?, ?] proposes that deteriorating interpersonal systems directly increase NSSI (e.g., to escape peer bullying or improve relationships) and that escalating depression increases NSSI frequency for immediate relief. Conversely, improved interpersonal relationships break the causal chain between negative experiences and depression, reducing depressive symptoms [?], and rendering initially frequent NSSI unnecessary, thereby decreasing NSSI [?, ?]. Thus, interpersonal rela-

tionships constitute a crucial driving force in the co-development of adolescent depression and NSSI.

Person-centered research supports this view. Vaillancourt and Haltigan [**?**] found that poor peer and parent relationships significantly increased the likelihood of belonging to "low-increasing depression"and "high-decreasing depression" groups compared to the "low-stable depression" group. Domestic researchers Hou and Chen [**?**] examined overall interpersonal stress from parent, teacher, and peer relationships, finding that greater interpersonal stress predicted persistently high depression. Regarding NSSI trajectories, only one large-scale Chinese study (N = 3,381; [**?**]) found that poor peer and parent relationships significantly increased the likelihood of belonging to "low-decreasing," "moderate-decreasing," and "high-stable" NSSI groups, with the highest probability for the "high-stable" trajectory. Notably, no research has examined teacher-student relationships as a predictor of depression and NSSI trajectories, though longitudinal associations between teacher-student relationships and both outcomes [**?**, **?**] suggest independent effects.

In summary, early adolescence represents a critical period for depression and NSSI development. This study adopts a person-centered perspective using latent class growth modeling to examine heterogeneous developmental trajectories of depression and NSSI during junior high school, establish a parallel-process latent class growth model to investigate their joint developmental trajectories, and comprehensively examine risk and protective effects of important interpersonal relationships (parent, peer, and teacher) on these joint trajectories.

2. Method

2.1 Participants and Procedure

The study recruited 890 junior high school students from two ordinary middle schools in Xi' an, Shaanxi Province, with 57.81% males and a mean age of 12.73 ± 0.43 years. The first assessment (T1) occurred in May 2015, with subsequent annual assessments in May, totaling three waves. Due to school transfers and absences, 31 participants were lost at the second and third waves, resulting in a final sample of 859 participants. Attrition analysis revealed no significant differences between retained and lost participants in age ($t(880) = -0.44$, $p = 0.66$), subjective family socioeconomic status ($t(737) = -1.07$, $p = 0.29$), only-child status ($^2(1) = 0.15$, $p = 0.70$), or migrant status ($^2(1) = 2.26$, $p = 0.13$), though gender differed significantly ($^2(1) = 4.73$, $p = 0.03$, Cramer' s $V = 0.08$), with slightly more males lost.

Assessments were conducted in group sessions lasting approximately 30 minutes, administered by trained graduate students. Researchers obtained informed consent from participants and parents one week prior to testing, and small gifts were distributed after each session.

2.2 Measures

2.2.1 Depression Depression was measured using the Chinese version of the Center for Epidemiologic Studies Depression Scale (CES-D; [**?**]), a widely used instrument assessing the frequency of depressive symptoms over the past week. The 20-item scale uses a 4-point rating (1 = rarely or none of the time, 4 = most or all of the time) across four dimensions: depressive affect, positive affect, somatic symptoms/retardation, and interpersonal problems. Positively worded items were reverse-scored, and mean item scores were computed, with higher scores indicating greater depression. Internal consistency coefficients were 0.89, 0.88, and 0.89 at T1, T2, and T3, respectively. Confirmatory factor analysis demonstrated good fit for the four-factor model (T1: CFI = 0.93, TLI = 0.92, RMSEA = 0.06, SRMR = 0.04; T2: CFI = 0.92, TLI = 0.90, RMSEA = 0.06, SRMR = 0.05; T3: CFI = 0.92, TLI = 0.90, RMSEA = 0.07, SRMR = 0.05), confirming adequate reliability and validity.

To describe heterogeneous depression trajectories, low, moderate, and high levels were defined following Ellis et al. [**?**]: mean scores of 1–2 (total 20–40) indicated low depression, 2–3 (total 40–60) moderate depression, and 3–4 (total 60–80) high depression.

2.2.2 Non-Suicidal Self-Injury NSSI was assessed using the Brief Deliberate Self-Harm Inventory (DSHI; [**?**]), which measures nine self-injurious behaviors (hitting, banging, cutting, carving, scratching, poking, burning, biting). Frequency was rated on a 6-point scale: 0, 1, 2, 3, 4, or 5+ times. Mean item scores were computed, with higher scores indicating greater NSSI severity. The measure has demonstrated good reliability and validity in Chinese adolescents [**?**, **?**]. Cronbach' s alphas were 0.92, 0.93, and 0.87 across the three waves. Confirmatory factor analysis indicated good fit for a single-factor model (T1: CFI = 1.00, TLI = 0.99, RMSEA = 0.05, SRMR = 0.01; T2: CFI = 1.00, TLI = 0.98, RMSEA = 0.07, SRMR = 0.01; T3: CFI = 1.00, TLI = 0.98, RMSEA = 0.07, SRMR = 0.01).

To describe heterogeneous NSSI trajectories, low, moderate, and high levels were defined based on prior research [**?**, **?**]: mean scores of 0–1 (total 0–9) indicated low NSSI, 1–3 (total 9–27) moderate NSSI, and 3–5 (total 27–45) high NSSI.

2.2.3 Peer Acceptance Peer acceptance was measured using the Chinese Revised Class Play procedure (RCP; [**?**]). Participants anonymously nominated up to five classmates best fitting the roles "most liked by everyone" and "least liked by everyone." Nomination frequencies were divided by class size minus one, and the difference between positive and negative nominations yielded peer acceptance scores, with higher scores indicating greater acceptance. Peer acceptance was assessed at T1.

2.2.4 Peer Rejection Peer rejection was also measured using the RCP [**?**]. Participants nominated up to five classmates best fitting "gets rejected by others"

and "no one wants to play with them." Nomination frequencies were divided by class size minus one and averaged to create peer rejection scores, with higher scores indicating greater rejection. Peer rejection was assessed at T1.

2.2.5 Friendship Support and Conflict The Network of Relationships Inventory (NRI; [?]) assessed friendship quality through 11 items measuring friendship conflict (e.g., "You and your good friend annoy each other") and friendship support (e.g., "When in trouble, your good friend seeks comfort and support from you"). Items were rated on a 5-point scale (1 = very little, 5 = extremely much), with higher subscale means indicating greater support or conflict. The measure has demonstrated good reliability and validity in Chinese adolescents [?]. Assessed at T1, internal consistency coefficients were 0.86 for support and 0.81 for conflict. Confirmatory factor analysis indicated good fit for the two-factor model (CFI = 0.99, TLI = 0.98, RMSEA = 0.04, SRMR = 0.04).

2.2.6 Teacher Emotional Support Teacher emotional support was measured using six items developed by Song et al. [?] (e.g., "When I encounter academic difficulties, my teacher helps me"). Items were rated on a 5-point scale (1 = strongly disagree, 5 = strongly agree), with higher means indicating greater perceived support. The measure has shown good reliability and validity in Chinese adolescents [?]. Assessed at T1, internal consistency was 0.93, and confirmatory factor analysis demonstrated good fit (CFI = 1.00, TLI = 0.98, RMSEA = 0.08, SRMR = 0.02).

2.2.7 Teacher-Student Conflict Teacher-student conflict was assessed using the conflict subscale of the Teacher-Student Relationship Questionnaire revised by Zou et al. [?], comprising seven items (e.g., "My relationship with my teacher is terrible"). Items were rated on a 5-point scale (1 = strongly disagree, 5 = strongly agree), with higher means indicating greater conflict. Assessed at T1, internal consistency was 0.94, and confirmatory factor analysis showed good fit (CFI = 0.99, TLI = 0.96, RMSEA = 0.11, SRMR = 0.02).

2.2.8 Parental Psychological Control Parental psychological control was measured using the Psychological Control Scale–Youth Self-Report (PCS-YSR; [?]), consisting of eight items (e.g., "My parents always try to change my views or attitudes about things"). Items were rated on a 5-point scale (1 = not at all true, 5 = very true), with higher means indicating greater control. Cross-cultural research has demonstrated good test-retest reliability and construct validity [?]. At T1, Cronbach' s alpha was 0.90, and confirmatory factor analysis indicated good fit (CFI = 0.99, TLI = 0.98, RMSEA = 0.07, SRMR = 0.02).

2.2.9 Parental Emotional Warmth Parental emotional warmth was assessed using the parental warmth subscale from the Parent-Child Interaction Questionnaire [?], measuring perceived paternal and maternal warmth separately (nine items each; e.g., "Does your father/mother tell you he/she loves

you?"). Items were rated on a 4-point scale (1 = never, 4 = always). Paternal and maternal warmth scores were averaged to create an overall parental emotional warmth score, with higher scores indicating greater warmth. Assessed at T1, both subscales had Cronbach' s alphas of 0.89, and confirmatory factor analysis demonstrated good fit for the two-factor model (CFI = 0.96, TLI = 0.95, RMSEA = 0.07, SRMR = 0.04).

2.3 Data Analysis

The analysis proceeded in several steps. First, descriptive statistics examined the developmental trends of depression and NSSI and their correlations with interpersonal variables. Second, separate latent class growth models (LCGM) identified independent developmental trajectories of depression and NSSI across the three-year junior high period. Third, a parallel-process latent class growth model examined joint developmental trajectories. Finally, multinomial logistic regression tested how interpersonal variables predicted joint trajectory class membership. SPSS 23.0 managed data entry and preliminary analyses, while Mplus 8.3 conducted latent class growth modeling.

2.4 Common Method Bias

Despite using peer nomination methods for peer acceptance and rejection at baseline, we controlled and tested for common method bias. Procedural controls included randomizing questionnaire and item order, using reverse-scored items, and ensuring anonymity to reduce demand characteristics [**?**]. Additionally, Harman's single-factor test assessed common method bias before formal analysis. The first common factor explained 19.16% of total variance, below the 40% threshold, indicating no significant common method bias.

3. Results

3.1 Descriptive Statistics

Means, standard deviations, and correlation matrices for all variables are presented in Table 1 . Depression at all three waves correlated significantly with all interpersonal variables. NSSI at all three waves correlated significantly with parental psychological control and teacher-student conflict, but not with peer acceptance, peer rejection, or friendship support. Friendship conflict and parental emotional warmth correlated significantly with NSSI only at T1 and T2.

3.2 Latent Class Growth Analysis of Depression and NSSI

Latent class growth models typically use multiple indices to determine the optimal number of heterogeneous trajectories. Following recommendations [**?**, **?**], we used: (1) Bayesian Information Criterion (BIC), where lower values indicate better fit; (2) Entropy (0–1), where values >0.7 indicate good classification accuracy; (3) Lo-Mendell-Rubin likelihood ratio test (LMR-LRT), where $p < 0.05$

supports the K-class model over the (K-1)-class model; (4) Bootstrap likelihood ratio test (BLRT), where $p < 0.05$ supports the K-class model, taking precedence over LMR-LRT when results conflict; and (5) each subgroup comprising $ $3% of the sample.

Unconditional LCGMs were estimated for depression and NSSI separately, extracting 1–5 latent classes. For depression, the 5-class model included a subgroup representing only 2% of the sample and was therefore rejected. BIC decreased with increasing classes, entropy exceeded 0.7 for all models, BLRT supported adding classes, and LMR-LRT indicated that only the 2- and 4-class models were acceptable. Thus, the 4-class model was selected as optimal. For NSSI, from the 4-class model onward, some subgroups comprised <1% of the sample, leading to rejection of the 4- and 5-class models. BIC decreased with more classes, entropy exceeded 0.7, BLRT supported additional classes, and LMR-LRT indicated that beyond the 2-class model, additional classes did not improve fit. Thus, the 3-class model was selected as optimal.

The 4-class depression model identified: (1) "Low-stable depression" (64% of sample) with consistently low scores across three years (intercept $I = 1.45$, $p < 0.001$; slope $S = -0.01$, $p = 0.48$); (2) "Low-increasing depression" (22%) with low initial levels that increased over time ($I = 1.83$, $p < 0.001$; $S = 0.18$, $p < 0.001$); (3) "Moderate-decreasing depression" (9%) with moderate initial levels that declined ($I = 2.40$, $p < 0.001$; $S = -0.40$, $p < 0.001$); and (4) "Moderate-increasing depression" (5%) with moderate initial levels that increased ($I = 2.53$, $p < 0.001$; $S = 0.22$, $p = 0.01$) (see Figure 1 [Figure 1: see original paper]).

The 3-class NSSI model identified: (1) "Low-stable NSSI" (92%) with minimal levels throughout ($I = 0.11$, $p < 0.001$; $S = 0.01$, $p = 0.54$); (2) "Low-increasing NSSI" (3%) with low initial levels that increased substantially ($I = 0.97$, $p = 0.03$; $S = 1.00$, $p < 0.001$); and (3) "Moderate-decreasing NSSI" (5%) with moderate initial levels that declined ($I = 2.52$, $p < 0.001$; $S = -1.09$, $p < 0.001$) (see Figure 2 [Figure 2: see original paper]).

3.3 Parallel-Process Latent Class Growth Analysis

A parallel-process LCGM examined joint developmental trajectories, extracting 1–6 latent classes. From the 4-class model onward, some subgroups comprised only six individuals (0.7% of the sample), leading to rejection of the 4-, 5-, and 6-class models. BIC decreased with more classes, entropy exceeded 0.7 for all models, BLRT supported additional classes, and LMR-LRT indicated the 3-class model was acceptable. Considering both statistical fit and practical interpretability, the 3-class model was selected as optimal.

The 3-class joint trajectory model identified: (1) "Low depression-low NSSI-stable" (91%) with consistently low levels across three years (depression intercept $I_{dep} = 1.63$, $p < 0.001$; NSSI intercept $I_{nssi} = 0.10$, $p < 0.001$; depression slope $S_{dep} = 0.00$, $p = 0.79$; NSSI slope $S_{nssi} = 0.00$, $p = 0.62$); (2) "Moderate depression-moderate NSSI-decreasing" (5%) with moder-

ate initial levels that declined together (I_{dep} = 2.36, p < 0.001; I_{nssi} = 2.48, p < 0.001; S_{dep} = -0.21, p < 0.001; S_{nssi} = -1.09, p < 0.001); and (3) "Low depression-low NSSI-increasing" (4%) with low initial levels that increased together (I_{dep} = 2.04, p < 0.001; I_{nssi} = 0.79, p = 0.002; S_{dep} = 0.23, p = 0.01; S_{nssi} = 0.90, p < 0.001). Table 4 presents mean depression and NSSI levels for each class across the three waves.

3.4 Interpersonal Predictors of Joint Developmental Trajectories

Multinomial logistic regression examined how early interpersonal factors (peer acceptance/rejection, parental warmth, parental psychological control, teacher support/conflict) predicted joint trajectory class membership, using T1 interpersonal factors as predictors and joint trajectory class as the outcome. Class 1 ("Low depression-low NSSI-stable") served as the reference group in initial comparisons, followed by Class 2 ("Moderate depression-moderate NSSI-decreasing") as the reference group for subsequent comparisons.

Results (Table 5) showed that parental psychological control and peer acceptance at T1 significantly predicted three-year joint developmental trajectories. Compared to the "Low-stable" class, higher parental psychological control increased the odds of belonging to both the "Moderate-decreasing" class (OR = 1.84) and the "Low-increasing" class (OR = 1.70). Higher peer acceptance decreased the odds of belonging to the "Low-increasing" class (OR = 0.20). Compared to the "Moderate-decreasing" class, higher baseline peer acceptance also decreased the odds of belonging to the "Low-increasing" class (OR = 0.17).

4. Discussion

4.1 Characteristics of Independent Developmental Trajectories

This study identified four heterogeneous depression trajectories in early adolescence: "low-stable," "low-increasing," "moderate-increasing," and "moderate-decreasing," consistent with previous research [**?**, **?**]. These findings suggest that adolescent depression development follows three basic patterns: "low-stable," "increasing," and "decreasing." With larger samples and more assessment points, researchers can identify more nuanced subgroups within these basic patterns. For example, Costello et al. [**?**] distinguished a "no depression" subgroup within the "low-stable" pattern in a sample of 11,559 adolescents, while Ellis et al. [**?**] identified both "moderate-decreasing" and "high-decreasing" trajectories in a seven-year study. This study differentiated "low-increasing" and "moderate-increasing" subgroups within the increasing pattern.

Additionally, this study identified three NSSI trajectories: "low-stable," "low-increasing," and "moderate-decreasing," showing both similarities and unique features compared to prior work. Consistent with previous findings, most adolescents maintained low NSSI levels long-term [**?**, **?**, **?**]. The "moderate-decreasing" trajectory replicated earlier results [**?**, **?**, **?**]. Critically, this study is the first

to identify an increasing NSSI trajectory in a general early adolescent sample, highlighting early adolescence as a key developmental window when some youth face escalating NSSI risk.

4.2 Characteristics of Joint Developmental Trajectories

This study confirmed three joint developmental trajectories of depression and NSSI: "low depression-low NSSI-stable," "moderate depression-moderate NSSI-decreasing,"and "low depression-low NSSI-increasing."The "Low-stable"class was largest (91%), maintaining low levels throughout. The "Moderate-decreasing" class (5%) began with moderate levels that declined together. The "Low-increasing"class (4%) started low but increased together. These findings support the functional model of NSSI [**?**, **?**].

Specifically, adolescents in the "Low-stable" class could manage negative emotions without NSSI or with minimal exploratory NSSI [**?**, **?**]. Their extremely low NSSI levels (M_{T1} = 0.10, SD_{T1} = 0.24; M_{T2} = 0.19, SD_{T2} = 0.55; M_{T3} = 0.10, SD_{T3} = 0.25) suggest some never engaged in NSSI, successfully using general emotion regulation strategies [**?**]. Teaching cognitive reappraisal and problem-solving skills could help these youth reduce depression and NSSI [**?**, **?**]. For the "Low-increasing" class, escalating depression reflected failed emotion regulation strategies, prompting parallel increases in NSSI for immediate relief. For the "Moderate-decreasing"class, declining depression reduced the functional value of moderate NSSI frequency, leading to parallel decreases. Thus, depression and NSSI show developmental synchrony in early adolescence.

Furthermore, research shows that depression and NSSI synchronize developmentally with other adolescent adjustment problems like perfectionism and suicidal ideation [**?**, **?**]. Combined with our findings, this suggests a fundamental commonality underlying different adolescent adjustment problems. On one hand, researchers should treat adolescent problems cautiously, as seemingly minor issues (e.g., shyness) may accompany severe disorders (e.g., depression, NSSI). On the other hand, identifying and addressing the most central adjustment problems could promote healthy development most efficiently [**?**].

4.3 Interpersonal Predictors of Joint Developmental Trajectories

This study found that high early peer acceptance significantly increased the likelihood of belonging to the "Moderate-decreasing" and "Low-stable" classes compared to the "Low-increasing" class, indicating that peer acceptance serves as a protective factor against depression and NSSI. Group socialization theory emphasizes that adolescents complete socialization tasks within peer groups [**?**], and high peer acceptance reflects elevated social status and group inclusion, representing a protective factor for social adjustment [**?**]. Research indicates that highly accepted individuals maintain advantageous peer status throughout adolescence [**?**, **?**], significantly reducing depression risk [**?**], while peer rejection increases depression risk [**?**]. Although no study has examined peer relationships

and NSSI trajectories specifically, variable-centered research shows that peer acceptance and rejection predict NSSI [**?**, **?**]. Thus, peer acceptance appears to be a protective factor for joint depression-NSSI trajectories.

This study also found that high early parental psychological control increased the likelihood of belonging to both the "Moderate-decreasing" and "Low-increasing" classes compared to the "Low-stable" class. As a maladaptive parenting practice that intrudes on adolescents' inner world, parental psychological control impairs social functioning [**?**, **?**] and represents a high-risk factor for depression and NSSI [**?**, **?**]. However, why would high parental psychological control also increase likelihood of the "Moderate-decreasing" class? To examine this unexpected finding, we conducted supplementary analyses. First, controlling for parental psychological control at T2 and T3, logistic regression still showed that high early parental psychological control increased odds of belonging to the "Low-increasing" class (OR = 1.73*, 95% CI = [1.09, 2.76]), ruling out false positives. Second, we examined developmental changes in perceived parental psychological control. Desjardins and Leadbeater [**?**] noted that increasing adolescent autonomy and changing parent-child interaction patterns lead to significant declines in perceived parental psychological control across adolescence, while parental warmth increases. Rogers et al. [**?**] identified a meaningful "decreasing" trajectory of perceived parental psychological control. Our analysis revealed that the "Moderate-decreasing" class also showed a "moderate-decreasing" trajectory of perceived parental psychological control (I = 3.16, 90% CI = [2.87, 3.46]; S = -0.23, 90% CI = [-0.45, -0.03]). Thus, decreases in depression and NSSI in this class may result from declining perceived parental psychological control under new parent-adolescent interaction patterns. Overall, parental psychological control represents a risk factor for joint depression-NSSI trajectories.

Teacher-student relationships did not significantly predict joint trajectories, possibly because teacher-adolescent interaction frequency and depth are relatively limited compared to parents and peers during junior high, resulting in smaller effects on adjustment outcomes [**?**]. Alternatively, teacher-student relationships may primarily influence school adjustment (e.g., academic performance) [**?**, **?**] rather than emotional or behavioral adjustment. Teacher-student relationships may also moderate effects of parent and peer relationships on adjustment [**?**], such as moderating direct effects of parent-child relationships on subjective well-being and mediating pathways through peer relationships [**?**]. Due to design limitations, this hypothesis requires future investigation.

4.4 Strengths and Limitations

This study's dynamic perspective on independent and joint developmental trajectories of early adolescent depression and NSSI offers specific insights. Additionally, this first comprehensive examination of interpersonal risk and protective factors for joint trajectories has practical value for intervention research.

Several limitations warrant mention. First, the sample size may be insufficient for finely distinguishing joint trajectories. Larger samples could identify five or more heterogeneous depression trajectories [**?**] and differentiate varying rates of increase or decrease within the same trajectory pattern. Future research should expand sample sizes for more nuanced identification of joint trajectories. Second, this study focused only on early adolescence (junior high). Increased autonomy, interpersonal changes, and academic pressures during senior high may affect depression and NSSI development. Future studies should extend tracking throughout adolescence. Third, this study did not examine gender differences in joint trajectories. Although research shows gender differences in depression trajectories [**?**], gender differences in NSSI trajectories remain unexamined. Future research should explore gender differences in NSSI trajectories and, if present, examine gender-specific joint trajectories.

5. Conclusion

Early adolescents exhibit four heterogeneous depression trajectories and three NSSI trajectories. Their joint development follows three heterogeneous trajectories: "low depression-low NSSI-stable," "low depression-low NSSI-increasing," and "moderate depression-moderate NSSI-decreasing." Parental psychological control and peer acceptance represent risk and protective factors, respectively, for these joint developmental trajectories.

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Appendices

Appendix 1: Center for Epidemiologic Studies Depression Scale (CES-D)

Below are some feelings and behaviors you may have experienced. Please indicate how often you experienced each during the past week.

Please respond to each statement:
1. I was bothered by things that usually don’ t bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake off the blues even with help from my family.
4. I felt I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt that everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life had been a failure.
10. I felt fearful.
11. My sleep was restless.

12. I was happy.
13. I talked less than usual.
14. I felt lonely.
15. People were unfriendly.
16. I enjoyed life.
17. I had crying spells.
18. I felt sad.
19. I felt that people disliked me.
20. I could not get "going."

Appendix 2: Deliberate Self-Harm Inventory (DSHI)

Below are some behaviors you may have engaged in during the past 6 months. Please read carefully and circle the number that best describes how many times you have done each behavior.

Number of times: 0 | 1 | 2 | 3 | 4 | 5 or more
1. Intentionally bruised yourself (e.g., by hitting or banging).
2. Intentionally prevented wounds from healing.
3. Cut your arms or other areas to draw blood.
4. Carved words or designs into your skin.
5. Cut your wrists, arms, or torso.
6. Intentionally scratched yourself severely enough to draw blood.
7. Stuck sharp objects into your skin.
8. Burned yourself with cigarettes, lighters, or matches.
9. Intentionally bit yourself hard enough to break skin.

Appendix 3: Network of Relationships Inventory (NRI)

The following describe behaviors between you and your good friend. Please circle the number that best describes your actual situation.

1. You and your good friend often annoy each other.
2. When in trouble, your good friend seeks comfort and support from you.
3. You and your good friend feel annoyed by each other' s actions.
4. When in trouble, you seek comfort and support from your good friend.
5. You and your good friend blame and put each other down.
6. You provide support for your good friend.
7. You and your good friend say hurtful things to each other.

8. You feel happy when with your good friend.
9. You and your good friend disagree or argue about some issues.
10. Your good friend provides support for you.
11. You and your good friend often have conflicts.

Appendix 4: Teacher Emotional Support Questionnaire

The following describe behaviors between teachers and students. Please circle the response that best describes your actual situation.

1. My teacher never ignores students' opinions.
2. My teacher treats every student fairly.
3. My teacher knows which areas I am weak in and need help with.
4. My teacher often helps students.
5. When I encounter academic difficulties, my teacher helps me.
6. My teacher wants us to study hard.

Appendix 5: Teacher-Student Conflict Questionnaire

The following describe behaviors between teachers and students. Please circle the response that best describes your actual situation.

1. My teacher and I always seem to be struggling against each other.
2. My relationship with my teacher is terrible.
3. I feel my teacher treats me unfairly.
4. My teacher and I often disagree and sometimes argue.
5. I feel angry about my teacher' s punishments and sometimes resist them.
6. I feel my teacher is always punishing and criticizing me.
7. Interacting with my teacher makes me feel exhausted.

Appendix 6: Parental Psychological Control Questionnaire

The following describe behaviors between you and your parents. Please circle the number that best describes your actual situation.

1. Whenever I have something to say, my parents change the subject.
2. My parents never let me finish what I' m saying.
3. My parents often interrupt me when I' m speaking.
4. My parents often act as if they know what I' m thinking or feeling.
5. My parents always try to instill in me what I should think or feel about things.
6. My parents always try to change my views or attitudes about things.
7. My parents blame me for other family members' problems.
8. When my parents want to criticize me, they always bring up past mistakes.

Appendix 7: Parental Emotional Warmth Questionnaire

The following describe your relationship with your father/mother. Please circle the response that best describes his/her actual behavior. Your relationships with your father and mother may differ; please answer separately.

1. Does your parent help you with important matters?
2. Does your parent let you know they care about you?
3. Does your parent listen carefully to your point of view?
4. Does your parent show you support and understanding?
5. Does your parent show you affection?
6. Do you laugh together when something funny happens?
7. Does your parent let you know they appreciate you, your ideas, or what you do?
8. Does your parent tell you they love you?
9. Does your parent understand how you see things?

Note: Figure translations are in progress. See original paper for figures.