Current Psychology (2024) 43:25201–25214
https://doi.org/10.1007/s12144-024-06184-1

Trajectories of positive and negative affect and state hope and their relationship with mental health among male adolescents in a juvenile correctional institution in China

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Accepted: 21 May 2024 / Published online: 18 June 2024

Abstract

Positive affect and hope contribute to individuals' psychological adjustment and positive youth development. The purpose of the study was to examine growth in positive and negative affect as well as state hope in Chinese adolescents in a juvenile correctional institution. We also investigated whether distinct trajectories of affect and hope predicted mental health and externalizing, internalizing, and prosocial behavior. The study included 198 male adolescents in a Chinese juvenile correctional institution and comprised nine measurement points (T1-T9) which were one week apart, respectively. Positive and negative affect and state hope were assessed from T1 to T8, and mental health and internalizing, externalizing, and prosocial behavior were measured at T9. Analyses of latent growth curve and latent class growth models were estimated. It was found that positive and negative affect, as well as state hope, decreased over time. Youth in classes characterized by higher state hope and lower negative affect reported better mental health than youth in classes characterized by lower levels of these constructs. Because of the beneficial effects of lower negative affect and higher state hope on mental health and internalizing, externalizing, and prosocial behavior, interventions strengthening hope and reducing negative affect may promote positive youth development in juvenile correctional institutions.

Keywords State hope · Mental health · Adolescence · Delinquency · China

The life trajectories of adolescents in detention are often characterized by adverse childhood experiences, trauma, and social disadvantages (Barnert et al., 2016; Hughes et al., 2020). Past research has also shown that those adolescents are especially vulnerable to mental disorders compared to the general adolescent population (see Fazel et al., 2008, for a meta-analysis). Recent studies and reviews have yielded alarmingly high rates of up to 95% of psychiatric disorders, including depression, anxiety, substance use, and conduct problems, for adolescents in detention globally (see Beaudry et al., 2021; Borschmann et al., 2020, for reviews), and in China (Xie et al., 2024; Zhou et al., 2012), where the current study was conducted. Considering the link between poor mental health and adverse outcomes, such as suicidal behaviors (Gili et al., 2019), prevention and intervention programs are of utmost importance for adolescents in detention to establish mental well-being and prevent recidivism. For the development of effective evidence-based programs, it is, however, essential to understand risk and protective factors as well as to identify which groups are especially vulnerable. Past research with general youth samples showed that both positive and negative affect, as well as hope, are associated with mental health and internalizing, externalizing, and prosocial behavior (e.g., dos Santos-Lopes-Santos et al., 2018; Padilla-Walker et al., 2011). However, studies predominantly examined dispositional (i.e., trait) hope and, to a lesser extent, hope linked to specific situations (i.e., state

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hope), and that mostly in general adolescent populations. Evidence on trajectories of affect and state hope among youth who exhibit delinquent behavior is scarce. Therefore, the present study sought to examine trajectories of positive and negative affect as well as state hope among male adolescents in a Chinese juvenile correctional institution over eight weeks. Following a person-centered approach, we further examined whether different classes (groups) of youth were characterized by distinct growth trajectories, and how class membership differentially predicted mental health and externalizing, internalizing, and prosocial behavior measured eight weeks after the baseline assessment.

Mental health and externalizing, internalizing, and prosocial behavior in adolescents exhibiting delinquent behavior

According to the World Health Organization (WHO, 2018), mental health is defined as "a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community" (paragraph 2). Numerous studies examined psychiatric disorders of adolescents exhibiting delinquent behavior because they represent an especially vulnerable group in terms of poor mental health (see Beaudry et al., 2021, for a review and meta-regression analysis; Hein et al., 2017). In line with this, a large body of studies has consistently demonstrated that adolescents in the juvenile justice system are more likely to be diagnosed with an internalizing and externalizing psychiatric disorder, such as major depression, attention-deficit/hyperactivity disorder, and conduct disorder, compared to the general adolescent population, both globally and in China (Beaudry et al., 2021; Zhou et al., 2012, 2014). Moreover, the same studies showed that especially high prevalence rates of up to 86.8% were found for conduct disorders, which, in turn, were related to juvenile recidivism (see Wibbelink et al., 2017, for a meta-analysis). Taken together, past research indicated that adolescents in detention are highly vulnerable to mental disorders, especially externalizing ones, which may promote an adult criminal career. However, little research attention has been paid to the strengths of adolescents in correctional settings, such as prosocial behavior (Samper et al., 2021). The experimental studies by Birkeland et al. (2014) suggested that adult offenders and non-offenders do not differ in their prosocial behavior. However, other studies with adolescents found negative associations between delinquency and prosocial behavior (see Memmott-Elison et al., 2020, for a meta-analysis). To our knowledge, none of these studies focusing on prosocial behavior in adolescents exhibiting delinquent behavior have been carried out in non-Western contexts. Hence, there is a need to study delinquent adolescents' mental health and behavior more closely, particularly over time, as this may contribute to developing evidence-based prevention efforts.

Trajectories of negative and positive affect

Trait and state mood are characterized by two dimensions, namely positive and negative affect (Watson et al., 1988a, 1988b). Positive affect refers to positive emotional experiences, such as happiness and satisfaction, and an overall sense of well-being, whereas negative affect includes a wide range of negative emotions, such as sadness and loneliness. With regard to adolescents in detention, a Spanish study found higher levels of anger, emotional instability, and anxiety in detained adolescents than in a non-offending comparison group (Mestre et al., 2017). Furthermore, a qualitative study with a sample of male adolescents in an Australian maximum-security detention facility revealed several negative emotions, including sadness, loneliness, frustration, and boredom (Ashkar & Kenny, 2008).

Due to the reorganization of affective systems during adolescence (Coe-Odess et al., 2019), changes in positive and negative affect are expected during adolescence. However, little is known about the directionality and magnitude of trajectories, and even less in high-risk samples. Assessing mood using daily diary assessments over 15 weeks of assessment across five years, Maciejewski et al. (2015) followed 474 Dutch adolescents from age 13 to age 18. Using latent growth curve modeling, positive (happiness) and negative affect (anger and sadness) linearly declined in this age period, whereas anxiety, after an initial increase, decreased in middle adolescence and slightly increased in late adolescence. More recently, Griffith et al. (2021) examined developmental trajectories of positive and negative affect in a sample of 665 youth in the United States (U.S.) aged 9 to 16 years (at baseline) at three time points, namely every 18 months over three years. Positive affect gradually decreased from middle childhood to late adolescence, whereas a non-linear pattern with increases and decreases over time was found for negative affect. Taken together, past studies that examined trajectories of affect over several years suggest that affect in adolescence is marked by a decline in positive affect and non-linear growth in negative affect. However, little is known about trajectories in shorter time periods, especially among adolescents in detention. Studying shorter time periods may better reveal how affect changes (or not) and may provide entry points for prevention programs, particularly considering the high rate of psychiatric disorders and negative emotions among adolescents in detention. Moreover, the time spent in detention varies substantially

for justice-involved youth in general and for our sample in particular (from 40 to 945 days). The information about a youth's goal-directed energy (agency, a crucial component of hope) may not be readily available to inform targeted intervention if assessments span long periods (e.g., months). Indeed, there have been recent attempts to understand the developmental dynamics of hope using an experience sampling technique that assesses agency and pathway thinking daily over seven days (Merolla et al., 2021). The authors found that within-person trajectories of state hope were related to more constructive conflict management strategies. Therefore, shorter intervals of measurement are preferred to reliably detect short-term changes in affect, hope, and mental health.

Associations between negative and positive affect and mental health, externalizing, internalizing, and prosocial behavior

Several studies investigated the associations between affect and psychological outcomes in general adolescent populations. For instance, Sánchez-García et al. (2018) found, in a sample of 1,664 Spanish adolescents aged 14 to 19 years, that positive affect was negatively linked to emotional and behavioral difficulties, whereas negative affect was positively linked to emotional and behavioral difficulties. Similarly, in a study with Portuguese adolescents ($N = 696$), positive affect was negatively associated with behavioral (externalizing) problems and emotional (internalizing) symptoms, but a positive link was found with prosocial behavior (dos Santos-Lopes-Santos et al., 2018). Also, negative affect was positively linked to behavioral (externalizing) problems and emotional (internalizing) symptoms, whereas the relationship between negative affect and prosocial behavior was nonsignificant. Although those associations have been found for general adolescent samples, the same links could be expected for adolescents in detention. Beyond positive and negative affect, hope has been identified as a predictor of mental health and plays an important role in positive youth development (Schmid Callina et al., 2015), as explained in the next sections.

Trajectories of hope

Hope is defined as "a positive motivational state that is based on an interactively derived sense of successful (a) agency (goal-directed energy) and (b) pathways (planning to meet goals)" (Snyder et al., 1991, p. 287). Hope is widely recognized as exerting a positive impact on various areas of development, such as school performance and emotional well-being (Ciarrochi et al., 2015; Marques et al., 2017). When individuals can achieve their goals via various means and show high levels of determination and motivation, they tend to experience a strong sense of hope and approach life positively (Snyder, 2000). For adolescents in detention, past research has indicated that they report various goals and aspirations for the future (Le et al., 2023), often hoping to "have a normal life and to be happy 1 day" (Van Hecke et al., 2019, p. 7).

Regarding trajectories of hope in adolescence, past research has produced mixed evidence. In a study with 196 adolescents ($M = 14.30$ years, $SD = 0.32$) from Fiji, dispositional hope was assessed four times over two years (Phan, 2013). The developmental trajectory of hope was characterized by an increase from the first to the third assessment, spanning 14 months, followed by a decrease in hope at the fourth assessment. Another study with 381 Chinese high school students aged 16 to 19 years assessed state hope four times over a one-year period and revealed three latent classes of hope (high, moderate, and low; Yin et al., 2019). In the groups of youth with high hope (40.4% of participants) and moderate hope (52.0% of participants), the levels of hope remained stable over time, whereas the levels of hope significantly decreased in the low-hope group (7.6% of participants) (Yin et al., 2019). Understanding how hope changes over short periods of time may present an important precondition to improving adolescents' health and well-being, as explained below.

Associations between hope and mental health, externalizing, internalizing, and prosocial behavior

Hope is an important factor in predicting psychological adjustment, such as emotional well-being, because more hopeful individuals are more likely to focus on things around them that are positive and face fewer actual or perceived barriers than those who are less hopeful (Ciarrochi et al., 2015; Valle et al., 2006). A study by Padilla-Walker et al. (2011) revealed that dispositional hope was positively linked to prosocial behavior and negatively linked to delinquency and internalizing behavior in 9-to-14-year-old children and adolescents. Similarly, Valle et al. (2006) found that dispositional hope was negatively associated with internalizing and externalizing behaviors assessed one year later. Taken together, research suggests that trait (i.e., dispositional) hope can be understood as a protective factor against numerous adverse outcomes (Jiang et al., 2018).

The current study

Past research has shown that adolescents in detention present a vulnerable group in terms of a heightened risk for psychiatric disorders and high levels of negative emotions such as anger, frustration, sadness, and loneliness (Ashkar & Kenny, 2008; Borschmann et al., 2020; Mestre et al., 2017). Nonetheless, they present a strong hope for a better life (Le et al., 2023), which could be used as a resource.

Because poor mental health is considered a risk factor for further negative life outcomes, for example, a higher risk of suicide (Gili et al., 2019) and recidivism (Wibbelink et al., 2017), it is important to foster mental health. One possibility to do so is to strengthen factors associated with well-being and mental health. Particularly, positive and negative affect, as well as hope, are important contributors to individuals' psychological adjustment (Snyder, 2002). Also, hope plays an important role in positive youth development (Schmid Callina et al., 2015). Hence, affect and hope may be understood as resources for improving mental health in (delinquent) adolescents. However, little is known about affect and hope in this group of youth, especially about short-term growth. Also, there is little evidence on youth with potentially different growth of affect and hope over time and how this growth relates to mental health. Hence, these gaps in past literature were addressed in the current study.

The study was conducted in a juvenile correctional institution. In China, adolescents between 14 and 18 years of age are held criminally liable and are sent to juvenile correctional institutions that aim at educational rehabilitation (Ren et al., 2021). We included male adolescents only because substantially more males than females are in Chinese correctional institutions (World Prison Brief, 2021), underlining the need to put a special focus on this group. Also, at the time of our data collection, there were only four detained girls.

The main aim of this study was to examine growth in positive and negative affect as well as state hope (pathways and agency) in Chinese adolescents in a juvenile correctional institution measured weekly over eight weeks (T1 to T8). In addition, we investigated whether distinct trajectories of positive and negative affect as well as state hope predicted mental health and externalizing, internalizing, and prosocial behavior measured eight weeks after T1 (T9). First, following a variable-centered approach, we examined the functional form of growth using latent growth curve analysis (LGCA). Based on past longitudinal studies (Griffith et al., 2021; Maciejewski et al., 2015), we hypothesized a decline in positive affect. Regarding negative affect and state hope, past research covering longer periods than the current study found non-linear changes (Griffith et al., 2021; Maciejewski et al., 2015; Phan, 2013). The confined correctional setting of the current study can lead to experiencing a loss of autonomy and dislocation from their primary caregivers (Ashkar & Kenny, 2008). Thus, we expected an increase in negative affect and a decrease in state hope over the eight weeks of measurement (Schnittker et al., 2012).

Second, following a person-centered approach, we sought to identify whether youth were characterized by distinct trajectories of positive and negative affect as well as state hope over time using latent class growth analysis (LCGA). Based on prior research on state hope in China (Yin et al., 2019), we expected to find three groups characterized by high, moderate, and low initial levels of affect and state hope, respectively.

Third, we examined the longitudinal associations between class membership, determined by the LCGA, mental health and externalizing, internalizing, and prosocial behavior. We hypothesized that youth groups (i.e., classes) high in positive affect and state hope would report better mental health, less externalizing and internalizing behavior, and more prosocial behavior compared to youth groups with low or moderate scores of positive affect and state hope. Furthermore, we expected that youth groups high in negative affect would report lower mental health, more externalizing and internalizing behavior, and less prosocial behavior than the moderate and low negative affect groups.

Methods

Participants

The initial sample consisted of $N = 200$ males in a juvenile correctional institution in China. Participants older than 18 years ($n = 2$) were excluded, given the focus on adolescents, resulting in a final sample of $N = 198$. Their age ranged from 14 to 18 years, with a mean age of 16.4 years ($SD = 0.85$). At the first measurement, the average duration of stay in the juvenile correctional institution was 305.1 days ($SD = 191.24$, range 40–945 days). They were detained due to different crimes, such as robbery, rape, and intentional injury.

Study design and procedure

The present study took place in a Chinese juvenile correctional institution that aims at detaining and rehabilitating adolescents who committed criminal acts (Xie et al., 2024). The study comprised nine measurement points (T1-T9) which were one week apart, respectively. From T1 to T8, we assessed state hope (agency and pathways) and positive and negative affect at each time point. At the final measurement point, T9, mental health and internalizing, externalizing,

and prosocial behavior were measured. Each participant completed the pencil-paper questionnaire in the juvenile correctional institution. The duration of data collection at each time point was about 10 min. Study participation was voluntary, and participants did not receive any compensation. Attrition was low, with only seven participants not taking part in the measurement at T9. We obtained informed consent from the participants. The participants were given information about the aims and content of the study, and all information was confidential. Participants were informed that refusal to participate in this study would not influence their judicial status. The study was approved by the ethics committee of Tianjin University.

Table 1 Means, standard deviations, and Cronbach's alphas of study variables

	Time point	α	*M* (*SD*)
Positive affect	T1	0.66	0.93 (0.68)
	T2	0.69	0.82 (0.67)
	T3	0.71	0.76 (0.70)
	T4	0.74	0.72 (0.70)
	T5	0.77	0.60 (0.70)
	T6	0.70	0.62 (0.64)
	T7	0.77	0.57 (0.68)
	T8	0.73	0.56 (0.64)
Negative affect	T1	0.77	0.54 (0.62)
	T2	0.82	0.51 (0.65)
	T3	0.81	0.44 (0.61)
	T4	0.83	0.40 (0.59)
	T5	0.84	0.42 (0.64)
	T6	0.85	0.40 (0.62)
	T7	0.84	0.39 (0.60)
	T8	0.84	0.40 (0.62)
State hope: Agency	T1	0.62	5.55 (1.30)
	T2	0.68	5.27 (1.37)
	T3	0.61	5.15 (1.30)
	T4	0.70	5.14 (1.37)
	T5	0.72	5.05 (1.40)
	T6	0.70	4.90 (1.43)
	T7	0.61	4.95 (1.33)
	T8	0.67	4.76 (1.44)
State hope: Pathways	T1	0.80	5.35 (1.38)
	T2	0.80	5.07 (1.39)
	T3	0.82	4.84 (1.38)
	T4	0.86	4.97 (1.48)
	T5	0.84	4.78 (1.44)
	T6	0.85	4.77 (1.52)
	T7	0.86	4.73 (1.53)
	T8	0.91	4.60 (1.57)
Mental health	T9	0.90	4.08 (0.95)
Externalizing behavior	T9	0.69	5.41 (2.98)
Internalizing behavior	T9	0.56	5.26 (2.53)
Prosocial behavior	T9	0.64	6.63 (1.80)

Positive and negative affect ranged from 0 to 3; agency and pathways from 1 to 8; mental health from 1 to 6; externalizing and internalizing behavior from 0 to 20; prosocial behavior from 0 to 10

Measures

For the translation of the measures, standard back translation procedures were used. This involved a translation from the English items into Chinese, which were then translated back into English by fluent speakers of both languages.

Positive and negative affect Positive and negative affect were assessed with a short scale adapted from the Positive and Negative Affect Scales (PANAS; Watson et al., 1988a, 1988b), using three items to measure positive affect (happy, satisfied, excited) and four items to measure negative affect (nervous, sad, afraid, lonely). Response options ranged from 0 (*not at all*) to 3 (*extremely*). Cronbach's alphas were at least 0.66 for positive and 0.77 for negative affect (see Table 1 for Cronbach's alpha at each time point). A confirmatory factor analysis (CFA) showed that the one-factor solution for negative affect at T1 fit the data well, χ^2 (2) = 5.79, p = .055, CFI = 0.963, RMSEA = 0.100, 90% CI [0.000, 0.199], SRMR = 0.040. The three-item positive affect scale is just-identified, and consequently could not be tested for unidimensionality. Mean scores were computed for both positive and negative affect.

State hope State hope was measured with the six-item State Hope Scale developed by Snyder et al. (1996), comprising two subscales: (1) *Pathways* (example item: "If I should find myself in a jam, I could think of many ways to get out of it."); and (2) *Agency* (example item: "Right now, I see myself as being pretty successful."). Each scale consists of three items, and responses were made on an eight-point scale ranging from 1 (*definitely false*) to 8 (*definitely true*). Cronbach's alphas were at least 0.80 for the pathways and 0.61 for the agency subscales (see Table 1 for Cronbach's alpha at each time point). Because agency and pathways were assessed by three items, the scale's unidimensionality could not be tested. Mean scores were computed for both subscales.

Mental health Participants' mental health was measured by the short form of the Mental Health Continuum (MHC-SF) developed by Keyes (2002, 2005). The scale comprises 14 items and assesses emotional (e.g., "satisfied with life"), social (e.g., "that you had something important to contribute to society"), and psychological well-being (e.g., "that you liked most parts of your personality") in the last month. Responses were made on a six-point scale that ranged from 1 (*never*) to 6 (*every day*). A CFA demonstrated that the one-factor solution had a good fit, χ^2 (72) = 132.88, p < .001, CFI = .931, RMSEA = .067, 90% CI [.048, .084], SRMR = .060. Based on the good internal consistency of the

14 items (α = .90) and the scale's unidimensionality, a total mean score was computed.

Externalizing, internalizing, and prosocial behaviors Externalizing, internalizing, and prosocial behaviors were assessed using the 25-item self-report Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). This questionnaire covers emotional symptoms, peer problems, conduct problems, hyperactivity, and, as a dimension of strengths, prosocial behavior with five items each. The subscales measuring conduct problems and hyperactivity were combined into an *externalizing* subscale, while emotional symptoms and peer problems were combined into an *internalizing* subscale (Goodman et al., 2010). SDQ items were rated on a three-point scale that ranges from 0 (*not true*) to 2 (*certainly true*). Three separate CFAs confirmed the unidimensionality of the SDQ subscales measuring externalizing behavior (χ^2 (34) = 49.37, p = .043, CFI = 0.925, RMSEA = 0.049, 90% CI [0.009, 0.077], SRMR = 0.058), internalizing behavior (χ^2 (31) = 38.53, p = .166, CFI = 0.946, RMSEA = 0.036, 90% CI [0.000, 0.069], SRMR = 0.056), and prosocial behavior (χ^2 (5) = 5.25, p = .386, CFI = 0.997, RMSEA = 0.016, 90% CI [0.000, 0.104], SRMR = 0.031). Cronbach's alphas were 0.69 for the externalizing, 0.56 for the internalizing, and 0.64 for prosocial subscales. For each subscale, a sum score was computed.

Data analysis

LGCA and LCGA for positive and negative affect and state hope were carried out with Mplus (version 8.6; Muthén & Muthén, 1998–2017). For all analyses, the robust maximum likelihood (MLR) estimator was used. Overall, 4% or less of the data were missing. Missing data were handled by full information maximum likelihood (FIML) estimation, a state-of-the-art approach for dealing with missing data (Enders, 2010). Following recommendations by Wickrama et al. (2022), we first estimated latent growth curve models, which was then followed by LCGA.

Regarding LGCA, change over the eight time points (T1-T8) was modeled as (1) a latent intercept factor, estimating interindividual differences in baseline scores, and (2) a latent slope factor, which captures the average growth. We tested models with both linear and quadratic slope factors to determine the functional form of change that best represents the trajectory of each variable. The factor loadings of the intercept were fixed at 1. For the linear slope, factor loadings were set to 0, 1, 2, 3, 4, 5, 6, and 7, which corresponds to the time point of measurement. For the quadratic slope, factor loadings were set to 0, 1, 4, 9, 16, 25, 36, and 49.

LCGA is utilized to identify different latent groups (i.e., classes) that share certain characteristics or a similar growth pattern. By constraining the variance of the intercept and slope to zero within a class, all individual trajectories within a class are homogeneous (Jung & Wickrama, 2008). To determine the number of classes, we started with a single class (unconditional) model and then estimated additional classes in the model to examine whether the model fit improved. Subsequent classes were added until the model could not run without errors or until a point was reached where an added class included less than 10% of the total sample (Hart et al., 2018). For the examination of the model fit, multiple criteria were used, including the Bayesian Information Criterion (BIC), the sample size adjusted BIC, the Lo–Mendell–Rubin adjusted Likelihood Ratio Test (LMR-LRT), and entropy values (Jung & Wickrama, 2008; van de Schoot et al., 2017).

Finally, to examine associations between class trajectories of state hope determined in the LCGA and mental health and externalizing, internalizing, and prosocial behavior, the BCH method in Mplus was employed (Asparouhov & Muthén, 2021). The BCH procedure is a modern approach to estimate the means of distal outcomes across latent classes, avoiding undesirable shifts in the latent classes. Due to covariates (i.e., age and length of stay in the juvenile correlational facility measured at T1) in the final model examining the effects of positive and negative affect on the outcome measures, the automatic BCH method could not be employed. Instead, a manual approach was used and mean differences in the outcomes across trajectory classes were tested using the Model Constraint command. To adjust for multiple comparisons, we calculated the false discovery rate (FDR; Benjamini & Hochberg, 1995). The corrected p-value was .025.

Results

Descriptive statistics

Means and standard deviations of all study variables for all time points are presented in Table 1. Bivariate correlations between study variables at T1 and T9 are shown in the Supplementary Material (SM). Given some significant correlations between affect and age/length of stay in the juvenile correctional institution (see SM), positive and negative affect were controlled for age and length of stay in the analyses.

The functional form of change: Positive and negative affect as well as state hope

Table 2 presents the fit indices of the models for positive and negative affect as well as state hope that estimated (1) linear change and (2) both linear and quadratic change. Furthermore, means and variances of the intercept and slopes are reported in Table 2. The linear and the quadratic growth models of positive and negative affect fit the data well. Because the variance of the quadratic slopes was not significantly different from zero (see Table 2), indicating that the individual slopes did not vary, the linear slope models were selected as final models. The adolescents displayed relatively low latent scores of positive ($M = 0.86$) and negative affect ($M = 0.50$) at the beginning of the study (intercept estimates). The statistically significant variance estimates of the intercepts indicated inter-individual variability in the initial means. In terms of the linear slopes, the means were significant and negative, indicating a linear decrease of both positive and negative affect over time. Also, the variance estimates of the linear slopes were significant, demonstrating inter-individual variability in growth over time. Next, the intercept and slope estimates of both positive and negative affect were controlled for age and length of stay in the juvenile correctional institution. For positive affect, the intercept was negatively associated with length ($b = -0.11$, $p = .007$), indicating that participants reported less positive affect at T1 the longer they were in the juvenile correctional institution. In addition, a positive link between the slope of positive affect and length was found ($b = 0.01$, $p = .006$), demonstrating that the participants who spent a longer time in the juvenile correctional institution reported a relatively slower decrease in positive affect. For negative affect, the intercept was positively associated with age ($b = 0.12$, $p = .002$), indicating that older participants reported more negative affect. No further significant associations emerged.

Regarding the models for state hope (agency and pathways), the linear models presented an acceptable fit to the data, whereas the quadratic models showed a good fit (see Table 2). As the variance estimates of both the linear and quadratic slopes were statistically significant, the models with a quadratic slope of pathways and agency were selected as final models. In terms of the intercept, average initial levels of agency and pathways were above the scale's midpoint ($M = 5.48$ and $M = 5.26$, respectively) and varied significantly around the mean. The significant and negative mean values of the linear slopes indicated a decrease in agency and pathways over the eight time points. Also, the variance estimates of the linear slopes were statistically significant, reflecting inter-individual differences in intra-individual change over time. In terms of the quadratic slope, the mean estimates of agency and pathways were not statistically significant. However, the variance estimate was significantly different from zero, showing inter-individual differences in the quadratic slope. Taken together, positive and negative affect, as well as hope, decreased over the eight weeks of assessment, while the significant variance estimates in the linear (for models on positive and negative affect) and quadratic slopes (for models on pathways and agency) indicated inter-individual variability in growth.

Group trajectories of positive and negative affect as well as state hope

Based on the best-fitting models selected in the LGCAs, we sought to determine whether different groups of youth differed in their initial levels (intercept) and growth (slope) over time. We first examined the unconditional models and then added subsequent classes. Again, models for positive and negative affect were controlled for age and length of stay in the juvenile correctional institution. As shown in the SM (Table SM3) and explained below, we selected two-class solutions for positive and negative affect, and three-class

Table 2 Model fit as well as unstandardized mean and variance estimates of intercept and linear and quadratic slopes

	χ^2	df	RMSEA	CFI	TLI	Intercept		Linear slope		Quadratic slope	
						Mean	Variance	Mean	Variance	Mean	Variance
Positive affect											
Linear model	59.00**	31	0.068	0.949	0.954	0.86***	0.29***	-0.05***	0.002**		
Quadratic model	40.45*	27	0.050	0.976	0.975	0.92***	0.25***	-0.09***	0.03*	0.01*	0.00
Negative affect											
Linear model	40.51	31	0.039	0.991	0.992	0.50***	0.31***	-0.02***	0.002***		
Quadratic model	31.56	27	0.029	0.996	0.995	0.54***	0.31***	-0.05***	0.01*	0.01**	0.00
State hope: Agency											
Linear model	85.07***	31	0.094	0.921	0.929	5.41***	1.11***	-0.09***	0.02***		
Quadratic model	43.00*	27	0.055	0.977	0.976	5.48***	1.02***	-0.14**	0.20***	0.01	0.003***
State hope: Pathways											
Linear model	91.73***	31	0.099	0.917	0.925	5.17***	1.32***	-0.08***	0.03***		
Quadratic model	49.16**	27	0.064	0.970	0.968	5.26***	1.05***	-0.15**	0.15***	0.01	0.003***

* $p < .05$, ** $p < .01$, *** $p < .001$

solutions for state hope agency and pathways, respectively, as best-fitting and interpretable models. The SM contains all estimated model parameters.

For positive and negative affect, the two-class models, compared to the unconditional models, presented a substantially lower BIC. For positive affect, the significant LMR-LRT indicated that the two-class solution provided a better fit to the data. Although the LMR-LRT of negative affect was not statistically significant, the lower BIC and the interpretability of the class solution justified retaining the two-class solution for further analyses. Moreover, adding a third class resulted in a sample size below 10% of one class, which is why the two-class models were selected as final models. To illustrate the findings, the participants were categorized in one of both classes based on their most likely class membership. In the SM, estimated means of latent trajectory classes across time for positive and negative affect are shown. For positive affect, the first trajectory class included 39.3% of the participants ($n = 77$) who reported a moderately high initial level of positive affect ($M = 1.42$) which decreased over time (mean linear slope = −0.04, $p = .001$). The second trajectory class comprised 60.7% of the participants ($n = 119$). Youth in this group were characterized by low initial levels of positive affect ($M = 0.53$) that further decreased over time (mean linear slope = −0.06, $p < .001$). Regarding negative affect, the first trajectory class comprised 17.7% of the participants ($n = 35$) who generally reported moderately high and stable negative affect ($M = 1.37$; mean linear slope = 0.00, $p = .778$). The second trajectory class included the majority of participants ($n = 163$; 82.3%). Youth in this group were characterized by low initial levels of negative affect ($M = 0.32$) with decreasing scores over time (mean linear slope = −0.02, $p < .001$).

Regarding state hope agency and pathways, the three-class models provided a lower BIC than the unconditional and the two-class models. The LMR-LRT was significant in the three-class solution, which favored the analysis of three groups of youth in this sample. Adding a fourth class did not further improve the model fit for agency and the sample size of one class dropped below 10% of the total sample, which substantiates the selection of three classes for further analyses. For pathways, although the four-class solution resulted in improved model fit, also one class dropped below 10% of the total sample, which is why the three-class model was selected as final model.

For agency, the first class comprised 22.2% of the participants ($n = 44$). Youth in this group were characterized by the highest initial agency scores ($M = 6.43$) and curvilinear growth over time (mean linear slope = 0.15, $p = .103$; mean quadratic slope = −0.03, $p = .019$). The second trajectory class comprised 25.8% of the participants ($n = 51$). Youth in this group presented the lowest initial scores ($M = 4.33$) for agency compared to the other two classes, a decrease over time (mean linear slope = −0.36, $p < .001$) as well as curvilinear growth (mean quadratic slope = 0.03, $p = .010$). The third trajectory class included 52.0% of the participants ($n = 103$) whose scores were moderately high ($M = 5.62$), i.e., between trajectory classes 1 and 2, and linearly decreasing over time (mean linear slope = −0.17, $p = .009$; mean quadratic slope = 0.01, $p = .239$).

With respect to pathways, the first trajectory class comprised 18.7% of the participants ($n = 37$). Youth in this group reported the lowest initial scores of pathways ($M = 4.19$), compared to the two other trajectory classes, a linear decrease (mean linear slope = −0.56, $p < .001$), and a curvilinear growth over time (mean quadratic slope = 0.05, $p = .002$). The second trajectory class included 32.3% of the participants ($n = 64$) and initial scores were high ($M = 6.22$) and stable over time (mean linear slope = 0.03, $p = .606$; mean quadratic slope = −0.01, $p = .272$). The third trajectory class included 49.0% of the participants ($n = 97$). Youth in this group presented moderately high initial scores ($M = 5.05$), which linearly decreased (mean linear slope = −0.13, $p = .048$; mean quadratic slope = 0.01, $p = .364$).

Prediction of mental health and externalizing, internalizing, and prosocial behavior

Next, we examined associations between each trajectory class of positive and negative affect and state hope over time (T1 to T8) and the outcome variables (mental health and externalizing, internalizing, and prosocial behavior) measured at T9. An overview of the means of the outcome variables across the different classes and chi-square equality tests are provided in Table 3.

For positive affect, no significant differences between trajectory classes 1 and 2 emerged for the outcome variables. Regarding the growth of negative affect, youth in trajectory class 1 (i.e., moderately high and stable negative affect) reported significantly lower levels of mental health and more externalizing and internalizing behavior compared to youth in trajectory class 2 (i.e., low and decreasing negative affect). No significant class differences were found for prosocial behavior.

For agency, mental health scores were significantly lower among youth in trajectory class 2 (i.e., low and curvilinear decrease of agency) compared to youth in trajectory classes 1 (i.e., high agency with a curvilinear pattern, that is, a slight increase after baseline followed by a decrease) and 3 (i.e., moderately high and decreasing agency). On average, the highest levels of externalizing behavior were found among youth in trajectory class 2, being significantly higher than scores of youth in trajectory class 3. Also, internalizing behavior was highest among youth in trajectory class

Table 3 Means and standard errors of outcome variables across the different classes as well as chi-square equality tests

Latent trajectory class	Mental health *M* (*SE*)	Externalizing behavior *M* (*SE*)	Internalizing behavior *M* (*SE*)	Prosocial behavior *M* (*SE*)
Positive affect				
Class 1	4.24 (0.14)	5.95 (0.43)	5.33 (0.39)	6.72 (0.23)
Class 2	3.99 (0.09)	5.08 (0.28)	5.21 (0.24)	6.58 (0.17)
Mean difference	0.26	0.87	0.12	0.14
Negative affect				
Class 1	3.62 (0.20)	7.61 (0.52)	6.98 (0.59)	6.01 (0.32)
Class 2	4.18 (0.07)	4.93 (0.23)	4.89 (0.19)	6.77 (0.14)
Mean difference	-0.56**	2.68***	2.09**	-0.76†
State hope: Agency				
Class 1	4.48 (0.16)	5.00 (0.55)	4.55 (0.44)	7.03 (0.29)
Class 2	3.69 (0.14)	6.59 (0.46)	6.00 (0.39)	5.84 (0.26)
Class 3	4.11 (0.09)	5.00 (0.26)	5.20 (0.24)	6.87 (0.18)
Overall test (χ^2)	14.01**	8.96*	6.29†	13.29**
Class 1 vs. 2 (χ^2)	13.77***	4.74†	6.04*	9.54**
Class 1 vs. 3 (χ^2)	3.91†	0.00	1.53	0.22
Class 2 vs. 3 (χ^2)	5.82*	8.35**	2.99	10.45**
State hope: Pathways				
Class 1	3.54 (0.16)	6.18 (0.43)	6.13 (0.42)	6.08 (0.32)
Class 2	4.44 (0.12)	4.53 (0.40)	4.54 (0.36)	7.31 (0.23)
Class 3	4.07 (0.10)	5.68 (0.33)	5.37 (0.25)	6.41 (0.18)
Overall test (χ^2)	19.53***	8.53*	8.45**	12.85**
Class 1 vs. 2 (χ^2)	19.41***	7.86**	8.24**	9.80**
Class 1 vs. 3 (χ^2)	7.47**	0.82	2.22	0.78
Class 2 vs. 3 (χ^2)	5.30*	4.63†	3.41	8.71**

$^{\dagger}p < .05$, * $p < .025$ (FDR-corrected p-value), ** $p < .01$, *** $p < .001$

2, being significantly higher than scores of youth in trajectory class 1. Regarding prosocial behavior, the lowest levels were found among youth in trajectory class 2, being significantly lower than scores among youth in trajectory classes 1 and 3. No significant differences in levels of mental health, externalizing, internalizing, and prosocial behavior emerged between trajectory classes 1 and 3.

Regarding pathways, levels of mental health were significantly lower among youth in trajectory class 1 (i.e., low and curvilinear decrease of scores of pathways) compared to youth in trajectory classes 2 (i.e., high and stable scores of pathways) and 3 (i.e., moderately high scores of pathways with a tendency to decrease). Also, youth in trajectory class 2 had higher scores of mental health than youth in trajectory class 3. In terms of externalizing and internalizing behavior, higher scores emerged among youth in trajectory class 1 compared to youth in trajectory class 2. Furthermore, lower scores of prosocial behavior were reported by youth in trajectory class 1 than by youth in trajectory class 2. Also, a significant difference was found between participants in trajectory classes 2 and 3, with lower scores of prosocial behavior in trajectory class 3.

Discussion

The purpose of the present study was threefold. First, we aimed at examining the functional form of change of affect and state hope among adolescents exhibiting delinquent behavior over eight weeks. Second, following a person-centered approach, we sought to investigate whether different classes (groups of youth) can be identified using LCGA. Third, we aimed to examine associations between class membership and mental health and externalizing, internalizing, and prosocial behavior.

Regarding the functional form of change of affect and state hope, we found that positive and negative affect were best described by linear growth, whereas state hope pathways and agency were best described by quadratic growth. As expected, positive affect and state hope decreased over the eight weeks of assessment, being consistent with past evidence that showed decreases in positive affect as well (Griffith et al., 2021; Maciejewski et al., 2015). Although past research found stable as well as declining trajectories of state hope (Yin et al., 2019), to our knowledge, no studies examined the functional form of state hope among Chinese adolescents in a juvenile correctional institution. Considering the confined institutional setting of the current study and the related strains on the adolescents, the expected decrease in state hope was found. Against our expectations, negative affect decreased over time as well. This may be related to an emotional adaptation to the institutional setting and a way of coping. Furthermore, it was noteworthy that the means of the intercepts of positive and negative affect were rather low at the beginning of the study. A similar pattern of results emerged in a study by Chui and Chan (2012) who also found scores of positive and negative affect below the scale's midpoint among juvenile probationers in Hong Kong.

The second aim of the current study was to identify different group trajectories of positive and negative affect as well as state hope using LCGA. Similar to past research (Yin et al., 2019), we expected a three-class solution, identifying trajectory groups characterized by high, moderate, and low initial levels of affect and state hope, respectively. Against our expectations, for both positive and negative affect, only two classes were revealed, respectively. In terms of positive affect, it was found that the majority of participants

reported low initial levels of positive affect, with decreasing scores over time. A second group of youth was characterized by moderate-high initial levels of positive affect, with scores also decreasing over time. It is notable that no group of youth reporting high levels of positive affect was found, which may be attributed to the study setting. For negative affect, the majority of participants reported low initial levels of negative affect that decreased over time. A second trajectory class comprised youth who reported moderately high and stable negative affect. The finding that only a minority of youth reported emotions such as being sad, afraid, or lonely to a moderate degree may be, as noted above, a way to cope with the situation in the juvenile correctional institution. Also, in interdependent, collectivistic cultures, such as China, it is endorsed to a lesser extent to express emotions than in individualistic cultures (Matsumoto et al., 2008), and emotional restraint and self-control are culturally highly valued (Markus & Kitayama, 1991). Particularly in negative emotional contexts, Chinese adolescents use more emotional display rules than in positive emotional contexts (Wang et al., 2012). Furthermore, Wei et al. (2013) suggested that the expression of negative emotions may have adverse effects on group harmony. Hence, youth in China expressing their emotions, transgressing cultural expectations, may encounter difficulties with their peers. This in turn may also explain the absence of high positive and negative affect groups in the present study.

In terms of state hope, for both pathways and agency, three-class solutions were revealed as expected. This pattern of results replicates to some extent the findings by Yin et al. (2019) who also found three latent classes with distinct developmental trajectories. However, in the study by Yin et al. (2019), the majority of participants (92.4%) fell into the high-hope and moderate-hope groups, whereas in the current study only 74.2% and 81.3% of participants were included in the trajectory groups of moderate and high agency and pathways, respectively. A further difference is that in the study by Yin et al. (2019), levels of hope remained relatively stable in the high-hope and moderate-hope groups and a decrease in hope was only observed in the low-hope group. In the current study, levels of hope mostly decreased over time. Again, this may, at least partly, be explained by the institutional setting of the current study. Both components of hope, agency and pathways, refer to achieving future goals by determination and motivation. However, hopelessness is prevalent among youth in the juvenile justice system (Abram et al., 2008). In addition, it has been argued that supportive relationships may contribute to the development of hope, whereas negative environmental factors, such as community violence, may confine adolescents' future orientation and hinder the development of hope (see Idan & Margalit, 2013, for an overview). Hence, the environment of the juvenile correctional institution, together with peers who have exhibited delinquent behavior, may limit the development of hope and goals for the future in our sample.

Finally, in this study, we aimed to examine associations between class trajectories and mental health and externalizing, internalizing, and prosocial behavior. Consistent with our expectations, youth in trajectory classes characterized by lower negative affect reported better mental health and less externalizing and internalizing behavior compared to youth in trajectory classes characterized by higher negative affect. This pattern of findings is consistent with past correlational and longitudinal studies (dos Santos-Lopes-Santos et al., 2018; Sánchez-García et al., 2018). However, no significant group differences were found for prosocial behavior which warrants further investigation. Also, against our prediction, no associations between positive affect and the outcomes have been found, contrary to past correlational evidence demonstrating positive links between positive affect and mental health and prosocial behavior and negative links between positive affect and externalizing and internalizing behaviors (dos Santos-Lopes-Santos et al., 2018; Sánchez-García et al., 2018). Given that only trajectory classes of low or moderate positive affect were found, the levels of positive affect may have been too low to have benefits on mental health and externalizing, internalizing, and prosocial behavior. However, future research is necessary to replicate this finding.

With respect to state hope, we found that youth in trajectory classes characterized by higher levels of agency and pathways reported better mental health, less internalizing, and more prosocial behavior than youth in trajectory classes characterized by lower levels of agency and pathways, respectively. For agency, also a difference between the moderate and low-level groups was found, with better mental health, less externalizing, and more prosocial behavior among youth in trajectory classes characterized by moderate levels of agency. For pathways, a difference between the moderate and high-level groups was found, with better mental health and more prosocial behavior among youth in trajectory classes characterized by higher levels of pathways. In addition, youth in the trajectory class characterized by moderate levels of pathways reported better mental health than youth in the trajectory class characterized by lower levels of pathways. This pattern of results is largely consistent with past evidence that has shown positive links between hope and prosocial behavior and negative links between hope and internalizing and externalizing behavior (Bolland, 2003; Padilla-Walker et al., 2011; Valle et al., 2006). Furthermore, our findings also underline past research that demonstrated a salutogenic function of hope, playing an important role in positive youth development (Jiang et al., 2018; Schmid Callina et al., 2015).

Strengths and limitations

The current study presents several strengths. First, the study was conducted in China, a non-Western country, contributing to an international knowledge base. This is particularly important because the majority of past research in this field has been conducted in North America. Second, the present study complements prior research with Chinese adolescents (e.g., Yin et al., 2019) by focusing on youth involved with the Chinese juvenile justice system. Third, we were able to conduct weekly assessments over a period of two months, allowing a comprehensive appraisal of changes in affect and state hope in this time period. Fourth, by following a person-centered approach using LCGA, we were able to characterize significant sample heterogeneity in different growth trajectories.

However, the current study is not without limitations. First, our sample only included male adolescents. Given that past studies have found gender differences in trajectories of affect (e.g., Griffith et al., 2021), future research including female and nonbinary youth is necessary to examine gender-specific trajectory classes and associations. Second, although we were able to discern short-term changes in affect and state hope, evidence on long-term trajectories and associations is missing, particularly in samples of adolescents exhibiting delinquent behavior. In addition, past research has shown that adult offenders with lower levels of hope had a higher risk for recidivism (Martin & Stermac, 2010). Hence, study designs covering longer time periods and specific measures of future criminal outcomes (e.g., recidivism) are necessary for future research. Third, some of the scales (e.g., SDQ) presented low internal consistencies, although we relied on widely used, validated instruments. Hence, future research should optimally pre-test their scales for use in non-Western study populations in detention. Despite these limitations, the current study is an important addition to the limited literature on trajectories of affect and state hope among youth exhibiting delinquent behavior. In particular, we demonstrated how affect and hope are related to mental health. This knowledge is, in turn, crucial for evidence-based prevention strategies to reduce mental health problems.

Practical implications

Based on our results, several implications can be drawn. Given the positive effects of lower negative affect and higher agency and pathways on our outcome measures, interventions strengthening hope and reducing negative affect should be implemented. These interventions should particularly target youth who display low hope and high negative affect to promote positive youth development. This may, in turn, reduce mental health problems of justice-involved youth. A strength-based intervention study in South Africa with juvenile sex offenders, aiming to improve hope and empower the adolescents, showed promising preliminary results of its effectiveness (Marsay et al., 2018), and may be adapted for adolescents in detention. Another study examining the Positive Re-Entry in Corrections Program, a positive psychology intervention, demonstrated that hope, gratitude, and life satisfaction can be increased among males in prison settings (Huynh et al., 2015). Hence, implementing strength-based interventions may be a promising way to tackle low mental health, externalizing and internalizing behavior, and increase prosocial behavior.

Moreover, based on the results showing overall decreases in hope over time and the potential nature of this decrease, namely the institutional setting, programs to improve the environment of the juvenile correctional institution may be an entry point to buffer against low levels of hope. Past research suggests a potentially necessary shift of juvenile correction systems from punitive institutions to rehabilitation institutions (Agnew & Brezina, 2022; Bernard & Kurlychek, 2010). This includes the need to build relationships between youth and staff that encourage the development of life goals, motivation to pursue these goals, and an understanding of barriers that one might face during and after release from detention. For instance, an interview study with youth and staff in a juvenile correctional facility in the U.S. underlined the importance of building positive, supportive relationships based on trust to ensure rehabilitation (Magidson & Feinstein, 2022). Another study of male adolescents in detention in the U.S. further found that a more positive perception of the staff was associated with less violent behaviors (Brown et al., 2019). There is, however, scarce research on intervention programs targeting supportive relationships and pertaining specifically to youth in China. Hence, intervention programs that address the climate within the correctional institution and the relationship between adolescents and staff may tackle the decline in hope and promote mental health.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-024-06184-1.

Author contributions IS performed the statistical analyses, interpreted the results, and wrote the manuscript; JLa helped to draft the manuscript; JZ participated in the design and coordination of the study and performed the measurement; LY participated in the design; JLu helped to prepare the data; YL participated in the design and secured the funding; SH conceived of the study, participated in its design and the statistical analyses, and helped to draft the manuscript. All authors read and approved the final manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL. The research reported in this paper was supported by a grant

from the Ministry of Justice (20SFB3011), the Department of Education, Tianjin (2020JWZD47), and the Social Science Foundation in Tianjin (2021HT-0012).

Data availability The data presented in this study are available on request from the corresponding author.

Declarations

Ethics approval The study was approved by the ethics committee of Tianjin University

Consent Informed consent was obtained from all participants included in the study.

Conflicts of interest The authors declare no conflict of interest.

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