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# Transitions of Developmental Trajectories of Depressive Symptoms Between Junior and Senior High School Among Youths in Taiwan: Linkages to Symptoms in Young Adulthood

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## Abstract

We investigated the heterogeneous developmental trajectories of depressive symptoms in junior and senior high school, the transitions to different trajectories after entering senior high school, and the linkages to the development of depressive symptoms in early adulthood among Taiwanese adolescents. An eight-wave longitudinal data set was analyzed, including 2687 Taiwanese adolescents (51.2% boys, *M* age = 14.3 at first wave). Using a manual three-step latent transition growth mixture model, we found that a three-class solution fit the data for both junior high school (termed *high-improving*, *cumulative*, and *JS-low-stable*) and senior high school period (termed *heightening*, *moderate-stable*, and *HS-low-stable*). The depressive symptoms of most individuals maintained at a low level (i.e., *low-stable*) from adolescence to early adulthood; however, nearly a quarter of the adolescents reported depressive symptoms that were moderately or highly severe in senior high school and beyond. More than 30% of the participants experienced transitioning into a different developmental trajectory between junior and senior high school. When perceiving a higher level of paternal behavioral control, adolescents categorized in the *high-improving* class in junior high school would have a higher chance to transition to the *moderate-stable* class than to *HS-low-stable* class in senior high school. Adolescent boys and girls did not differ in the probability of transitioning between trajectories across junior and senior high school. However, a clear and consistent pattern of symptoms between late adolescence and early adulthood was not observed. These results help elucidate the heterogeneity and fluidity associated with the development of depressive symptoms between early adolescence and early adulthood in light of school transition among youths in Taiwan.

Empirical studies and clinical reports from a variety of countries have long reported a generally low yet heightened level of depressive symptoms in adolescence (Greenberger and Chen 1996; Gutman and Eccles 2007; Kochel et al. 2012). Beyond this general observation, recently, researchers have started to investigate the possibility of multiple developmental trajectories of depressive symptoms in order to better identify subgroups of youths who might need clinical help (Brendgen et al. 2010; Wang 2014), and empirical inquiries conducted in both western and non-western countries tend to support such speculation (e.g., Cumsille et al. 2016; Wang et al. 2015). In addition to illustrating the trend of depressive symptoms, researchers have documented several factors that correlate with such development. Among these factors, environmental influences, such as stressful life events over which individuals may not have control, have garnered much scholarly attention (Ge et al. 1994; Lim et al. 2016).

Transitioning from junior to senior high school is a particularly critical stressful life event shaping youths' mental wellbeing. During this transition, students must cope with multiple challenges simultaneously, such as new academic and interpersonal challenges (Ge et al. 2001). The stress associated with school transitions can be agonizing in some Asian

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societies (e.g., China, Hong Kong, Japan, South Korea, and Taiwan), due to high-stakes exams that determine where students will attend senior high school and college (Wang and Hsiao 2007) and additional schooling to prepare for such exams (Rindermann and Ceci 2009). Therefore, when a longitudinal perspective is adopted to explore the development of depressive symptoms among adolescents, such major life events should be considered.

As such, in this study, by analyzing a large-scale, longitudinal data set, we explored the potentially diverse developmental trajectories of depressive symptoms from adolescence to early adulthood in Taiwan using a multi-trajectory approach that has been advocated by recent researchers. We expected that, on par with prior research conducted in Western and non-Western countries (Musliner et al. 2016), most Taiwanese adolescents would report a low level of depressive symptoms over time, while the total number of trajectories remained unknown. Furthermore, in an exploratory manner, we sought to determine whether and to what degree the trajectories change after the transition from junior to senior high school. We then used the developmental trajectories observed during adolescence to predict the level of depressive symptoms after senior high school graduation. Previous research based on the same data set either explored topics irrelevant to the current study or focused on certain waves of data collection (Chen et al. 2016; Lin et al. 2014), or a specific stage of schooling (e.g., junior high school; Wang et al. 2015) when examining students' depressive symptoms. The present study was the first empirical inquiry to dismantle the boundary of life and schooling stages to map out the fluctuation of mental well-being. Knowledge of mental well-being through adolescence and early adulthood has theoretical and practical implications for youths and practitioners in highly academically competitive societies.

## Relevant Literature

### Stressful Life Events and Depressive Symptoms in Adolescence

It is not uncommon for adolescents to experience high levels of challenge that may impact their mental well-being. Several theoretical frameworks have been proposed to describe how adolescents respond to these transitions and accompanying stresses. The notion of resilience posits that, in spite of exposures to risk, individuals who possess assets and/or resources resume positive adaptation soon in their ecological contexts (Garmezy et al. 1984; Masten et al. 2008). It asserts that protective factors moderate or mediate the impact of adversity on developmental outcome (Fergus and Zimmerman 2005; Rutter 1985), so individuals would eventually adapt successfully given the presence of such risk factors. Resilience-related research cumulated a short list of protective factors

for depression and stress among adolescents. For example, Herman-Stahl and Petersen (1996) found that a positive relationship with parents and peers was associated with fewer depressive symptoms in adolescence. In addition, coping strategies and personal assets such as self-esteem were also found to serve as a protective role against the experience of stress and depression (Burke et al. 2017; Dumont and Provost 1999). In reviewing resilience-related research, Masten (2001) concluded that resiliency is not a rare phenomenon or process, but an ordinary magic in development.

The transition between junior and senior high school is a stressful event that could disturb the mental well-being of adolescents (Wang and Degol 2014). In life course perspective, scholars argue that individuals' developmental pathways constantly intersect with socially structured processes (e.g., schooling; Elder 1994). Starting as a sociological perspective and later turning into a developmental theory, life course perspective focuses on individuals' developmental experiences within a highly structured institutional system, and how individuals interact with the ever-changing system as they develop (Elder 2008). Therefore, the long-term trajectory of individuals' educational pursuits is a great example of such intertwined relationships in which individuals undergo the processes of learning and intellectual development when new challenges emerge simultaneously as the environment changes (Crosnoe and Benner 2016; Miech and Shanahan 2000). Adolescents' educational journeys are rich in transitions. The transition from junior to senior high school, therefore, poses as a disruption to multiple aspects of development (e.g., social, emotional, cognitive; Benner et al. 2017). Crosnoe and Johnson (2011) argued that it is imperative to tackle how adolescents experience their development in the environment, how they respond to and interact with the constantly changing social structures, and how this experience influences future development in their life course.

As most adolescents experience difficulties during the transition from junior to senior high school, the high-stakes entrance exams administered in Taiwan can exacerbate these challenges. Unlike students in the United States who typically attend public senior high school in their local school district, Taiwanese adolescents vie for positions in elite, college-preparation public and private senior high schools (Kao and Lu 2001); as such, the attendance and later academic trajectory in senior high school and beyond is directly impacted by their academic performance in junior high school (Gamoran 1992). The prevalence of credentialism and a near universal emphasis on academic merit in Taiwan can make the transition from junior to senior high school particularly stressful, due to the fact that attending the best senior high school is often perceived as critical to future career goals set by parents and society (Crystal et al. 1994; Yau and Smetana 1996). As a result, American youths tend to have the lowest self-concept at the age of 12 or 13, when they are undergoing drastic

physiological and environmental changes because of the transition from elementary to junior high school (Demo 1992). Conversely, Taiwanese youths tend to have the lowest self-concept during the third year of junior high school, when they prepare for the aforementioned high-stakes senior high school entrance exam (Huang 2002).

Even a successful transition to an elite college-preparation senior high school may open up another round of unsettling academic experiences. The race to the top senior high school can create an utterly different classroom environment in senior high school as opposed to junior high school (Huang 2009). In Taiwan as well as many countries in Asia, admission to senior high school is based solely on academic achievement (i.e., ability stratification; Hsieh 1987), which produces an academically homogeneous environment after the stratification. Students who enter these senior high schools were once the top students back in junior high school. However, a majority of them are not able to stay at the top rank anymore. These students may be subject to tremendous academic pressure in order to combat this contrasting experience before and after entering senior high school. For example, nearly 80% of high school students in Taiwan attend cram schools for at least one subject (Lin and Chen 2006), hoping to keep up with their peers academically (Chang 2012). Cram schools are private educational institutes which provide additional lessons on major subjects, such as mathematics, chemistry, physics, and English. Students attend these schools after regular class hour, sit in lecture hall for these subjects, and practice a great number of mock tests (i.e., *cramming* students with tests). Institutes such as the Kaplan Test Prep in the United States and the United Kingdom are rough equivalences to such institutes in Taiwan. Comparing to those admitted to less competitive senior high schools, a significantly higher number of students in elite senior high schools go to cram schools for subjects such as physics and chemistry (Huang 2009). Regardless of how cram schools improve adolescents' educational performance, time spent at cram schools was found to be negatively associated with their psychological well-being (Chen and Lu 2009). Given such drastic changes and profound challenges, it is imperative to understand whether and how adolescents' psychological well-being, such as depressive symptoms, fluctuates as a result.

## Heterogeneity of Developmental Trajectories of Depressive Symptoms During Adolescence

Advances in statistical techniques have made it possible for researchers to uncover distinct trajectories of the development of depressive symptoms, hoping to explain the various developmental trajectories that occur within a developmental stage. Studies conducted in the United States tend to identify three to four developmental trajectories of depressive symptoms in adolescence (e.g., Reinke et al. 2012; Rodriguez et al. 2005), in which most adolescents consistently report a low level of symptoms across years, while some an increasing or decreasing trend (Brook et al. 2015; Olino et al. 2014; Reinke et al. 2012).

Researchers outside the United States have reported similar findings. Studies involving European youths (e.g., German, Finnish, Flemish; Fernandez Castelao and Kröner-Herwig 2013; Korhonen et al. 2014; Prinzie et al. 2014), Canadian and Québécois teens (e.g., Brendgen et al. 2005; Brière et al. 2015; Willoughby and Fortner 2015), and Chilean adolescents (Cumsille et al. 2016) have reported that there are between two and five developmental trajectories of depressive symptoms in adolescence. Specifically, the majority of these community-based studies have found that approximately 25.0%–94.1% of the participants reported a rather monotonous growth trajectory of depressive symptoms (i.e., low and stable) throughout adolescence and even in early adulthood. For other youths in these studies, researchers tended to identify one to four additional distinctive developmental trajectories that describe an increasing or decreasing trend in adolescence (e.g., Brendgen et al. 2005; Olino et al. 2010). Studies considering adolescents in Taiwan have further noted that depressive symptoms tend to fluctuate over time in a nonlinear fashion (Hsiao and Tung 2011), and there are also multiple developmental trajectories of depressive symptoms in early adolescence (Wang et al. 2015).

## Modeling the Transitions Between Developmental Trajectories: An Integration of School Transition and Depressive Symptoms

Given the voluminous theoretical frameworks and empirical research on the crucial role of stressful life events, such as school transitions, in individuals' well-being and the various developmental trajectories of depressive symptoms in adolescence, it is time to reconsider how to depict such developmental trends to reflect the inevitable contextual changes—two transitions in this study—that nearly every adolescent in Taiwan undergoes. The pioneering empirical research tended to assume that individuals follow the same trajectory across adolescence and early adulthood (e.g., Olino et al. 2010, 2014), probably due to limitations of the statistical analyses. Instead, we argue that a more flexible analytical technique is needed when addressing the impact of major life events (e.g., Benner et al. 2017; Graber and Brooks-Gunn 1996; Gutman and Eccles 2007). The statistical models should be flexible enough to capture youths who begin in the same developmental trajectory but differ in their responses to stressful major life events over time. Some types of longitudinal data analysis, such as growth curve modeling (Muthén 1991), attempt to summarize various trends using a single, succinct pattern defined by the intercept and slope. As a result, studies incorporating this technique would assume a singular growth trajectory over time (e.g., Strong et al. 2016). However, this

approach disregards the possibility of heterogeneity in growth functions (Kaplan 2009), which could bias the results. Other types of technique, such as growth mixture modeling (GMM; Muthén 2001), can be regarded as a form of longitudinal latent class analysis and relaxes the assumption of a single growth pattern (i.e., it describes multiple patterns of growth). Furthermore, some adolescents may show different depressive symptoms before and after experiencing school transition, and these symptoms can manifest in distinctive patterns. Statistical techniques should be able to illustrate these kinds of changes. For example, latent transition analysis (LTA) provides a suitable approach for addressing variability in class membership and estimating the development of each class before and after a major life event.

Moreover, when modeling the transitions of the developmental trajectories as a response to major life events, researchers are able to investigate whether other factors could influence the transition process (Benner et al. 2017). For instance, studies conducted in different countries have found that adolescent boys and girls may react to the transitions differently (e.g., United States, Germany, Taiwan; Burwell and Shirk 2007; Hampel and Petermann 2005; Yang and Chang 2012). In turn, this may lead to a difference in the development of depressive symptoms. In a meta-analysis of 95 empirical studies of gender difference in depressive symptoms conducted in different countries, Salk et al. (2017) found that the disparity peaked in middle adolescence, in which girls were estimated to have a higher level of depressive symptoms, and then decreased and remained stable in adulthood. These findings indicate that boys and girls follow different developmental trajectories across adolescence and adulthood. Moreover, age was the most prominent predictor of such disparity. Similar gender disparity has been documented within the group of adolescents who reported the lowest level of depressive symptoms over time, in which adolescent boys outnumbered girls (e.g., Brook et al. 2015; Fernandez Castelao and Kröner-Herwig 2013; Rodriguez et al. 2005; cf. Benner et al. 2017).

Similarly, according to the life course perspective, adolescents are not the sole individuals who must cope with this socially structured transition. Rather, contextual changes in responding to the transition (e.g., parenting practice; Elder 1994) also take place, which could in turn influence the development of depressive symptoms. Research generally indicates a relationship between parental behavior and children's well-being (Eccles et al. 1993). Wang et al. (2016) found that maternal punitiveness is positively linked to adolescent depressive symptoms. Kao and Lu (2001) found that the level of stress and anxiety of ninth-graders in Taiwan was related to the perceived parental expectation of academic achievement and future career measured in the same year. As a result, it is important to consider and statistically model contextual and demographic background factors that may shape individuals' depressive symptoms as a response to major life events.

## Current Study

To address the challenges raised by school transitions on adolescents' mental well-being in Taiwan, the present study analyzed an eight-wave longitudinal data base to depict the developmental trajectories of depressive symptoms from the beginning of junior high school (i.e., seventh grade) until two years after high school graduation. We treated the transition between junior and senior high school as a major life event to examine the fluidity of depressive symptoms among adolescents over time. That is, we investigated whether adolescents transitioned to a distinctive developmental trajectory after moving to senior high school in tenth grade. We also examined how changes in the contextal (i.e., parental behavioral control) and demographic background characteristics (i.e., gender) may shape the developmental trajectories after transitioning to senior high school. Given the importance of parental behavioral control in adolescents' developmental outcomes (Shek 2005, 2007), we focused on parents' behavioral control over children's leisure time management that was not perceived by their children before. This variable represents parents' response to children's senior high school entrance exam as a proxy of changes in daily life environment, a critical factor in the life course perspective (Elder 1994). Altogether, we employed a latent transition growth mixture model (LT-GMM) as the primary analytical technique to address the following research questions:

1. What are the major developmental trajectories of depressive symptoms during the junior high school stage for adolescents in Taiwan?
2. What are the major developmental trajectories of depressive symptoms during the senior high school stage for adolescents in Taiwan?
3. How do adolescents in Taiwan transition to a different developmental trajectory of depressive symptoms after moving onto senior high school?
4. How do the new paternal and maternal behavioral control, as a response to children's senior high school entrance exam, and adolescents' gender shape the transition of developmental trajectories for depressive symptoms?
5. How do the depressive symptoms develop in early adulthood, based on the trajectories of depressive symptoms during adolescence?

Similar to prior empirical research, we hypothesized that most adolescents in Taiwan exhibit a low level of depressive symptoms over time, and these adolescents do not transition to another developmental trajectory after entering senior high

school and after senior high school graduation. However, it was less clear how many subtypes of developmental trajectories exist, how adolescents grouped in these subtypes transition to other developmental trajectories after entering senior high school and after senior high school graduation, and how paternal and maternal behavioral control and adolescents' gender shape the transition of developmental trajectories of depressive symptoms. As such, these research questions were answered in an exploratory manner.

## Methods

### Data and Participants

Analysis was performed on a large, longitudinal panel data collected through a research project entitled *Taiwan Youth Project*, hosted by the Academia Sinica of Taiwan (described in the "Procedure" section; Academia Sinica 2014). Data related to the current study were retrieved from the first eight waves of the project, denoted Year 1 (Y1) to Year 8 (Y8). A total of 2687 seventh grade students (i.e., the first year of junior high school in Taiwan) participated in Y1. There were mild to moderate attrition rates over the eight waves of data collection (see Missing Data section for details). In Y1, 48.8% of the participants were girls, which was not statistically different from the national gender distribution of the same birth cohort (48.4%; $\chi^2 = 0.18$, $df = 1$, $p > 0.05$; Ministry of Interior Affair (Taiwan) 2017). The average age of participants was 14.3 years at Y1. Approximately 30% of the students' parents had earned a high school diploma or above, and 77.3% of the students reported living in an urban area (12.8% suburban, and 9.9% rural area). Upon graduating from junior high school, 47.6% of the adolescents attended a college-preparation senior high school, while 52.4% attended a vocational senior high school.

In Y7 (i.e., one year after senior high school graduation), women accounted for 48.8% of the participants, which again was not statistically different than the national gender distribution of the same birth cohort (48.4%; $\chi^2 = 0.18$, $df = 1$, $p > 0.05$; Directorate-General of Budget, Accounting and Statistics (Taiwan) 2017). In Y7, 78.4% of the participants were enrolled in a postsecondary institution (83.7% for participants attending college-preparation senior high schools and 67.0% for vocational senior high school in prior year, on par with national trend [91.1% and 69.8%, $\chi^2 = 2.51$ and 0.16, $df = 1$, $p$s > 0.05, respectively]; Directorate-General of Budget, Accounting and Statistics (Taiwan) 2017), 8.1% were preparing to retake the college entrance exam the next year, and the remaining 13.5% indicated otherwise (e.g., working, awaiting the mandatory military service; see Table 1 for a summary of the demographic backgrounds of the participants). Other demographic information was also collected in the same survey questionnaire across waves, such as the number of family members, parents' employment statuses, and location of residence that have been analyzed in other studies utilizing the same data set (see Lin et al. 2014; Tsai 2012, for examples).

### Measures

**Depressive Symptoms** In all eight waves of the study, participants responded to questions derived from the Symptom Checklist-90-Revised (SCL-90-R; Derogatis and Savitz 2000), which had been previously translated into traditional Chinese and validated by the principal researchers of the *Taiwan Youth Project* as a part of a large battery of survey questionnaires (Academia Sinica 2014). The SCL-90-R was the only scale included in the research project measuring participants' depressive symptoms. Participants responded to the items on a five-point Likert scale (1 = never, 5 = very frequent) to indicate the frequency of experiencing each depressive symptom (e.g., *experienced insomnia*, *picked a quarrel with someone*, *felt lonely*, *felt down*) in the past seven days. Therefore, a higher score indicated more prominent depressive symptoms. Due to funding limitations and time constraints on phone interviews in more recent waves of data collection, the number of items varied between waves of data collection from two to sixteen items. The internal consistency remained at an acceptable to high level across all eight waves (Cronbach αs = [0.74, 0.94]). Participants' depressive symptoms were moderately correlated across time (Pearson $r = [0.19, 0.51]$, $p$s < 0.05), and were negatively correlated with self-concept and life satisfaction across years (Pearson $r = [-0.30, -0.47]$ and $[-0.26, -0.40]$, respectively, $df = [1648, 2681]$, $p$s < 0.05), indicating a good criterion-related validity. We used the scores measured from Y1 to Y6 in the LT-GMM analysis, and scores from Y7 to Y8 as the distal outcomes.

**Paternal and Maternal Behavioral Control** The self-report paternal and maternal behavioral control was hypothesized to moderate the transition of developmental trajectories of depressive symptoms between junior and senior high school. At Y3 (i.e. the last year of junior high school), the participants were asked whether their father and mother, separately, have made certain new arrangements regarding the usage of leisure time as a response to their preparation for senior high school entrance exam, which took place after junior high school graduation. These constraints were neither previously imposed on nor perceived by the participants until they faced the entrance exam. Four items measured the implementation of new restrictions on the time the participants spent on activities distracting them from academics (i.e., *What have your mother/father done because of the senior high school entrance exam: 1) limited your time spent with friends; 2) limited your time spent on phone or on the Internet; 3) limited your TV*

**Table 1** Descriptive statistics and Pearson correlation of SCL-90-R between Y1 and Y8

| Wave | Girls % | Age M (SD) | SCL-90-R M (SD) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Y1 | 48.8% | 14.3 (0.47) | 3.10 (1.68) | – | | | | | | | | | |
| 2 Y2 | 48.8% | 15.3 (0.47) | 3.22 (1.65) | 0.43* | – | | | | | | | | |
| 3 Y3 | 48.5% | 16.3 (0.47) | 3.53 (1.77) | 0.40* | 0.51* | – | | | | | | | |
| 4 Y4 | 49.4% | 17.3 (0.46) | 2.89 (1.46) | 0.22* | 0.30* | 0.35* | – | | | | | | |
| 5 Y5 | 49.2% | 18.3 (0.46) | 2.78 (1.31) | 0.26* | 0.33* | 0.35* | 0.36* | – | | | | | |
| 6 Y6 | 49.1% | 19.3 (0.47) | 3.56 (1.78) | 0.25* | 0.35* | 0.38* | 0.33* | 0.36* | – | | | | |
| 7 Y7 | 48.8% | 20.3 (0.47) | 3.01 (1.47) | 0.20* | 0.29* | 0.30* | 0.30* | 0.36* | 0.38* | – | | | |
| 8 Y8 | 49.0% | 21.3 (0.47) | 3.54 (1.74) | 0.19* | 0.28* | 0.25* | 0.26* | 0.26* | 0.35* | 0.29* | – | | |
| 9 MBC | | | | 0.02 | 0.05* | 0.06* | 0.04 | −0.001 | 0.07* | 0.002 | 0.05* | – | |
| 10 PBC | | | | 0.03 | 0.04* | 0.04 | 0.03 | 0.002 | 0.11* | 0.001 | 0.06* | 0.74* | – |
| 11 Girls | | | | 0.16* | 0.19* | 0.15* | 0.19* | 0.17* | 0.15* | 0.13* | 0.09* | −0.03 | −0.08* |

MBC Maternal behavior control ($M = 1.69$, $SD = 1.45$), PBC Paternal behavioral control ($M = 1.44$, $SD = 1.46$). MBC and PBC were measured in Y3
*$p < 0.05$

time; 4) set up the daily schedule for you) on a dichotomous scale (1 = yes, 0 = no). The survey scores were the summation of the four items, separately for father and mother, and a higher score indicated a higher level of paternal or maternal behavioral control.

**Gender** Following robust research on the gender differences in depressive symptoms (Rodriguez et al. 2005; Salk et al. 2017), we hypothesized that adolescent boys and girls would have different probabilities of transitioning to one of the developmental trajectories in senior high school, even though they might be grouped in the same developmental trajectory of depressive symptoms in junior high school. A binary indicator of gender (reference group = boy) reported at Y1 was included as a moderator of transition probability between junior and senior high school.

## Procedure

The *Taiwan Youth Project* is a longitudinal research project following two cohorts of Taiwanese adolescents over time in order to understand the changes in their daily activities, educational aspiration, relationship with peers and family members, and career development. Two cohorts of students were targeted, in which one cohort was in the seventh grade and the other in the ninth grade during the first wave of data collection (Y1). In the current study, data from the first cohort were analyzed. The project adopted a stratified cluster random sampling technique, in which the stratum was the level of urbanization (i.e., urban, suburban, and rural area), the first cluster was school, and the second cluster was homeroom class. As a result, 40 junior high schools (162 homeroom classes in total) from several urban, suburban, and rural districts in Taipei City, New Taipei City, and Yilan County, Taiwan, were targeted.

The principals of the targeted schools provided informed consent of research participation *in loco parentis* before the first wave of data collection, and parents or legal guardians were informed through written notice and offered the opportunity to opt out the student. Students' contact information, including the residential addresses and phone numbers, were supplied by the participating schools to Academia Sinica.

Between Y1 and Y3, when the participants were attending junior high school, paper-and-pencil questionnaires were administered in the homeroom class during regular class hours every January (the last month of the fall semester). Students were instructed that the submission of completed survey questionnaire was regarded as their assent to be part of the study in that particular wave of data collection. In Y4 and Y5, when the participants were attending senior high school, participants were interviewed by phone. In Y6, interviewers visited the participants' residence and left a hard copy of the questionnaire to the participants with a return envelope and postage. In Y7, the participants were interviewed by phone; in Y8, the same procedure adopted in Y6 was implemented again. Completion of phone interviews or survey questionnaires were regarded as participants' assent to take part in the study. Completed questionnaires and phone interview records were handled by the research team of Academia Sinica. All data were de-identified after collection. The ethics approval of data collection for *Taiwan Youth Project* was granted by the Institute of Sociology, Academia Sinica. The current study and our access to the data was approved by Academia Sinica.

## Analysis

Data was analyzed using the manual three-step approach of LT-GMM with a robust maximum likelihood estimator, as suggested by Asparouhov and Muthén (2014) and Nylund-

Gibson et al. (2014) in M*plus* 6.1 (Muthén and Muthén, 1998-2012). Briefly, in the first step, the goal was to identify the number of classes and developmental trajectories fitting the junior and senior high school data appropriately. We estimated an unconditional mixture model to elucidate the development of depressive symptoms. Depressive symptom scores from Y1 to Y3 and from Y4 to Y6 were modeled separately. During the process of model comparison, the best-fitting model should have the lowest Bayesian Information Criterion (BIC), and the *p*-values of the Lo-Mendell-Rubin (LMR) and bootstrapped likelihood ratio test (BLRT) with one more class specified should be greater than 0.05. Following Nylund-Gibson et al. (2014), we further considered previous findings from empirical research analyzing the same data set or similar cultural settings, the size of each class (i.e., each class should account for 5% of the participants or more), and the interpretability of results during this process (e.g., whether different classes merely formed parallel developmental trajectories, or shown a more complex relationship).

In the second step, we assigned individuals to latent classes using the modal class assignment procedure and the posterior distribution information separately for growth mixture models pertaining to junior and senior high school. In the third step, we fixed threshold values for these latent class variables to account for measurement errors in class assignment. The latent class variable derived from the senior high school GMM was regressed on that of the junior high school GMM. Two continuous distal outcome variables—the depressive symptoms at Y7 and Y8—were regressed on the latent class variable of the senior high school GMM in order to determine how the different developmental trajectories were associated with the level of the depressive symptoms in early adulthood. It should be noted that we did not estimate a mixture model for the depressive symptoms at Y7 and Y8, but treated them as continuous distal outcomes. With two time points, the mixture model would yield linear developmental trajectories, which may not be a truthful description of the development of depressive symptoms in early adulthood. As we are awaiting the release of more recent data in order to empirically estimate linear, quadratic, or cubic developmental trajectories, the marginal mean of depressive symptoms reported two years after senior high school graduation would provide a glance into the potential developmental trajectories in young adulthood.

### Missing Data

Like other longitudinal studies, the current research suffered from mild to moderate attrition over time (1.6%–14.4%; see Fig. 1 for the yearly attrition rate). For example, only 61.3% of the participants in Y1 returned completed questionnaires in Y8. About 33.2% of the participants had complete data, and 15.1% of the data points were missing. Participants who were
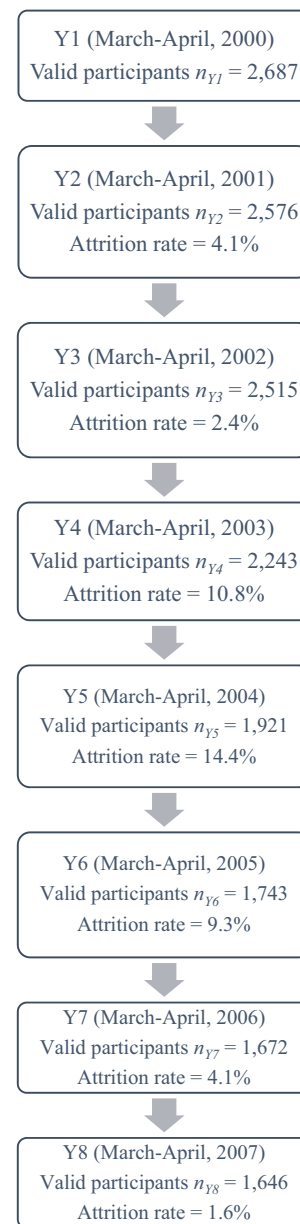


**Fig. 1** Consort diagram of data collection and attrition

retained or dropped out of the research project in a particular wave did not differ in the gender distribution ($\chi^2 = [0.03, 2.01]$, $df = 1$, $ps > 0.05$). Furthermore, over the eight waves of data collection, the gender distribution of the retained participants did not significantly differ from the national gender distribution of that year ($\chi^2 = [0.001, 0.02]$, $df = 1$, $p = [0.89, 0.99]$; Ministry of Interior Affair (Taiwan) 2017). In addition, Little's Missing Completely at Random test was not statistically significant ($\chi^2 = 318.10$, $df = 292$, $p = 0.14$). All missing data were handled by the full information maximum likelihood procedure in M*plus* 6.1, which is found to yield unbiased estimations of coefficients when latent variables and auxiliary variables are present (Baraldi and Enders 2010; Graham 2003; Little et al. 2014).

# Results

## Descriptive Statistics

We examined the descriptive statistics of depressive symptoms and the auxiliary variables, the Pearson correlation coefficients, and repeated measure ANOVA with pairwise comparisons for each wave of the survey (see Table 1 for a summary). Depressive symptoms reached the highest level in the last year of junior high school (Y3; i.e., when students faced high-stakes senior high school entrance exams). During senior high school, the least severe depressive symptoms were reported in the first two years, but the level of symptoms peaked again in the following year (Y6), when students were about to graduate and preparing for the college entrance exam. Repeated measure ANOVA of the depressive symptoms with gender and parental behavioral control as the covariates was also conducted. As a result, the levels of depressive symptoms were significantly different among the eight waves of data (Wilk's $\lambda_{(7, 884)} = 11.41$, $p < 0.05$) and formed a nonlinear relationship, peaking at Y3 and Y6 (i.e., the end of junior and senior high school, respectively). Pairwise comparisons with Bonferroni adjustment demonstrated that, during junior high school (from Y1 to Y3), depressive symptoms were significantly more severe in Y3 than in Y1 and Y2. Similarly, in senior high school (from Y4 to Y6), the severity of depressive symptoms reached the highest in Y6. However, the level of depressive symptoms at Y3 and Y6 were not statistically different.

Across waves, adolescent girls reported a significantly higher level of depressive symptoms than boys ($F_{(1, 890)} = 32.44$, $p < 0.05$). Also, students who reported a higher level of paternal behavioral control at Y3 tended to have a higher level of depressive symptoms over time ($F_{(1, 890)} = 7.30$, $p < 0.05$), while maternal behavioral control was not significantly associated with depressive symptoms ($F_{(1, 890)} = 0.04$, $p > 0.05$). All eight waves of depressive symptoms were positively correlated at a moderate level (Pearson $r = [0.19, 0.51]$, $p$s $< 0.05$).

## Developmental Trajectories of Depressive Symptoms in Junior and Senior High School

GMM was conducted to illustrate the heterogeneity of development of depressive symptoms during junior and senior high school. A number of model fit indices (BIC, LMR, and BLRT) and findings from prior research indicated that a three-class solution fit the data of the junior high school stage (e.g., Korhonen et al. 2014; Wang et al. 2015; see Table 2 for details). Every class in this solution also accounted for a sizable number of participants (i.e., greater than 5.0%) and identified that most students reported a low level of depressive symptoms. Although we did not report the model fit when more classes were specified, we found that despite the better model fit than the three-class solution, some classes account for fewer than 5.0% of the adolescents when looking beyond the four-class solution. Additionally, one previous study using the same data base found that a three-class solution was the best option to describe the development of depressive symptoms among junior high school students in Taiwan (Wang et al. 2015). As a result, the three-class solution was favored.

The first class was termed *JS-low-stable* and included students who only showed negligible symptoms throughout junior high school (JS). This was also the largest of the three classes (76.9% of the study sample). The second class (16.8%) was termed *cumulative* and included students who showed low depressive symptoms in Y1 (i.e., the first year of junior high school), increased in Y2, and reached the highest level in Y3 (i.e., the last year of junior high school). The third class (6.3%) was named *high-improving* and included adolescents showing depressive symptoms which were more pronounced in Y1 and then dropped in Y2 and Y3 (see Table 3). Panel A in Fig. 2 presents the estimated levels of depressive symptoms in

**Table 2** Summary of model fit indices

| Number of class | Log likelihood | BIC | LMR test | BLRT test |
|---|---|---|---|---|
| Junior high school (Y1 to Y3) | | | | |
| 1 | −14,452.12 | 28,959.51 | – | – |
| 2 | −13,998.58 | 28,076.11 | 0.000 | 0.000 |
| 3 | −13,738.79 | 27,580.23 | 0.055 | 0.000 |
| 4 | −13,535.73 | 27,197.79 | 0.000 | 0.000 |
| Senior high school (Y4 to Y6) | | | | |
| 1 | −10,473.24 | 21,000.94 | – | – |
| 2 | −10,131.43 | 20,340.66 | 0.000 | 0.000 |
| 3 | −9804.45 | 19,710.04 | 0.002 | 0.000 |
| 4 | −9567.16 | 19,258.80 | 0.000 | 0.000 |

Numbers reported in the columns of LMR Test and BLRT Test are *p*-values
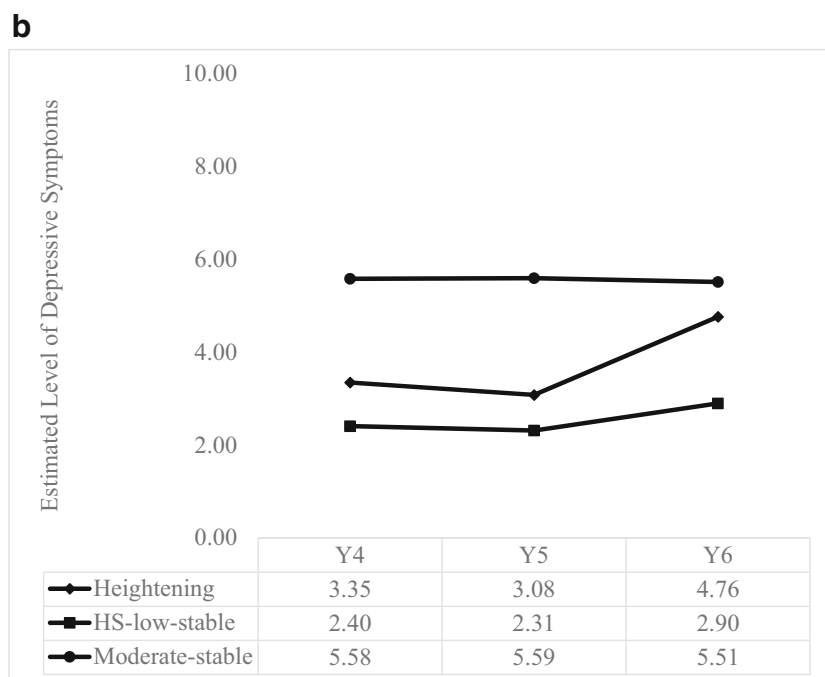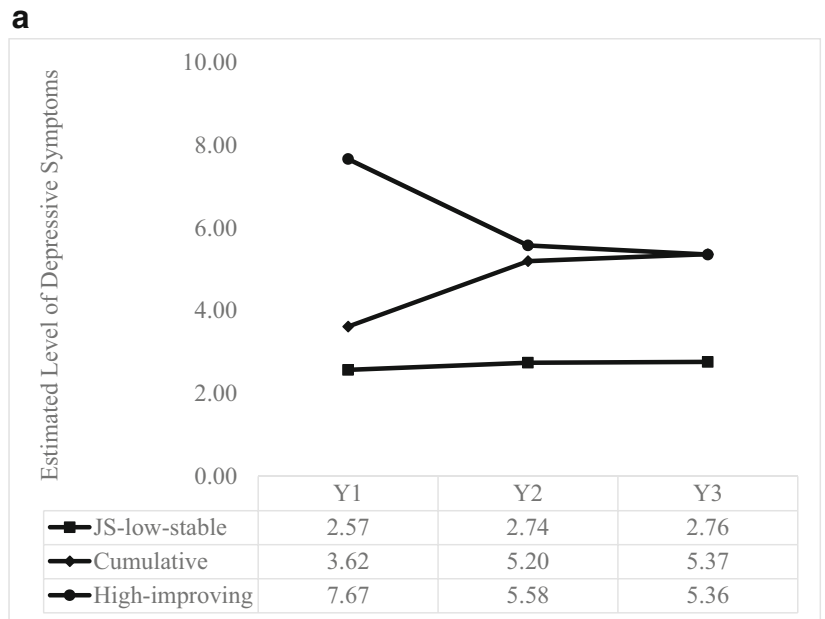
*BIC* Bayesian Information Criterion, *LMR* Lo-Mendell-Rubin test, *BLRT* bootstrapped likelihood ratio test

**Table 3** Proportions of headcount of each developmental trajectory

| Junior high school class | Senior high school class | | | Total |
|---|---|---|---|---|
| | Heightening | HS-low-stable | Moderate-stable | |
| JS-low-stable | 7.4% | 67.0% | 2.5% | 76.9% |
| Cumulative | 12.6% | 1.3% | 2.9% | 16.8% |
| High-improving | 1.6% | 2.9% | 1.8% | 6.3% |
| Total | 21.6% | 71.2% | 7.2% | 100.0% |

Cell entries are percentages of each combination of developmental trajectories across junior and senior high school, based on the headcount of each combination relative to the sample; therefore, the summation of the nine cells would be 100%

**Fig. 2** Estimated mean scores of depressive symptoms by stage and time point. **a** Estimated mean scores of depressive symptoms for each junior high school class (possible scores ranged between 2.00 and 10.00). **b** Estimated mean scores of depressive symptoms for each senior high school class (possible scores ranged between 2.00 and 10.00)



**a**

| | Y1 | Y2 | Y3 |
|---|---|---|---|
| JS-low-stable | 2.57 | 2.74 | 2.76 |
| Cumulative | 3.62 | 5.20 | 5.37 |
| High-improving | 7.67 | 5.58 | 5.36 |

**b**

| | Y4 | Y5 | Y6 |
|---|---|---|---|
| Heightening | 3.35 | 3.08 | 4.76 |
| HS-low-stable | 2.40 | 2.31 | 2.90 |
| Moderate-stable | 5.58 | 5.59 | 5.51 |

junior high school (i.e., from Y1 to Y3), separated by class membership.

During senior high school (HS; also see Table 3), the first class was termed *heightening* because students in this class (21.6% of the study sample) reported a similar level of depressive symptoms during the first two years of senior high school. Afterward, however, the level of symptoms elevated. The second class was termed *HS-low-stable*. Similar to the *JS-low-stable* class, these students showed depressive symptoms that were relatively low between Y4 and Y6 and comprised the most populous class in senior high school (71.2%). However, students in the *HS-low-stable* class seemed to present more severe depressive symptoms in Y6 than in Y4. The remaining 7.2% of students were named *moderate-stable* because their depressive symptoms presented a relatively stable growth trajectory from Y4 to Y6, but were more pronounced than those in the *HS-low-stable* class. Panel B in Fig. 2 presents estimations of depressive symptoms for the three classes during Y4 to Y6 (i.e. senior high school).

## Transition Probability in Developmental Trajectories of Depressive Symptoms Between Junior and Senior High School

As shown in Table 4, students in the *JS-low-stable* class in junior high school tended to stay in the *HS-low-stable* class in senior high school (probability = 83.0%), while those classified in the *cumulative* class in junior high school were more likely to be grouped in the *heightening* class in senior high school (probability = 68.3%). However, students in the *JS-low-stable* class still had a 17.0% chance to report a higher level of depressive symptoms during senior high school: 3.8% to the *moderate-stable* and 13.2% to the *heightening* group. Besides a high probability of transitioning to the *heightening* group in senior high school, students in the *cumulative* group would have about 20.0% probability to exhibit a steady, moderate level of depressive symptoms during senior high

school (i.e., the *moderate-stable* group), and another 11.5% chance to report a low level of symptoms throughout senior high school (i.e., the *HS-low-stable* group). Finally, students in the *high-improving* class in junior high school had a similar chance to transition to one of the three classes in senior high school.

## Moderators of Transition Probability

Adolescents' gender and parents' behavioral control (separated into paternal and maternal control) were entered into the LT-GMM in the third step. Contrary to our hypotheses, adolescent boys and girls did not differ in the probability of transitioning from one developmental trajectory of depressive symptoms in junior high school to the other in senior high school (see Table 5 for a summary). The presence of paternal and maternal behavioral control did not alter the transition probability between junior and senior high school, with only one exception: under a higher level of paternal behavioral control, adolescents grouped in the *high-improving* trajectory in junior high school would be more likely to be classified into the *moderate-stable* trajectory in senior high school than into the *HS-low-stable* group. In other words, despite the lowering depressive symptoms towards the end of junior high school, these adolescents would have a moderate level of depressive symptoms in senior high school if they perceived that their fathers enforced more behavioral control during the last year of junior high school.

## Depressive Symptoms in Early Adulthood

Students also presented distinctive yet diverse patterns in the development of depressive symptoms following senior high school graduation (see Table 6 for details). We found that, on average, students who reported a low level of depressive symptoms in junior high school (i.e., the *JS-low-stable* and the *high-improving* group) would also have a relatively low level of symptoms in early adulthood if they remained in the

**Table 4** Transition probabilities

| Junior high school class | Senior high school class | | | Total |
|---|---|---|---|---|
| | Heightening | HS-low-stable | Moderate-stable | |
| JS-low-stable | 13.2% | 83.0% | 3.8% | 100.0% |
| Cumulative | 68.3% | 11.5% | 20.1% | 99.9% |
| High-improving | 31.3% | 35.8% | 32.8% | 99.9% |

Cell entries are the probabilities of transitioning from one class in junior high school to another in senior high school. For example, students classified in the *JS-low-stable* class in junior high school would have 13.2% chance to transition to the *heightening* class, 83.0% chance to the *HS-low-stable* class, and 3.8% chance to the *moderate-stable* class in senior high school. The summation of percentage values of each row may not be 100% due to rounding

**Table 5** Summary of moderation effect of gender and parental behavioral control

| Junior high school class | Senior high school class | Moderator | Logit (SE) | OR |
|---|---|---|---|---|
| JS-low-stable | Heightening | Gender[a] | 1.26 (0.70) | 3.52 |
| | | MBC | −0.14 (0.31) | 0.87 |
| | | PBC | 0.14 (0.31) | 1.15 |
| | HS-low-stable | Gender | 0.08 (0.52) | 1.08 |
| | | MBC | 0.15 (0.21) | 1.16 |
| | | PBC | 0.12 (0.20) | 1.12 |
| Cumulative | Heightening | Gender | −0.90 (0.64) | 0.41 |
| | | MBC | 0.42 (0.28) | 1.52 |
| | | PBC | −0.18 (0.29) | 0.83 |
| | HS-low-stable | Gender | −0.28 (0.41) | 0.76 |
| | | MBC | −0.15 (0.18) | 0.86 |
| | | PBC | 0.17 (0.17) | 1.19 |
| High-improving | Heightening | Gender | −0.19 (0.80) | 0.83 |
| | | MBC | −0.33 (0.32) | 0.72 |
| | | PBC | −0.07 (0.31) | 0.94 |
| | HS-low-stable | Gender | 0.52 (0.62) | 1.67 |
| | | MBC | 0.05 (0.23) | 1.06 |
| | | PBC | −0.55 (0.25) | 0.58* |

The reference class of senior high school class was *moderate-stable*. For students grouped in the *High-improving* class in junior high school, they were more likely to be grouped in the *moderate-stable* class in senior high school, instead of in the *HS-low-stable* class, when they reported a higher level of paternal behavioral control

*MBC* Maternal behavior control, *PBC* Paternal behavioral control

*$p < 0.05$

[a] The reference group was adolescent boys

*HS-low-stable* group in senior high school. Students who started in the *cumulative* group in junior high school, followed by being classified into the *moderate-stable* group in senior high school, would have depressive symptoms of the greatest severity within two years after graduating from senior high school. In addition, those starting from the *high-improving* group in junior high school and proceeding to the *heightening* class in senior high school would also have a moderate level of depressive symptoms in Y7 and Y8. Figure 2 further illustrates the estimated level of depressive symptoms across the eight waves of data, separated by the class membership in junior and senior high school. Overall, the nine trajectories of depressive symptoms are summarized in Fig. 3.

## Discussion

The current study describes preliminary findings pertaining to the heterogeneous development of depressive symptoms among adolescents in Taiwan. Our findings are in line with most of the recent results reported in the West (e.g., Brendgen et al. 2005; Brière et al. 2015; Brook et al. 2015; Cumsille et al. 2016; Musliner et al. 2016). According to self-reported depressive symptoms, more than 70% of the adolescents in this study stayed away from being adversely affected by school transition or the high-stakes exams between junior and senior high school. They also demonstrated considerable fluidity in their developmental trajectories before and after this

**Table 6** Estimated levels of depressive symptoms after high school

| Junior high school class | Senior high school class | | | | | |
|---|---|---|---|---|---|---|
| | Heightening | | HS-low-stable | | Moderate-stable | |
| | Y7 | Y8 | Y7 | Y8 | Y7 | Y8 |
| JS-low-stable | 5.07 | 4.18 | 2.32 | 3.02 | 2.83 | 4.53 |
| Cumulative | 3.09 | 4.54 | 6.50 | 3.72 | 6.19 | 5.56 |
| High-improving | 5.61 | 4.99 | 2.20 | 3.40 | 3.89 | 4.69 |

Cell entries are estimated mean levels of depressive symptoms in Y7 and Y8, separated by the class membership in junior and senior high school. Possible scores ranged between 2.00 and 10.00
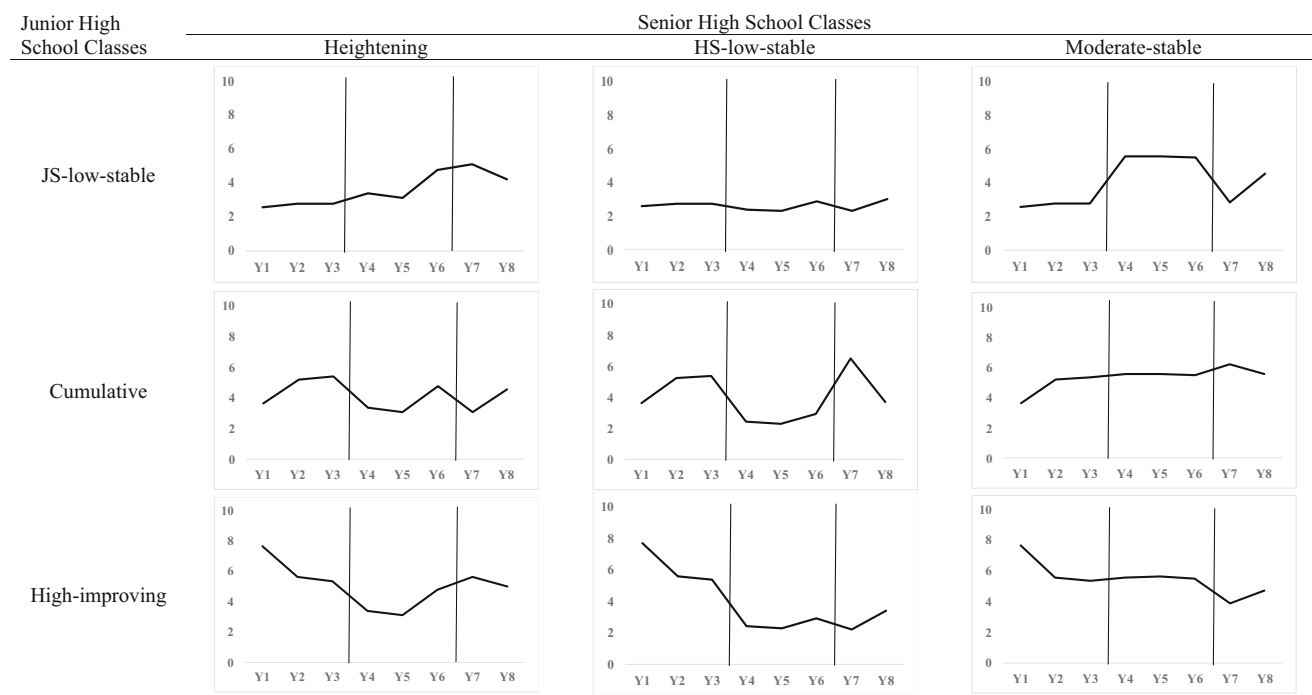
**Fig. 3** Estimated mean scores of depressive symptoms with distal outcome. *Note*. The horizontal axis denotes the waves of data collection (from Y1 to Y8), the vertical axis the estimated level of depressive symptoms, and the two vertical lines transitions between schools (the left one represents the transition from junior to senior high school, and the right one from senior high school to college or workforce). Possible scores ranged between 2.00 and 10.00

stressful life event. Furthermore, it was shown that the severity of depressive symptoms in early adulthood might be traced back to the symptoms reported in junior and senior high school. Most youths kept a low level of depressive symptoms across junior and senior high school, as if the school transition had little impact on them. These results indicate that students are generally resilient against the stress stemming from school transition and high-stakes exam, and that this resiliency extends beyond senior high school. This finding also resonates with several studies conducted with youths in Europe and North America, where a majority of adolescents do not suffer from severe depressive symptoms (e.g., Dekker et al. 2007; Measelle et al. 2006).

Contrary to prior literature, which implied several but fixed developmental trajectories of symptoms, the current study demonstrated a sizable fluidity of the developmental trajectories over time: the probability of transitioning to a more worrying trajectory ranged between 3.8% and 68.3% (e.g., from *JS-low-stable* to *HS-moderate-stable* trajectory). Such fluidity was found to be the greatest for adolescents exhibiting a lowering level of depressive symptoms by the end of junior high school (i.e., the *high-improving* trajectory). They were estimated to have equal chance to transition to one of the three classes of depressive symptoms in senior high school. In other words, the experience of school transition plays a crucial role in shaping their future mental well-being as they recover from more severe depressive

symptoms. Parents, teachers, and counselors should pay special attention to this group of students, in that they may be sensitive to certain experiences, which may not be observed in the current study, that drive them to different directions of development.

To further understand the relationship between transition experience and the development of depressive symptoms following transition, we adopted an ecological perspective advocated by the life course theory (Elder 1994). Paternal behavioral control, reflected in fathers' attempts to prepare their children for the upcoming high-stakes exam by imposing new restrictions on their leisure activity, seemed to exacerbate the mental well-being of some adolescents, specifically, those who have recovered from a high level of depressive symptoms. It is plausible that these adolescents were more sensitive to new pressure and restrictions, given the history of a heightened level of symptoms. Additionally, they seldom experience such level of paternal restrictions until preparing for the high-stakes exam, in that culturally, the nature of Chinese parental control is a mixture of perceived parental expectations and relatively loose parental discipline (Shek 2007). It could be challenging for some adolescents when both school and home environments are changing. Another possible explanation is that fathers might take more direct means to enforce the new restrictions and were perceived as intruding their children's autonomy, given that the traditional belief of "strict father, lenient mother" is still prevalent in Taiwan (Chen 2005).

Scholars have long argued that behavioral control, or parental monitoring as some researchers use these terms interchangeably, is associated with positive psychosocial development for adolescents (Barber et al. 2005; Kerr and Stattin 2000). However, these parenting strategies would have a detrimental effect when adolescents perceive them as intrusive (Kakihara and Tilton-Weaver 2009; Poulin et al. 2012; Rote and Smetana 2016), and it could be particularly disruptive for adolescents recovering from a high level of depressive symptoms. It is likely that paternal behavioral control disrupted the improvement of mental well-being and directed these adolescents to experience a moderate level of depressive symptoms until early adulthood.

It is surprising that adolescent boys and girls did not differ in the transition probability when stepping into senior high school. The disparity of the development of depressive symptoms between gender has been widely documented in both Western countries and Taiwan (Brière et al. 2015; Brook et al. 2015; Huang and Lin 2010; Salk et al. 2017), and researchers have argued that adolescent girls may be more susceptible to the negative impact of stress encompassing puberty (Eccles et al. 1993), negative attribution of the self (Kouros and Garber 2014), or more likely to express distress through internalizing behavior (Strong et al. 2016). We further demonstrated that adolescent boys and girls in Taiwan might be influenced by the stress of exam preparation and school transition in a comparable way or at a similar degree. In a more recent study conducted by Sze et al. (2013), they found that gender did not predict the progression of depressive symptoms of Taiwanese adolescents in the context of entrance examination stress. In other words, Taiwanese adolescents may be equally susceptible to such pressure, which contradicts prior research based on Western adolescents (Chen et al. 2009). More research is needed to clarify the relationship between gender, school transition, and adolescents' depressive symptoms in Taiwan.

Finally, given the great heterogeneity of depressive symptoms in early adulthood, it seems that individuals' earlier depressive symptoms in secondary school have limited predictability of that in early adulthood. Prior research based on Canadian youths (Ferro et al. 2015; Rawana and Morgan 2014) has reported a cubic growth trajectory of depressive symptoms between 12 and 25 years of age, demonstrating that the development of symptoms in early adulthood may be distinctive from that of adolescence. For Taiwanese youths, it is likely that the entry to early adulthood opens up yet another set of new challenges that were not captured in this study, which need to be plotted to understand the development of symptoms at this stage (Elder 1994). For example, young adults' perceptions of meeting parental expectations regarding academic and career achievement (e.g., attending a top-tier senior high school or college, landing an acceptable job), or parents' disappointment thereof, is a salient factor that is related to young adults' mental well-being in Taiwan (Crystal et al. 1994; Lin et al. 2008; Wang 2012). Following life course perspective, researchers in the future could further examine how parents' reactions to adolescent child's transitions are related to youths' mental well-being longitudinally.

## Implications

Future researchers may want to further tackle questions the current study invoked. To account for the factors that can alleviate or exacerbate the mental well-being of students in the present study, we encourage future researchers to further explore culturally relevant factors affecting the development of depressive symptoms, when replicating the empirical findings, in addition to the ones included in the present study. For example, it is unclear why nearly one in five adolescents reporting a low level of depressive symptoms across junior high school would exhibit a heightened level of symptoms in senior high school. Recent empirical studies have identified several factors which are related to the development of depressive symptoms during adolescence (as either predictors or outcomes). These include intra-individual factors, such as personality (Prinzie et al. 2014) and self-esteem (Zeiders et al. 2013). Researchers have also investigated how parenting practices (Cumsille et al. 2016), academic performance (Brière et al. 2015), peer relationships and social competence (Benner et al. 2017; Korhonen et al. 2014), and substance abuse (Brook et al. 2015; Willoughby and Fortner 2015) are related to depressive symptoms. Negative environmental influences, such as socioeconomic status and other stressful life events, have also been documented in recent studies (e.g., Fernandez Castelao and Kröner-Herwig 2013; Musliner et al. 2016).

Based on the aforementioned pioneering work, we argue that in the next step, researchers should examine social and cultural variables pertinent to the development of depressive symptoms among adolescents and how to clinically intervene. This line of studies would further provide a valuable reference for counseling professionals to better address mental health needs and devise culturally responsive prevention and intervention programs. For example, future studies conducted in Taiwanese or East Asian cultures that are dominated by Confucianism (Chao and Tseng 2002) could focus on the impact of relational factors, such as family and familism (e.g., parenting practices; Chao 1994; Wang et al. 2015). Studies based on Western samples have underscored the importance of a balance between familial and peer relationships during adolescence (Aldeis and Afifi 2013; Brown and Bakken 2011; Tilton-Weaver et al. 2013), as well as peer networks that could mitigate individuals' anxiety and improve adjustment when entering senior high school or college (Chow et al. 2015; Swenson et al. 2008). It is likely that these factors are equally

critical for Taiwanese adolescents (Chang 2007; Tung and Wang 2007). Moreover, since the high-stakes exam directly tracks students into a college-preparation or a vocational senior high school, such life-changing events may affect youths' mental health, as parents and other family members generally expect students to follow a particular career path. As a result, academic stress accumulates and may lead to conflicts when expectations are not met (Shek 2005). In contrast, these familial variables and practices are central to Confucianism. When managed well, they may be the key to cultivating adolescents' resiliency against the pressure from academics and school transition.

Future research should also keep modeling the multitudinous development of depressive symptoms rather than recognizing it as a uniform trend. Previous researchers have shown that a one-size-fits-all approach does not accurately describe the diversity of adolescent development in western cultures, and our results indicate that this is also true for adolescents in Taiwanese culture. Recent statistical advances have allowed researchers to adopt a more flexible approach when exploring the multi-faceted development of depressive symptoms over time by incorporating auxiliary variables into the LTA model (Nylund-Gibson et al. 2014). We advocate the use of these flexible statistical techniques to explore fluidity in the development of depressive symptoms.

In addition, given the availability of the data, researchers in the future could examine major developmental trajectories of depressive symptoms in early adulthood and empirically estimate how individuals transition from one trajectory in late adolescence to another in early adulthood. At the same time, factors potentially shaping such transition can be incorporated to identify the salient predictors of the development in individuals' depressive symptoms across adolescence and adulthood. Such knowledge could have practical implications to inform educators and researchers to sort through the sophisticated heterogeneity and fluidity of different trajectories. Research in the future could address how the fluctuation of symptoms in adolescence predicts the onset of major depression in young adults, as well as measure causal factors that might account for the trajectories observed in the present study. To aid professionals in clinical settings, researchers could consider incorporating clinically proven diagnostic tools (e.g., Major Depression Inventory; Bech et al. 2001) so that the results can be combined with the history of depressive symptoms and gain a more comprehensive picture of how individuals' depressive symptoms unfold. Counselors should be aware of the heterogeneity of the developmental trajectory of symptoms, though most students may exhibit a steadily low level of depression.

Finally, a few limitations should be noted when interpreting the findings of the present study. First of all, although we adopted a longitudinal approach for data collection and analysis, our findings are correlational, not causal. Falling within a given developmental class during junior high school does not cause the development of depressive symptoms afterward. Second, many East Asian countries share a similar educational and curricular system (e.g., mandatory high-stakes high school and college entrance exams), but whether our results can be generalized to youths in other countries and cultures is not empirically clear. Third, while we have considered the role of gender and parents' behavioral control that encompassed school transition in shaping the developmental trajectory of depressive symptoms, other unobservable variables could be at play and contribute to the development of symptoms. As stated above, culturally relevant factors should be addressed to examine how such variables affect the developmental trajectories. Fourth, the moderate attrition rate over the eight waves of data collection could bias the results. Though the statistically non-significant Little's MCAR test indicated that the missingness was not related to any observable data and full information maximum likelihood technique was applied throughout the analysis, potential biases cannot be completely ruled out. Future research could consider a cross-validation procedure to further understand the influence of missingness on the results. Finally, all of the variables analyzed in the present study were based on self-report data, and participants' responses may be biased because of the condition of data collection or other unobserved influences. Researchers in the future could consider a multiple-informant design to address possible biases from self-report data.

## Compliance with ethical standards

**Conflict of Interest**   The authors declare that they have no conflict of interest.

**Ethical Approval**   All procedures performed in studies involving human participants were in accordance with the ethical standards of the national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent**   Informed consent was obtained from the principals of participating juinior high schools *in loco parentis*.

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