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A Tangled Web: The Reciprocal Relationship between Depression and Educational Outcomes in China

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Keywords

depression, educational achievement, educational attainment, reciprocal relationship

Disciplines

Early Childhood Education | Education | Family, Life Course, and Society | Inequality and Stratification | Social and Behavioral Sciences | Sociology

Comments

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Key Words

depression, educational achievement, educational attainment, reciprocal relationship

Introduction

Much research has revealed a negative association between depression and educational outcomes (e.g., Clayborne et al., 2019; McLeod & Kaiser, 2004; Needham et al., 2004). However, most prior research has focused on a unidirectional relationship, examining either how depression affects educational outcomes or how educational outcomes influence depression. Without consideration of reciprocal effects, the estimate of one's effect on the other may be biased. In addition, although many studies have analyzed how educational attainment affects depression (e.g., Bauldry, 2015; Ross and Mirowsky, 2006), little is known about how the other educational outcome – educational achievement – affects depression. This limits the development of a complete understanding of the relationship between depression and educational outcomes.

To address this gap, this researcher examines China as a case study to investigate the reciprocal relationship between depression and educational outcomes. China has the largest education system in the world, with 260 million students enrolled in nearly 51,400 schools in 2013 (OECD, 2016). China's exam-oriented education system is highly competitive and produces much pressure on students (Deng and Guo 2007; Li et al., 2012; Yu and Suen 2005). For most Chinese students, the transition to a higher level of education depends solely on their scores on admission examinations. For this reason, educational performance is extremely important for students in China – more so than in most western countries (Stevenson, 1994). Few studies have examined how Chinese students' depression and educational outcomes interact in the context of this education system, and how their interaction is affected by students' families, schools, and peers in everyday life.

This researcher investigates, first, whether there is a reciprocal relationship between depression and educational outcomes (both achievement and attainment) in China and, second, what mechanisms link educational achievement to depression. To answer these questions, three large-scale datasets are analyzed using structural equation modeling: the China Family Panel Studies (CFPS, 2010, 2012, 2014), the China Education Panel Survey (CEPS, 2013-2014), and the Gansu Survey of Children and Families (GSCF, 2000, 2009, 2015).

The following sections first review the existing literature on depression and educational outcomes. Next, the research questions, data, and methods for analysis are outlined, and the key results are presented. This paper ends with a discussion and conclusions.

Literature Review

Depression is a mood disorder that causes a persistent feeling of sadness and loss of interest (Akhtar, 2016; Hughes et al., 2015). It is one of the most common mental health problems among children worldwide (Bhatia and Bhatia, 2007; Heller, 2016). While depression relates to the non-cognitive aspect of child development, education often reflects child development's cognitive aspect. Education is also a highly influential factor in children's future social status (Hauser, 1994; Mirowsky, 2017). The interplay between depression and educational outcomes affects not only children's well-being but also the complex process of social stratification since health and education are two critical dimensions of social stratification (Binelli et al., 2015).

Current literature on depression and education focuses on the relationship between depression and two educational outcomes – achievement and attainment. Educational achievement refers to a student's academic performance in school, measured by test scores or GPA, and is a short-term outcome evaluated while children are attending school. Educational attainment refers to the highest level of education, or total years of education, that a student has completed. It is a more stable outcome, evaluated when formal schooling has finished and is often an indispensable indicator of socioeconomic status. As educational achievement and educational attainment measure different aspects of education, it is informative to examine how both relate to depression. The following section provides a brief review of the literature on depression and these two outcomes.

Educational achievement and depression

Depression is associated with cognitive decline or cognitive impairment (e.g., Gilchrist and Creed, 1994; Rock et al., 2014; Starkstein et al., 1992), which can impede one's learning process. Thus, depression is commonly found to reduce educational achievement (e.g., Crystal et al., 1994; Ding et al., 2006; Owens et al., 2012). For example, in China, a two-wave study of 540 sixth-grade children randomly sampled in Shanghai showed that prior depression negatively

predicted subsequent educational achievement reported by teachers (Chen and Li, 2000). Another study of 55 children aged 6–13 years from three elementary schools in Finland found that even mild symptoms of depression were associated with poorer working memory and more concentration difficulties, both of which corresponded to teacher-reported academic performance (Aronen et al., 2005).

An alternative explanation for the negative association between depression and educational achievement is the high expectation for educational achievement. For instance, a study of 123 10th–12th-grade students showed that a discrepancy between their personal standards and actual performance led to an increase in their depression levels (Accordino et al., 2000). In addition to children's expectations for themselves, their parents' expectations may be important (Lee et al., 2006). An analysis of 872 adolescents from secondary schools in Hong Kong showed that higher parental expectations significantly increased students' levels of depression, and higher levels of depression were negatively associated with academic performance (Ma et al., 2018).

To the extent that expectations for educational achievement play a role, the negative association between depression and educational achievement would be expected to be stronger in cultures where academic achievement is particularly emphasized. For example, this situation prevails in China, where there is a longstanding cultural tradition linking educational achievement to financial success and social status (Hesketh and Ding, 2005). A comparative study that examined the correlation between symptoms of depressed mood and academic achievement among adolescents in the U.S. and China showed that poorer academic achievement was more strongly associated with depressive symptoms among Chinese youth than among U.S. youth (Greenberger et al., 2000).

Along with the above studies of how depression affects or is associated with educational achievement, some literature has examined how educational achievement affects subsequent depression, with mixed findings. Some research has shown that higher educational achievement protects against subsequent depression. For example, a longitudinal study analyzed data from a sample of 2,745 urban elementary school children aged 6–11 years and found that prior educational achievement was negatively related to later depression (Morales and Guerra, 2006). A meta-analysis of 24,557 participants in 43 studies consisting of 50 samples showed that prior high academic achievement was associated with lower subsequent depression when controlling

for prior depression. Hence, prior academic achievement had a protective overall effect on subsequent depression after controlling for initial depression, even if the protective effect was not very large (Huang, 2015).

However, there are also studies that found no association between educational achievement and depression (e.g., Chen and Li, 2000). For instance, a study compared 1,386 American, 1,633 Chinese, and 1,247 Japanese 11th-grade students, and found that high academic achievement was generally not associated with psychological maladjustments including depression (Crystal et al., 1994).

Despite their diverse findings, most studies of the relationship between depression and educational achievement share a major limitation: each study explores only the association between depression and educational achievement, or the unidirectional relationship of how one affects the other, rather than how the two affect each other. This can result in three problems. First, if the relationship between depression and educational achievement is reciprocal, the unidirectional estimate of one's effect on the other will be biased. Second, without considering the effect of educational achievement on depression, it is impossible to identify all the primary causes of depression, which will ultimately increase the difficulty of depression prevention. Third, mechanisms linking educational achievement to depression are still not well documented. Current studies have focused on individual cognitive function or stressful events to explain the association between depression and educational achievement. However, the mechanisms through which educational achievement affects depression, particularly in the cultural and social contexts, have rarely been studied. The uncertainty around these mechanisms hinders the understanding of whether there is a causal relationship between educational achievement and depression and of the nature of that relationship.

Educational attainment and depression

Although several studies have shown that educational attainment is uncorrelated with depression (e.g., Berndt et al., 2000; Miech et al., 1999; Nishimura, 2011), most have demonstrated a negative association between educational attainment and depression (e.g., Fergusson et al., 2007; Fergusson and Woodward, 2002; Fletcher, 2010). Research on the negative relationship between educational attainment and depression has followed two theoretical approaches: dropout theory and protection theory.

Dropout theory (known as “selection” in some literature) argues that children with depression have lower academic competence and a higher chance of dropout, which eventually results in lower educational attainment. Studies based on this theory may or may not make claims of causality, but their commonality is to treat depression as an independent variable and emphasize the negative effect of depression on educational attainment (e.g., Fletcher, 2010). For example, Fergusson and Woodward (2002) examined a birth cohort of 1,265 children born during mid-1977, using data from the New Zealand Christchurch Health and Development Study. They found that adolescents aged 14–16 with depression were at increased risk of school failure and were less likely to enter college or pursue another form of tertiary education.

Protection theory (known as “causation” in some literature) argues that higher educational attainment provides advantages that protect against depression, and that people with higher educational attainment thus have lower levels of depression. It treats educational attainment as an independent variable and emphasizes the protective effect of educational attainment on depression. Many studies have, implicitly or explicitly, subscribed to protection theory (e.g., Hu and Hibell, 2013; Ross and Mirowsky, 2006). For instance, Chevalier and Feinstein (2006) analyzed data from the National Child Development Study, which surveyed all the children born in Britain during a given week of 1958. Results showed that education reduced people’s risk of becoming depressed and that reaching the Ordinary Level (O Level) educational qualification led to a reduction in the probability of depression for both men and women.

Despite these findings, current studies on the relationship between educational attainment and depression continue to have a major limitation. In the existing literature, educational achievement prior to the first measure of depression is rarely controlled for when analyzing the relationship between educational attainment and depression. Educational achievement is a strong predictor of educational attainment. As the preceding literature suggests, educational achievement may also predict subsequent depression. Therefore, the association between educational attainment and depression may merely be due to their common cause – educational achievement. Thus, educational achievement prior to both educational attainment and depression must be controlled to avoid the problem of spurious association. Since educational achievement always precedes educational attainment, it is critical to have educational achievement measured prior to the first measure of depression. In the current literature, however, educational achievement is rarely measured before the first measure of depression, which undermines the

effectiveness of controlling for the confounding effect of initial educational achievement, even if educational achievement is included as a control variable (e.g., Fletcher, 2010).

In summary, existing studies on the relationship between depression and educational outcomes have three major limitations. First, most of these studies have focused only on a unidirectional relationship between depression and educational outcomes. Neglecting the reciprocal nature of this relationship may lead to a biased estimation of the effect of one on the other. Second, the mechanisms linking educational achievement to depression have not been fully revealed, which limits our understanding of how educational achievement could affect depression. Third, when examining the relationship between depression and educational attainment, the confounding effect of initial educational achievement prior to both depression and educational attainment has rarely been ruled out. Controlling for educational achievement prior to the first measure of depression will not only help us reveal the true mechanisms that link depression and educational attainment but will also help uncover the long-term effect of educational achievement on depression.

Research Questions and Hypotheses

Learning is a process that involves cognition. According to the cognitive theory of depression, people who are more prone to depression are characterized by cognitive vulnerability (Haaga et al., 1991; Lakdawalla et al., 2007), which can disadvantage their educational outcomes. Meanwhile, educational outcomes can act as an indicator of socioeconomic status (Hauser, 1994; Mirowsky, 2017) or ability as suggested by signaling theory (Adams and Demaiter, 2008; Spence, 1978). Consequently, those with better educational outcomes may receive preferential treatment (e.g., less criticism) and have more access to resources (e.g., higher income) which protect them against depression. Thus, the relationship between depression and education can be reciprocal. This research tests and analyzes this reciprocal relationship empirically, examining three major questions.

First, is there a reciprocal relationship between educational achievement and depression? Depression can weaken one's cognitive ability and impede one's learning process (Gilchrist and Creed, 1994; Quiroga et al., 2013; Rock et al., 2014), which reduces educational achievement. Meanwhile, in a culture like China's, where great importance is attached to educational achievement (Hesketh and Ding, 2005; Stevenson, 1994), the pursuit of high educational

achievement may result in high levels of stress, which is a common cause of depression (Hammen, 2005; Kendler et al., 1999). Thus, it can be hypothesized that there is a reciprocally negative relationship between educational achievement and depression. This reciprocal relationship should be analyzed by estimating the effect of previous educational achievement (or previous depression) on both subsequent educational achievement and subsequent depression. This leads to the first hypothesis.

Hypothesis 1. Higher educational achievement reduces the level of subsequent depression, and a high level of depression also lowers subsequent educational achievement.

The second question is: What are the mechanisms that link educational achievement to depression? According to Bronfenbrenner's human ecology theory, five components form the microsystem which has the most immediate and direct impact on children's development – peers, family, school, religious institutions, and neighborhood (Bronfenbrenner, 1981; Rosa and Tudge, 2013). Among these five components, children's peers, family, and school are not only typically aware of their educational achievement, but they also interact with children differently based on their educational achievement. The mechanisms linking educational achievement to depression will accordingly be examined from the perspectives of peers, family, and school.

Given that high achievement is a gold standard in China's education system, research has found that high-achieving students have advantages in status and popularity among their peers (Chiang, 2017; Y. Li et al., 2012; Niu et al., 2016). For instance, Chiang (2017) performed an ethnography study that showed that Chinese students use academics as the primary criterion to establish status hierarchy and that those with the highest academic achievement are placed at the top of the hierarchy. There has been much evidence suggesting that high status and popularity among peers can protect against depression (Field et al., 2001; Greca and Harrison, 2005; Nangle et al., 2003). On the contrary, in a climate where academic achievement is highly valued, low-achieving students are at a higher risk for peer victimization (Card and Hodges, 2008), and peer victimization can lead to depression (Hawker and Boulton, 2000; Klomek et al., 2008). In short, high-achieving children are less likely to feel unfriendliness from peers, which results in lower levels of depression.¹

¹ This does not imply that unfriendliness is the only mediating mechanism by which high status affects depression. Rather, unfriendliness is one of the diverse possible mechanisms that may link high status and depression, and this paper only focuses on unfriendliness.

Most Chinese parents have high expectations for their children's educational achievement (e.g., Dandy and Nettelbeck, 2002; Francis and Archer, 2005; Stevenson et al., 1993). In the 2010 China Family Panel Studies (CFPS), 79.75% of parents reported they expected their children to achieve an average score of 80 out of 100, and 47% expected their children to achieve over 90 out of 100 (Institute of Social Science Survey, 2010). Facing these widespread high expectations from parents, it is likely that high-achieving students feel less pressure than low-achieving students since the former can perform better on exams than the latter.

Further, educational achievement affects not only students' chances of admission to better schools, but also the evaluation of teachers' performance. For this reason, compared with high-achieving students, low-achieving students are more likely to receive teachers' criticism. Teachers' criticism has been found to be associated with children's feelings of stress, helplessness, and negative self-judgment (Heyman et al., 2001; Kontos and Wilcox-Herzog, 1997), all of which can lead to depression. Based on the above evidence, a second hypothesis is proposed.

Hypothesis 2. Higher educational achievement leads to less peers' unfriendliness, less pressure from parents' expectations, and less teachers' criticism, which results in a lower level of depression.

In the Chinese culture and education system, hard work is valued by both students and their parents. A comparative study showed that more Chinese than American students (59% vs 27%) regarded studying hard as the most important factor for good academic performance (Stevenson et al., 1993). According to the 2010 CFPS, 64.28% of parents, when asked the most common remedy for children's unsatisfactory academic achievement, stated that their children should work harder (Institute of Social Science Survey, 2010). The most common evidence of hard work is spending more time on studies. While more time on studies may improve academic performance, it can also reduce leisure-time physical activity and increase sleep debt, both of which can increase the risk for depression (Chang et al., 1997; Kremer et al., 2014; Mikkelsen et al., 2010). This leads to the third hypothesis.

Hypothesis 3. More time on studies leads to higher educational achievement at the cost of a higher level of depression.

The final question examined in this paper is as follows: How do educational attainment and depression interact in the long term? The negative association between educational attainment and depression has two major explanations – dropout theory and protection theory. Dropout theory emphasizes that children with depression have lower academic competence (Cornell et al., 2013; Quiroga et al., 2013) and thus fall behind others and drop out of school earlier, resulting in lower educational attainment. Protection theory underscores education’s protective effect against depression. Current literature suggests four advantages of higher educational attainment: learned effectiveness (which makes individuals better at acquiring health information), better work and economic conditions, more social-psychological resources and social support, and healthier lifestyles (Lahelma et al., 2004; Mirowsky, 2017; Ross and Wu, 1995; Winkleby et al., 1992).

In the previous literature, the dropout and protection theories have been examined separately. However, these two theories can coexist and take effect sequentially. Further, since the above hypotheses have stated that educational achievement can affect depression, and since educational achievement is a strong predictor of educational attainment, an examination of the relationship between educational attainment and depression should also control for the confounding effect of educational achievement prior to both depression and educational attainment, in order to avoid the problem of spurious association. These suppositions suggest the fourth hypothesis:

Hypothesis 4. After controlling for educational achievement, a higher level of early depression can still lower educational attainment; and after controlling for early depression, higher educational attainment can still lower the level of future depression.

These hypotheses are illustrated in the conceptual map depicted in Figure 1. In the conceptual map, Question One (Hypothesis 1) is addressed in the period spanning from Time 1 to Time 2. Question Two (Hypothesis 2 and Hypothesis 3) is examined at Time 1. Addressing Question Three (Hypothesis 4) involves the analysis of all stages from Time 1 to Time 3.

(Figure 1)

Data and Method

Data

The researcher analyzed three datasets since no individual dataset is ideally suited for all the analytic goals of this paper. Data from the CFPS (2010, 2012, 2014) were analyzed to answer Question One, which asks if there is a reciprocal relationship between educational achievement and depression. The CFPS is the only nationally representative dataset in China that contains more than three waves of measurement of children's depression and education. This enables the analysis of the reciprocal relationship between depression and educational achievement. The CFPS collects longitudinal data about individuals, families, and communities in contemporary China. Approximately 15,000 families were interviewed for the 2010 baseline survey. During each wave, children aged 10–15 were surveyed regarding their mental health. A total of 1,137 children were matched across the three waves from 2010 to 2014 for the measures of mental health.

The researcher analyzed data from the China Education Panel Survey (CEPS, 2013-2014) to answer the second question regarding the potential mechanisms linking educational achievement to depression, which is equivalent to test the second and the third hypotheses. The CEPS is a nationally representative longitudinal survey tracing the influence of family, school, community, and society on educational outcomes. It is the only nationally representative dataset in China that includes measures of students' family, school, and peers, which are necessary to examine the mechanisms linking educational achievement to depression. At the time of this research, only the first wave of data was publicly available. A total of 19,487 7th and 9th graders were sampled in this initial survey.

The researcher examined data from the Gansu Survey of Children and Families (GSCF, 2000, 2009, 2015) to answer the final question about how depression and both educational outcomes – achievement and attainment – affect each other in the long term. The GSCF is a longitudinal, multi-level study of children's welfare outcomes, including education, health, and psycho-social development in the Gansu province of China. Two thousand children, ages 9–12, were first interviewed in 2000, and 1,613 of these subjects participated in follow-up interviews in 2015. Although not nationally representative, the GSCF is the only currently-available dataset in China that can trace education outcomes and child development from childhood to adulthood,

which makes it suitable for analyzing the long-term relationship between depression and educational outcomes.

Measures

There are two approaches to the assessment of depression in the existing literature. The first approach is the categorical diagnosis. It is a dichotomous measure, based on the number and duration of symptoms described in the Diagnostic and Statistical Manual of Mental Disorders (DSM) or the International Statistical Classification of Diseases and Related Health Problems (ICD), which diagnoses whether or not an individual has the mental disorder of depression. The second approach is the dimensional scale. It evaluates depression by rating along a continuum the presence, frequency, or intensity of symptoms during a specific timeframe. This approach does not yield a binary result but reveals the likelihood and severity of depression. The present research, like most survey studies, adopts the dimensional approach. Thus, when depression is referred to in the following sections, it does not necessarily indicate a confirmed diagnosis of depression. Rather, it refers to the dimensional scale of depression, for which “a higher level of depression” signifies a higher likelihood or severity of depression.

Variables in the China Family Panel Studies (CFPS)

The researcher used the CFPS measures of depression and educational achievement for 2010, 2012, and 2014. Depression was addressed in six items in 2010 and 2014: feeling frustrated, feeling nervous, feeling unsettled, feeling hopeless, feeling everything is difficult, and feeling life is meaningless. For each item, participants rated the frequency of these feelings on a scale of 1 to 5 to denote *almost every day, two or three times per week, two or three times per month, once per month, and never*. Each item was then reverse-coded so that higher values meant more depressed. Since this was not a standard measure of depression, a latent variable for depression was created, using these six items as indicators to allow for measurement error. This analysis used the reflective measurement approach, which means the latent variable is assumed to cause the indicators. Each latent variable has at least two reflective indicators. In the 2012 wave, depression was measured by the widely-accepted 20-item CES-D scale (Center for Epidemiological Studies-Depression). Each item ranged from 0 to 3, with higher values indicating more depressed. A summative score of these 20 items indicated the level of depression in this wave. The Cronbach’s alpha reliability score was 0.81.

A word recognition test and a math test measured educational achievement in each wave. Both tests were adjusted for respondents' age differences. The latent variable approach has been used to allow for measurement errors. This treats the two scores of the word recognition and math tests as indicators of educational achievement.

Variables in the China Education Panel Survey (CEPS)

The researcher used the CEPS measures of educational achievement, depression, peers' unfriendliness, teachers' criticism, pressure from parents' expectations, time on studies, and family socioeconomic status. The survey's Chinese, math, and English test scores were averaged and used as the measure of educational achievement. These three scores were school-standardized to allow for comparability across schools. Depression was measured using the frequencies of experiencing the following five feelings in one week: feeling frustrated, feeling depressed, feeling unhappy, feeling that life is meaningless, and feeling sad. Respondents reported these frequencies using a scale of 1 to 5 denoting *never*, *seldom*, *sometimes*, *often*, and *always*, respectively. Thus, higher values indicated more depression. The researcher used a latent variable analysis approach to allow for measurement errors and to guarantee the quality of the measure of depression using these five items.

Peers' unfriendliness and teachers' criticism were measured using the following two items: "Teachers often criticize you" and "You feel peers surrounding you are unfriendly." Respondents rated these statements on a scale of 1 to 4 denoting *totally disagree*, *disagree*, *agree*, and *totally agree*. Thus, higher numbers represented more unfriendliness or criticism. Pressure from parents' expectations was measured using responses to the question, "How do you feel about parents' expectations?" with a scale of 1 to 5 denoting *no pressure at all*, *a little pressure*, *moderate pressure*, *a comparatively large amount of pressure*, and *a lot of pressure*. Thus, higher values represented more pressure. Respondents reported the average number of hours per day in one week spent on assignments and tutorial classes and this number was used as the measure of time on studies.

The subjective economic conditions of family and parents' average years of education served as the measure of family socioeconomic status. Since there was no objective measure of families' economic conditions in the CEPS, parents' rating of their family's economic conditions was used, with a scale of 1 to 5 denoting *very difficult*, *difficult*, *ordinary*, *affluent*, and *very affluent*. Thus, higher values indicated more affluent family economic conditions.

Variables in the Gansu Survey of Children and Families (GSCF)

The researcher analyzed the GSCF measures of educational achievement in 2000, family socioeconomic status in 2000, depression in 2009 and 2015, and educational attainment in 2015. Educational achievement was measured using the Chinese and math test scores reported by teachers in the last semester of 2000. As these were not objective measures, a latent variable of educational achievement was used to account for measurement errors. Depression was first measured in 2009 with the abbreviated 12-item CES-D scale, which is validated and used widely in the literature (e.g., Assari and Moazen-Zadeh, 2016; Foley et al., 2002; Poulin et al., 2005; Surkan et al., 2012). Subsequent depression in 2015 was measured with another shortened (10-item) form of the CES-D scale, also validated and used in many studies (e.g., Andresen et al., 1994; Baron et al., 2017; González et al., 2017; Huang et al., 2015). On both scales, a range of 1 to 4 on each item indicated *never*, *occasionally*, *sometimes*, and *often* for the frequency of each depressive symptom. Thus, higher values indicated a higher likelihood of depression. The Cronbach's alpha reliability scores for depression in 2009 and 2015 were 0.75 and 0.74, respectively.

Based on their age, sampled children should have completed formal education before 2015, and thus the measure of depression in 2015 took place after the completion of educational attainment. This circumstance enabled the estimation of the effect of educational attainment on depression. Educational attainment was measured using the total years of education completed. Parents' average years of education and family income per capita in 2000 (unit is 1,000 *yuan*), were used as measures of family socioeconomic status and were included as control variables.

Method

The researcher utilized structural equation modeling (SEM) for analyses. Four advantages of SEM make it an appropriate method to examine the reciprocal relationship between depression and educational outcomes. First, SEM can estimate different equations simultaneously, enabling the modeling of the reciprocal relationship between depression and educational outcomes. Second, it allows for the inclusion of latent variables with measurement errors, such as the latent variable of depression in this study. Third, it includes a convenient and powerful technique for handling missing data, the full information maximum likelihood (FIML) method, which is used in this study. As compared with conventional multiple imputation, which

uses two models (imputation model and analysis model) that may produce incompatibility, the FIML method uses only one model – the real analysis model. Thus, results are unaffected by the imputation model, and are also asymptotically efficient (Allison, 2015). Fourth, in addition to the typical hypothesis testing, SEM features an overall goodness-of-fit test of the entire model.

The researcher specified a cross-lagged structural equation model (Model 1) to answer Question One. Educational achievement and depression are modeled as affecting each other in the immediate following wave (the “cross” part). Prior educational achievement as a lagged dependent variable is modeled to affect subsequent educational achievements, to control for past characteristics of the individual (the “lagged” part), and the same rule applies to depression. The error terms of educational achievement and depression are correlated in each wave, which indicates that, at the same time point, educational achievement and depression, though not directly affecting each other, are not independent but are correlated. The model is depicted in Figure 2.

(Figure 2)

To answer Question Two, educational achievement is modeled to directly influence peers’ unfriendliness, pressure from parents’ expectations, and teachers’ criticism, all of which are modeled to affect depression. Time spent on studies is assumed to affect both educational achievement and depression. Further, family SES is modeled to affect educational achievement, depression, and pressure from parental expectations. Since educational achievement and depression were measured in the same wave, it is difficult to isolate the effect of educational achievement on depression from the effect of depression on educational achievement. Thus, in this model, there is no direct effect modeled between educational achievement and depression. Rather, their error terms are correlated with each other, which indicates that educational achievement and depression are in fact correlated, even if the effect direction is not specified. This model (Model 2) is depicted in Figure 3.

(Figure 3)

To answer Question Three, educational achievement in 2000 is modeled to affect subsequent depression in 2009 (as in Hypothesis 1) and to affect educational attainment as measured in 2015. Depression in 2009 is modeled to influence subsequent educational attainment (dropout theory) and depression in 2015. Educational attainment is assumed to affect

depression in 2015 (protection theory). Parents' average years of education and family income in 2000, used as indicators of family SES, serve as control variables for educational achievement and educational attainment.² The error terms of early educational achievement (in 2000) and early depression (in 2009) are modeled to be correlated to account for the possibility that other variables may affect both of them, in order to arrive at accurate parameter estimates (Bocell, 2015). Following the same logic, the error terms of later educational attainment (in 2015) and later depression (in 2015) are also correlated. This model is depicted in Figure 4.

(Figure 4)

Results

All descriptive statistics for the three datasets are listed in Table 1. Children's average word test and math test scores in the CFPS both increased from 2010 to 2014. The average rating score for each depressive symptom increased slightly, although all average rating scores were approximately 1.5, which falls between *never* and *once per month*. In the CEPS, the average rating score for each depressive symptom was approximately 2, indicating *seldom*. These measures of depression in the CFPS and the CEPS may indicate that, although children's average depression slightly increased over time, their average depression level was not high. The CEPS survey also showed that, on average, children in junior middle school spent approximately 3.5 hours per day on assignments and tutorial classes. Their average level of pressure from parents' expectations was slightly over 3 (*moderate pressure*) while the average rating scores for peers' unfriendliness and average teachers' criticism were quite low – both below 2 (*disagree*). In the GSCF, respondents' average years of education was 11.2, which is very close to high school (12 years). Their average depression levels increased from 2009 to 2015, although the average depression level in 2015 was still not high (average rating score for each depressive symptom was approximately 2 or *occasionally*).

(Table 1)

² For a robustness check, the possibility that family SES in 2000 can affect depression in 2009 and 2015 is also tested. However, results indicate that there is no significant effect of family SES in 2000 on subsequent depression in 2009 and 2015. The likelihood ratio test suggests that there is no significant difference between the simple model (Model 3 in this paper, which does not include the specified effect of family SES in 2000 on depression in 2009 and 2015) and the complex model (the tested alternative model with specified effect of family SES in 2000 on depression in 2009 and 2015). Thus, the simple model (Model 3 in this paper) is chosen.

Question One asks whether there is a reciprocal relationship between educational achievement and depression. The model results are shown in Table 2, and the path diagram and standardized coefficients are shown in Figure 2. These results show a reciprocal and negative relationship between depression and educational achievement. For instance, Figure 2 shows that a one-standard-deviation increase in educational achievement in 2010 corresponds to a 0.111-standard-deviation decrease in depression in 2012, and a one-standard-deviation increase in depression in 2010 corresponds to a 0.068-standard-deviation decrease in educational achievement in 2012. To increase the power of hypothesis testing, the unstandardized coefficients for the same pair of variables across two waves are constrained to be the same.³ In general, one unit increase in depression corresponds to a 0.07-unit decrease in subsequent educational achievement, and one unit increase in educational achievement corresponds to a 0.139 unit decrease in subsequent depression, as shown in Table 2. These results are consistent with Hypothesis 1. This implies that students may be caught in a vicious spiral of worsening educational achievement and depression if, at the starting point, either educational achievement or depression is disadvantaged, and if there is no interim process that counters this disadvantage.

Table 2 also shows the goodness-of-fit test statistics for Model 1. Standardized Root Mean Square Residual (SRMR) is not reported because of missing values. The Chi-square test of model fit is significant, which seems to indicate a poor fit. However, since the Chi-square test is very sensitive to sample size, this test alone cannot determine the goodness-of-fit. The other goodness-of-fit statistics all indicate that the model fits the data well. The Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) are both above the 0.90 threshold, and the Root Mean Squared Error of Approximation (RMSEA) is 0.035, which is below 0.05. Therefore, the model can be accepted.

(Table 2)

Table 3 and Figure 3 display analysis results related to the second question regarding the potential mechanisms linking educational achievement to depression. Consistent with Hypothesis 2, educational achievement negatively corresponds to peers' unfriendliness, pressure from

³ Results do not differ significantly in both effect direction and magnitude if this constraint is removed. For example, without this constraint, the unstandardized coefficients for the effect of achievement in 2010 on depression in 2012 and the effect of achievement in 2012 on depression in 2014 will be -0.129 and -0.118, respectively. These two are very similar and thus can be constrained to be the same which will both facilitate interpretation and increase the power of hypothesis testing.

parents' expectations, and teachers' criticism, and these three factors positively correlate to depression. For example, a one-standard-deviation increase in educational achievement corresponds to a 0.093-standard-deviation decrease in pressure from parents' expectations, and a one-standard-deviation increase in pressure from parents' expectations corresponds to a 0.151 increase in depression. Thus, peers' unfriendliness, pressure from parents' expectations, and teachers' criticism are mediators for the negative relationship between educational achievement and depression. More time on studies is not significantly related to better educational achievement but significantly corresponds to a higher level of depression, which is only partly consistent with Hypothesis 3.

Children with higher family SES feel less pressure from parents' expectations. The reason for this could be that, in China, parents' expectations for their children's educational achievement is universally high and is also largely independent of their economic level (Pandey and Zhan, 2000). In such a case, compared with children from higher-SES families, children from lower-SES families have fewer resources to improve their educational achievement. With almost equivalently-high expectations, yet fewer resources, children from low-SES families may feel more pressure due to their parents' expectations. Another finding illustrated in Figure 3 is that the more pressure perceived from parents' expectations, the more time children spend on studies, although more time on studies is not significantly associated with higher educational achievement.

The goodness-of-fit test statistics for Model 2 are listed at the end of Table 3. It is difficult to achieve a p-value over 0.05 for the Chi-square test when the sample size is this large (19,486) since the Chi-square test is very sensitive to sample size. Therefore, a small p-value from the Chi-square test does not necessarily mean a poor fit. The RMSEA (0.039) is less than 0.05, and the CFI (0.971) and the TLI (0.957) are both greater than 0.90. Thus, all these statistics indicate that the model fits the data well.

(Table 3)

Table 4 and Figure 4 show results related to the final question regarding the long-term interplay between depression and both educational outcomes – achievement and attainment. After controlling for family SES (parents' average education and economic status) as well as children's early educational achievement in 2000, both of which strongly affect educational attainment, depression in 2009 still lowers educational attainment in 2015. Specifically, a one-

standard-deviation increase in depression in 2009 corresponds to a 0.056-standard-deviation decrease in total years of education. In addition, even after controlling for the prior level of depression in 2009, final educational attainment still protects against depression in 2015, with a one-standard-deviation increase in total years of education corresponding to a 0.2-standard-deviation decrease in depression in 2015. Therefore, the long-term relationship between depression and educational attainment is a reciprocal relationship: they can negatively affect each other.

It is worth noting that the effect of educational achievement on depression persists in the long term. Early educational achievement in 2000 is negatively linked to depression in 2009: a one-standard-deviation increase in educational achievement in 2000 reduces 0.413 standard deviation of depression in 2009, which is consistent with the above findings from Model 1. Educational achievement also has an indirect impact on later depression via educational attainment, which again indicates that educational achievement can affect depression in addition to being affected by depression.

Table 4 also shows the goodness-of-fit statistics for the overall model. The Chi-square test has a high p-value (0.6853), the RMSEA is less than 0.001, the CFI is equal to 1, and the TLI is 1.003 (TLI is usually between 0 and 1, but is also normal when it slightly exceeds 1). All these statistics point to the conclusion that the model fits the data well.

(Table 4)

Discussion

This study finds a reciprocally negative relationship between depression and educational outcomes. Specifically, depression lowers later educational achievement, and higher educational achievement reduces the level of subsequent depression, which operates through less peers' unfriendliness, less pressure from parents' expectations, and less teachers' criticism. Contrary to traditional beliefs, more time spent on studies does not correspond to higher educational achievement, but it significantly increases the level of depression. Moreover, children from lower SES families face more pressure from parents' expectations and thus spend more time on studies, which only associates with a higher level of depression. From a long-term perspective, after controlling for the confounding effect of initial educational achievement, a higher level of

depression lowers educational attainment, and higher educational attainment also protects against subsequent depression after controlling for prior depression.

As with any research project, this study is not without limitations. First, the researcher uses three datasets for this study, with each dataset answering a specific question regarding the reciprocal relationship between depression and educational outcomes. More datasets provide larger variability to test the robustness of the theory. For instance, the negative effect of educational achievement on subsequent depression revealed by data from the CFPS is verified when examining the relationship between depression and educational attainment using data from the GSCF. However, the use of different participants from different datasets makes it unclear how the complex relationships among depression, educational achievement, and educational attainment change from childhood to adulthood.

Also, the measure of educational achievement in the CFPS and the measure of depression in the CEPS are not the standard measures. There is no technique to completely overcome these intrinsic limitations to the dataset. The latent variable approach utilized in this study is the best strategy to adjust for possible measurement errors since it allows for and quantifies measurement errors.

The age differences among the sample subjects, resulting from using three datasets in the three analytical models, may draw criticism. As explained in the preceding sections, there is no single dataset suitable for all analyses. However, even with three datasets used, there are no fundamental age differences among the children sampled. The GSCF initially sampled children at ages 9-12, and the subjects of the CFPS were first interviewed at ages 10-11. These two samples are in the same age range. The CEPS includes 7th and 9th graders, who should be 13-15 years old according to the common school enrollment policy and practice in China. The CFPS subjects were last interviewed at ages 14-15, which also overlapped with the sample in the CEPS. Thus, the age differences in the three analytical models are due more to the different requirements of time spans for different questions than to fundamental differences in age among the children sampled.

In light of these limitations, future research may benefit from a more detailed longitudinal dataset with standardized measures of depression, educational outcomes, and changes in family, community, and school environment. Such a dataset will enable a description of the trajectories

of the interactive relationships among depression, educational achievement, and educational attainment for the same participants from childhood to adulthood.

Future research may also explore cohort, gender, and regional differences in the reciprocal relationship between depression and educational outcomes. Much research has shown cohort, gender, and rural-urban differences in depression or educational outcomes (e.g., Breen et al., 2009; Piccinelli and Wilkinson, 2000; Qian and Smyth, 2008; Twenge and Nolen-Hoeksema, 2002). But the differences in the reciprocal relationship between depression and educational outcomes are still unclear. Future research can examine questions such as what the different effect sizes are, whether there are different mediators, and how the reciprocal relationships change over time for children of different ages, genders, and regions.

Beyond this, future researchers may also investigate whether the reciprocal relationship between depression and educational outcomes exists and unfolds differently across different cultures. The reciprocal relationship between depression and educational outcomes in China is rooted in an exam-oriented system, where test scores are the dominant criteria used to select and evaluate students, and in a culture in which people tend to link educational achievement to financial success and social status (Hesketh and Ding, 2005). A similar reciprocal relationship may also be found in societies with similar education systems or cultures, such as in other East Asian countries.

In western countries which differ from the Chinese culture, the relationship between depression and educational outcomes may differ, at least in the mechanisms of operation. For example, this paper identifies peers' unfriendliness as a mechanism through which educational achievement affects depression. One reason this mechanism can take effect is that students in China establish hierarchies according to academic performance (Chiang, 2017) and those of lower status are more likely to be victimized by peers. In other countries where academic performance is not the most critical standard for evaluating peers, the hierarchy among students may follow different rules, which may invalidate or change the mechanism of peers' unfriendliness. Given the diversity in cultures and education systems, more research should be conducted to examine how the relationship between depression and educational outcomes varies across countries.

Although this paper focuses on the case of China, it has broader implications. First, the findings from this paper can enrich our global understanding of the bidirectional relationship

between depression and educational outcomes and can identify the diverse mechanisms by which these are linked. This may supplement the research toolkit for examining these issues in different cultures.

Second, this paper may offer nuance to the current literature highlighting China's strong performance in comparative assessments of students' educational achievement (Reinikainen, 2012; Zhang and Kong, 2012), which has prompted many laudatory calls from other nations to learn from China in math and science education (Asia Society, 2006; Stevenson, 1994). However, Chinese students' high achievement is not without cost. The results reported here may provide needed perspective for weighing the advantages and disadvantages of different education systems, by going beyond educational outcomes to considering students' psychological well-being.

Conclusions

Utilizing three large-scale datasets, this paper reveals a reciprocal and negative relationship between depression and educational outcomes. Prior depression is associated with lower educational achievement. Higher educational achievement is associated with less peers' unfriendliness, less pressure from parents' expectations, and less teachers' criticism, which corresponds to lower levels of subsequent depression. Children from lower-SES families bear more pressure and spend more time on studies. Though more time spent on studies does not correspond to higher educational achievement, it does significantly increase levels of depression. In the long term, prior depression lowers educational attainment and, after controlling for prior depression, lower educational attainment is also associated with higher levels of subsequent depression.

These findings have several theoretical implications. First, much literature has shown that China's exam-oriented educational system produces high levels of achievement (e.g., Ho, 2009; Y. Li et al., 2012; Sellar and Lingard, 2013) at the cost of high pressure and low psychological well-being among students (e.g., Li, 2017; Sun et al., 2013; Tan, 2017). However, by simultaneously examining Chinese students' depression and educational achievement, this paper demonstrates that low achievers are more likely to bear the major psychological burden of this pressure and that the psychological tolls of low achievement tend to reinforce educational disadvantage.

Second, this research contributes to the theories of educational mobility and social reproduction. With education serving as a form of social reproduction, this research demonstrates that children from lower-SES families have lower educational outcomes not only because they have fewer economic, social, and cultural resources, but also because the disadvantages associated with lower SES have a “drag” effect on their education, through the interaction between education and mental health. Educational opportunities in the exam-oriented education system are heavily dependent upon test scores, which reduces the influence of family SES (Hu and Kao, 2018). However, children from lower-SES families are under more pressure due to parents’ high educational expectations which corresponds to more time spent on studies. The higher perceived pressure and increased time spent on studies do not correspond to higher educational achievement (Ma et al., 2018) but to higher levels of depression, which in turn reduces students’ subsequent educational achievement and attainment. In this case, low family SES has a “drag” effect on children’s education through the mechanism of depression.

Third, related to the sociology of mental illness, this research shows that the relationship between education and depression can be reciprocal. In addition to the widely-recognized evidence that depression has detrimental effects on educational outcomes, lower educational achievement can also increase the risk of depression by incurring more peers’ unfriendliness, more pressure from parents’ expectations, and more teachers’ criticism. If a student starts with low educational achievement or with elevated levels of depression and does not receive sufficient support from schools and family, he or she may become stuck in a vicious spiral, which may eventually be associated with poorer educational outcomes and increased depression.

Finally, in the arena of education policy and practice, this research sheds light on the need to protect students’ mental health. Most mental disorders start during youth (12–24 years of age) and mental disorders account for a large proportion of the disease burden among children and adolescents in all societies (Patel et al., 2007). While schools have been recognized as a unique and valuable setting for mental health promotion, most mental health service needs are unmet, even in wealthy countries (Patel et al., 2007). In China, the country with the world’s largest population and education system, data from the 2012 CFPS showed that approximately 20% of children ages 10–15 (or more than 150 million children) may be depressed. However, the 2013-2014 CEPS showed that 70% of students indicated that their school has no psychological counseling facility or that the facility is outdated.

This mismatch between the critical importance of early intervention in mental health issues and the lack of available school services in this area points to an urgent need for better psychological support for students. By thoroughly examining the relationship between depression and education, this research suggests that academically-vulnerable students are at heightened risk for psychological problems. Thus, well-being programs and counseling initiatives may find value in focusing screening and support efforts on academically-vulnerable students. Due to the reciprocal interaction between depression and education, protecting children against depression may have an additional positive effect: it may boost their academic performance, which will have long-term implications for children's development.

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Tables and Figures

Table 1 Descriptive Statistics

	Mean	SD	Min	Max	N
<i>CFPS 2010, 2012, 2014</i>					
Word Test 2010	17.869	6.938	0	34	1129
Math Test 2010	7.844	3.022	0	24	1129
Feeling Frustrated 2010	1.556	0.985	1	5	1121
Feeling Nervous 2010	1.609	1.073	1	5	1129
Feeling Unsettled 2010	1.394	0.880	1	5	1127
Feeling Hopeless 2010	1.247	0.726	1	5	1127
Feeling Everything Is Difficult 2010	1.470	0.947	1	5	1127
Feeling Life Is Meaningless 2010	1.237	0.732	1	5	1127
Word Test 2012	6.136	1.749	1	10	839
Math Test 2012	9.623	3.393	0	15	652
Depression 2012	8.694	7.405	0	40	1083
Word Test 2014	25.186	6.794	0	34	786
Math Test 2014	12.697	4.934	0	24	786
Feeling Frustrated 2014	1.798	0.862	1	5	786
Feeling Nervous 2014	1.659	0.837	1	5	786
Feeling Unsettled 2014	1.478	0.745	1	5	786
Feeling Hopeless 2014	1.319	0.758	1	5	786
Feeling Everything Is Difficult 2014	1.585	0.753	1	5	786
Feeling Life Is Meaningless 2014	1.261	0.663	1	5	786
<i>CEPS 2013-2014</i>					
Achievement	70.047	12.183	1.323	155.148	18944
Feeling Frustrated	2.265	0.978	1	5	19026
Feeling Depressed	2.008	1.044	1	5	18972
Feeling Unhappy	2.323	1.025	1	5	19007
Feeling Life is Meaningless	1.770	1.065	1	5	18960
Feeling Sad	2.073	1.026	1	5	18998
Parents' Average Years of Education	9.728	3.237	0	19	18963
Economic Conditions	2.808	0.596	1	5	18541
Pressure from Parents' Expectations	3.034	1.109	1	5	19365
Peers' Unfriendliness	1.740	0.808	1	4	19270
Teachers' Criticism	1.675	0.829	1	4	19258
Time on Studies (hour)	3.516	2.948	0	23	18335

GSCF 2000, 2009, 2015

Chinese in 2000	72.504	13.194	0	100	1951
Math in 2000	73.963	14.597	0	100	1957
Parents' Average Years of Education	5.195	3.406	0	13.5	1974
Family Income Per Capita (1,000 yuan) in 2000	1.645	2.948	0	81.32	2000
Depression in 2009	17.556	4.255	12	46	984
Depression in 2015	21.463	5.229	10	40	1366
Total Years of Education	11.235	3.529	0	19	1613

Note: Data from China Family Panel Studies (CFPS), China Education Panel Survey (CEPS), and Gansu Survey of Children and Families (GSCF).

Sample of CFPS 2010, 2012, 2014 is restricted to those who could be surveyed about mental health in all three waves by design, i.e., respondents aged 10 and 11 in 2000.

Table 2 Maximum Likelihood Parameter Estimates for the Reciprocal Relationship between Depression and Educational Achievement (Model 1)

Model 1				
Parameter	Unstandardized	SE	Standardized	P-value (two-tailed)
Achievement 2010 → Depression 2012	-0.139	0.033	-0.111	0.000
Depression 2010 → Depression 2012	0.021	0.003	0.002	0.000
Achievement 2010 → Achievement 2012	0.078	0.011	0.726	0.000
Depression 2010 → Achievement 2012	-0.070	0.025	-0.068	0.007
Achievement 2012 → Depression 2014	-0.139	0.033	-0.172	0.000
Depression 2012 → Depression 2014	0.021	0.003	0.306	0.000
Depression 2010 → Depression 2014	0.177	0.039	0.213	0.000
Achievement 2012 → Achievement 2014	0.078	0.011	0.010	0.000
Depression 2012 → Achievement 2014	-0.070	0.025	-0.104	0.006
Achievement 2010 → Achievement 2014	0.528	0.050	0.628	0.000
Goodness-of-fit Test Statistics				
$\chi^2 (df)$	346.748 (144)			
p-value	0.000			
RMSEA	0.035			
CFI	0.950			
TLI	0.940			

Note: Number of observations is 1,137.

Data from China Family Panel Studies (CFPS) 2010, 2012, 2014.

Standardized Root Mean Square Residual (SRMR) is not reported because of missing values.

Table 3 Maximum Likelihood Parameter Estimates for Mediators of the Relationship between Depression and Educational Achievement (Model 2)

		Model 2			
Parameter		Unstandardized	SE	Standardized	P-value (two-tailed)
Achievement	→	-0.013	0.000	-0.214	0.000
Peers' Unfriendliness					
Achievement	→	-0.008	0.001	-0.093	0.000
Pressure from Parents' Expectations					
Achievement	→	-0.010	0.005	-0.167	0.000
Teachers' Criticism					
Peers' Unfriendliness	→	0.176	0.007	0.191	0.007
Depression					
Pressure from Parents' Expectations	→	0.101	0.005	0.151	0.000
Depression					
Teachers' Criticism	→	0.097	0.007	0.108	0.000
Depression					
Pressure from Parents' Expectations	→	0.143	0.020	0.054	0.000
Time on Studies					
Time on Studies	→	0.004	0.007	0.004	0.631
Achievement					
Time on Studies	→	0.028	0.002	0.111	0.006
Depression					
Economic Conditions	→	1.168	0.168	0.053	0.000
Achievement					
Parents' Education	→	0.972	0.030	0.239	0.000
Achievement					
Economic Conditions	→	-0.075	0.010	-0.060	0.000
Depression					
Parents' Education	→	-0.007	0.002	-0.031	0.000
Depression					
Economic Conditions	→	-0.061	0.014	-0.033	0.000
Pressure from Parents' Expectations					
Parents' Education	→	-0.028	0.003	-0.082	0.000
Pressure from Parents' Expectations					
Goodness-of-fit Test Statistics					
χ^2 (df)		1340.851 (44)			
p-value		0.000			
RMSEA		0.039			
CFI		0.971			
TLI		0.957			

Note: Number of observations is 19,486.

Data from China Education Panel Survey (CEPS) 2013-2014.

Standardized Root Mean Square Residual (SRMR) is not reported because of missing values.

Table 4 Maximum Likelihood Parameter Estimates for the Relationships between Educational Achievement, Depression, and Educational Attainment in the Long Run (Model 3)

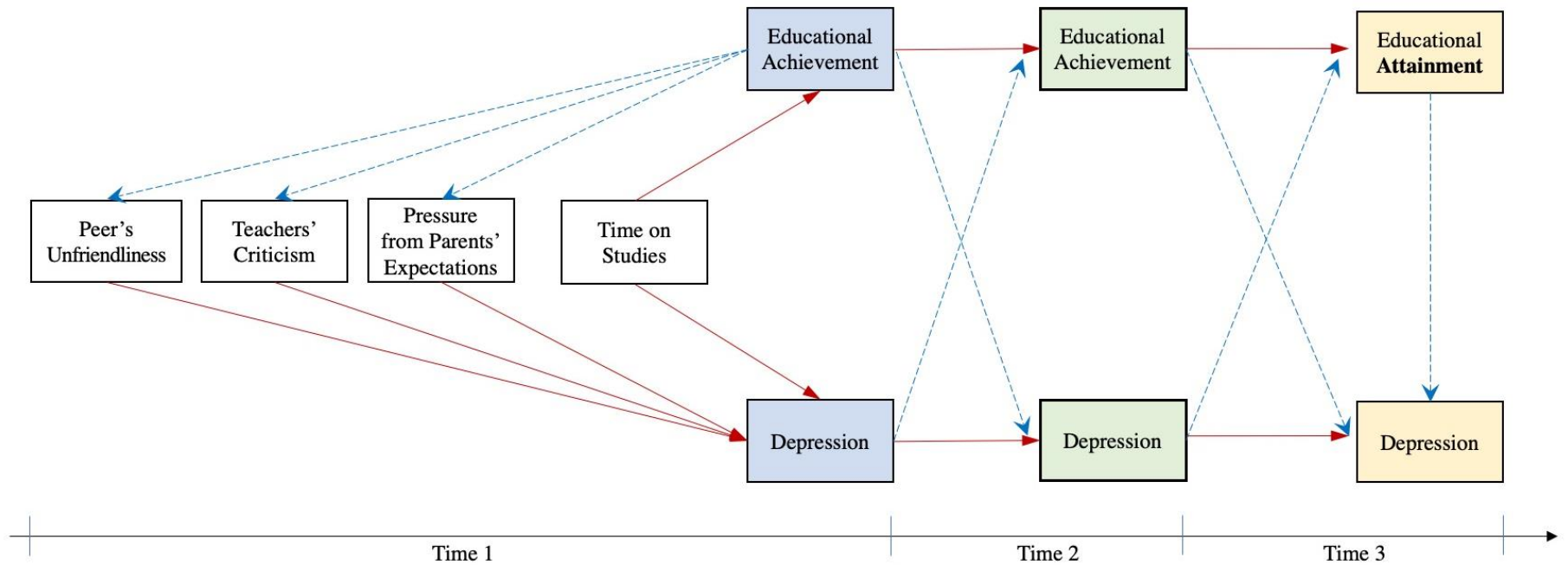
Model 3					
Parameter		Unstandardized	SE	Standardized	P-value (two-tailed)
Achievement 2000	→	-0.160	0.065	-0.413	0.015
Depression 2009					
Achievement 2000	→	0.074	0.007	0.281	0.000
Years of Education					
Depression 2009	→	-0.038	0.019	-0.056	0.046
Years of Education					
Depression 2009	→	0.153	0.030	0.187	0.000
Depression 2015					
Years of Education	→	-0.242	0.089	-0.200	0.006
Depression 2015					
Family Income Per Capita	→	0.267	0.103	0.058	0.010
Achievement 2000					
Parents' Education	→	0.606	0.094	0.153	0.000
Achievement 2000					
Family Income Per Capita	→	0.115	0.029	0.096	0.000
Years of Education					
Parents' Education	→	0.264	0.024	0.254	0.000
Years of Education					
Goodness-of-fit Test Statistics					
$\chi^2 (df)$		4.792 (7)			
p-value		0.685			
RMSEA		0.000			
CFI		1.000			
TLI		1.003			

Note: Number of observations is 2,000.

Data from GSCF 2000, 2009, 2015.

Standardized Root Mean Square Residual (SRMR) is not reported because of missing values.

Figure 1 The Conceptual Map



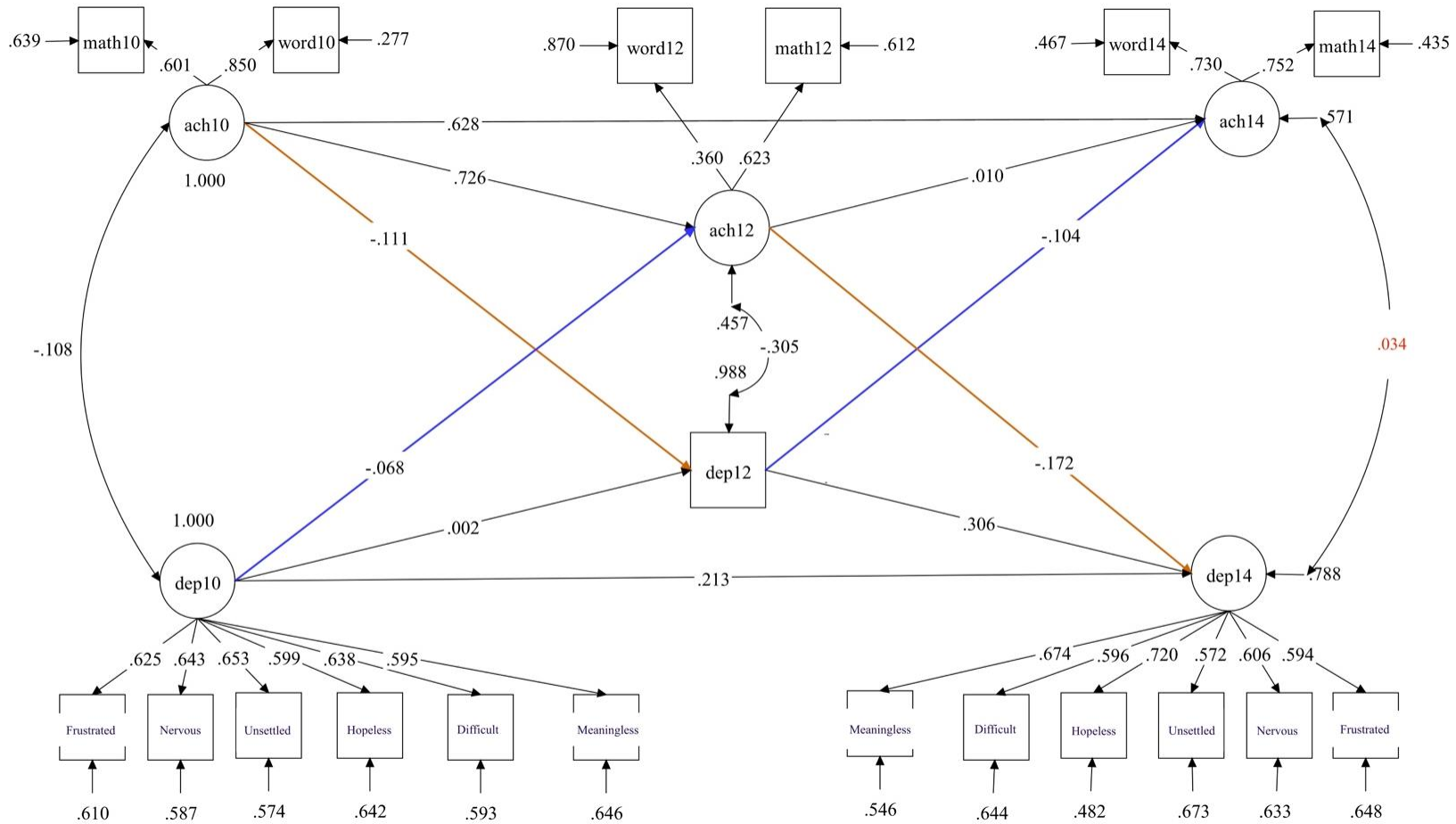
Note: Blue dashed arrows represent negative effects while red solid arrows represent positive effects.

Educational achievement is the measure of academic performance like test scores or GPA.

Educational attainment is the measure of the highest level of education like total years of education.

Time 3 is when students finish formal education. At this time, there is no measure of educational achievement since they are no longer in school.

Figure 2 Cross-lagged Structural Equation Modeling of the Relationship between Depression and Educational Achievement (Model 1)



Note: Symbols “ach”, “dep”, “math”, and “word” represent achievement, depression, word recognition test score, and math test score; the suffix “10”, “12”, and “14” indicate the year 2010, 2012, and 2014.

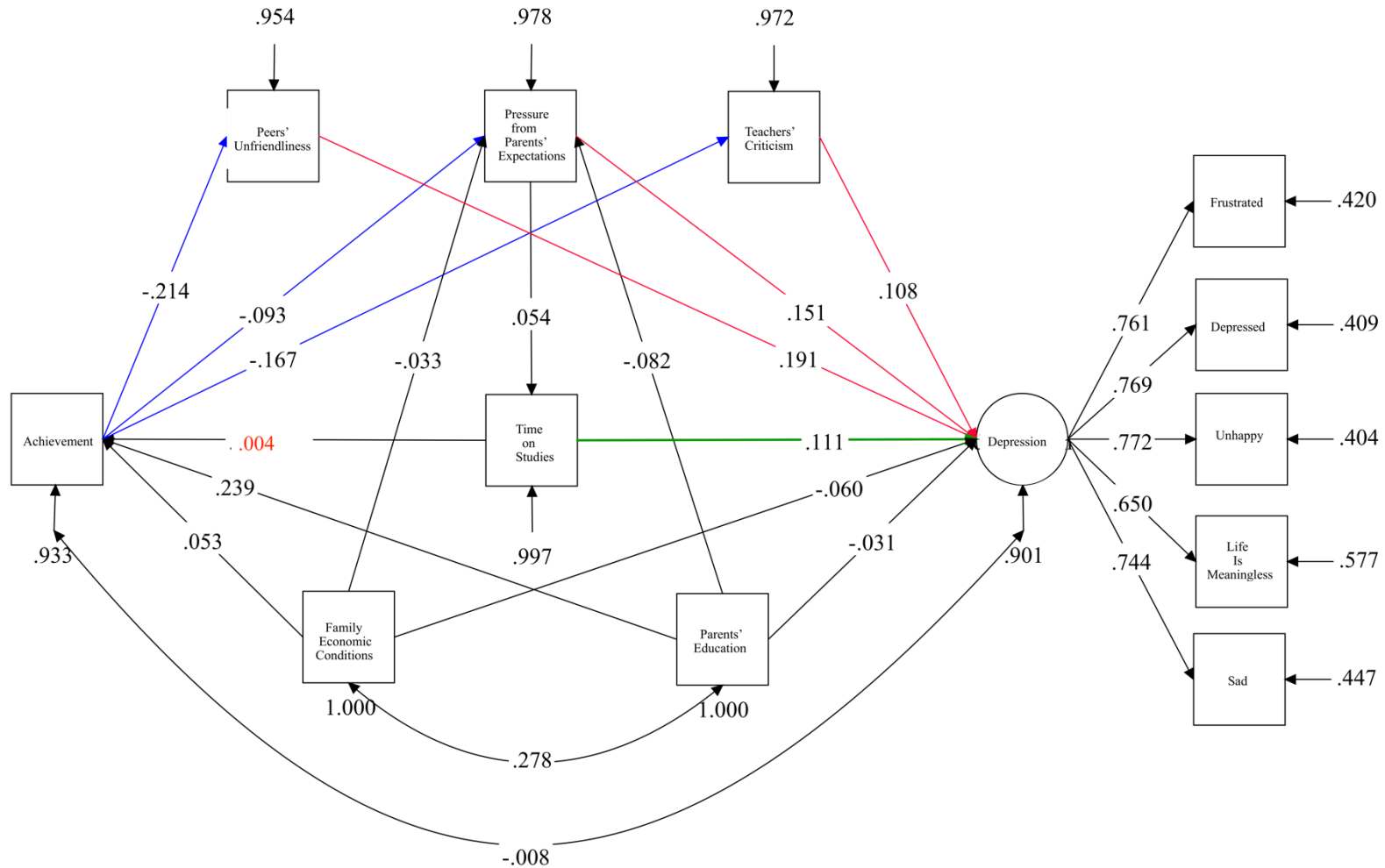
In rectangles are observed variables while in circles are latent variables.

Straight arrows represent direct effects while curved arrows are correlations.

All numbers are standardized parameter estimates; all numbers except those in red are significant at least at $p < 0.05$ level (two-tailed test).

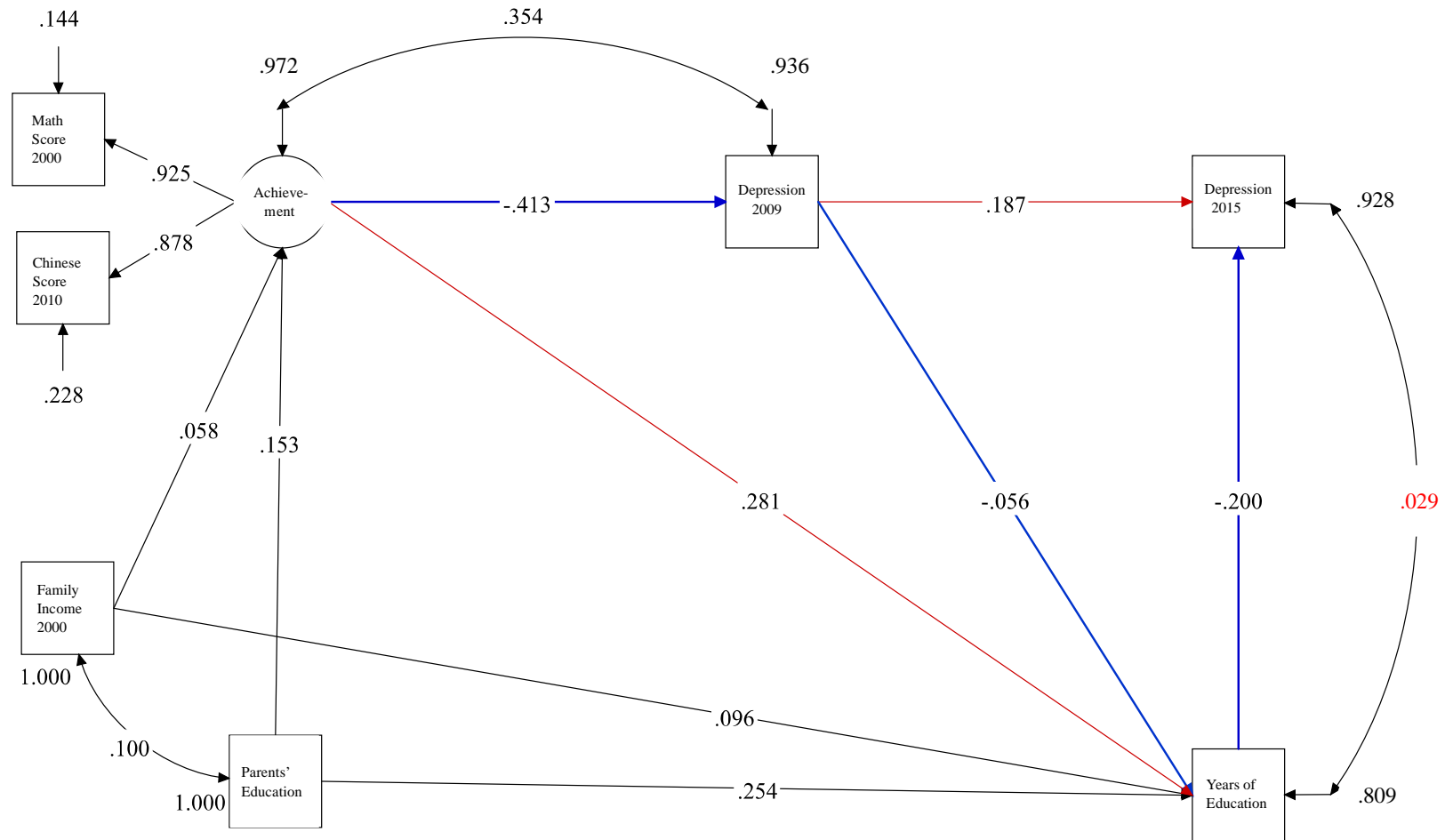
Data from China Family Panel Studies (CFPS) 2010, 2012, 2014.

Figure 3 Mediators for the Relationship between Depression and Educational Achievement (Model 2)



Note: In rectangles are observed variables while in circles are latent variables. Straight arrows represent direct effects while curved arrows are correlations. All numbers are standardized parameter estimates; all numbers except those in red are significant at least at $p < 0.05$ level (two-tailed test). Data from China Education Panel Survey (CEPS) 2013-2014.

Figure 4 The Relationships among Educational Achievement, Depression, and Educational Attainment in the Long Run (Model 3)



Note: In rectangles are observed variables while in circles are latent variables. Straight arrows represent direct effects while curved arrows are correlations. All numbers are standardized parameter estimates; all numbers except those in red are significant at least at $p < 0.05$ level (two-tailed test). Data from Gansu Survey of Children and Families (GSCF) 2000, 2009, 2015.