Is teachers' depression contagious to students? A study based on classes' hierarchical models

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Abstract

Background: According to the theory of emotional contagion, emotions in one person can trigger similar emotions in groups within social networks. In schools, the class just like a small social network, that teachers' emotion, such as depression, might be contagious to their students. However, until now there is few studies reporting this issue. This study aims to determine whether teachers' depression be contagious to students and what mechanics behind the phenomenon.

Methods: Using Children's depression and cognitive scales to assess 2579 students, meanwhile using teachers' depression and emotional labor scales assess 529 teachers. The nested data from 112 classes were analyzed.

Results: Teachers' depression was positively correlated with emotional labor surface and deep acting, and teachers' depression cross-level predicted students' depression inversely. For teachers with higher levels of depression, the teacher's deep acting affected their students' depression significantly, the more effortful the teachers' deep acting, the lower the degree of the students' depression, however, for teachers with lower levels of depression, the deep acting was not significant.

Conclusion: The results maybe state that depression in teachers is not readily transmitted to students, one of reasons is that teachers' emotional labor may alleviate the influence of their depression on students. However, considered that teachers' emotional labor was positively correlated with their depression, the teachers' emotional labor may be like a double-edged sword, while alleviating the influence of teachers' depression on students, it also deteriorated their own depression, making it impossible sustainable. For students' depression interventions based in school, including teachers maybe a better selection.

Trial registration: This article is not a interventional research, so it was not registered.

Key words: depression, emotional contagion, emotional labor, teachers, students

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Background

Approximately one half of mental disorders begin in childhood and adolescence [1-3] and the global prevalence of mental health disorders in children and adolescents is almost 15% [4, 5]. Epidemiological studies show that depression and anxiety are among the most prevalent and recurrent mental disorders in children and adolescents [6-8]. With an estimated 1-year prevalence of 4 ~ 5% in mid to late adolescence, depressive disorder has become one of the common mental health problems in adolescents [9].

In China, we have not found reports concerning nationwide investigation of depression in children and adolescents. However, some regional studies have shown that the prevalence of depressive symptoms is similar to those stated in worldwide reports. For example, studies on the prevalence of depressive symptoms in children yielded figures of 6.4% in the Guangdong province and 13.2% in Beijing city [10, 11]. Further studies conducted on the prevalence of depressive symptoms in adolescents found incidences of 15.7% in Nanjing city and 21.9% in the Hunan province [12, 13]. A meta-analysis study examined 1460 Chinese articles concerning the prevalence of depression in Chinese children and adolescents published from 2000 ~ 2014 and selected 14 which included a total of 72,402 participants from 16 provinces (districts or cities). The meta-analysis found that the pooled prevalence of depression was 15.4% [14].

Reports suggest high incidences of depression symptoms in children and adolescents, and that youth depression is associated with numerous adverse personal, social, and academic outcomes [15 , 16]. Moreover, if left untreated, depressive symptoms tend to persist and increase in severity during adolescence and adulthood [17]. Substantial and sustained efforts have been made over many decades to develop and evaluate evidence-based treatment for depression in children and adolescence [18]. Besides treatment, researchers have also investigated programs and initiatives designed to prevent depression onset in children and adolescents [19-22]. When implementing a prevention program, it is critical to identify the sources of heterogeneity in intervention effects and to attempt to bolster the impact of interventions. One means of achieving this goal is the implementation of prevention programs in schools, for that community surveys of mental disorders in children and adolescents have commonly used schools as a sampling frame [4]. Schools have unparalleled contact with children and

adolescents and represent a location in which the majority of children and adolescents can be reached. Therefore, schools are considered to be an ideal environment in which to implement prevention programs [21, 23]. For this reason, prevention programs based in schools have been increasingly implemented [24-26]. Werner-Seidler et al. [26] summarized studies on school-based prevention programs for depression, concluding that: (1) school-based prevention programs have small effects on depression, but do have the potential to reduce mental health burdens; (2) prevention program types and the personnel implementing the prevention program influence the outcomes; and (3) there is some evidence that interventions for depression delivered by external personnel are superior to those delivered by school staff. However, Jennings and Greenberg [27] posited that to ensure children's wellbeing, mental health interventions in schools must begin with mentally healthy teachers. In this regard, Granger's study [28] reported that teachers' well-being, specifically teacher depression, limits the extent to which teachers engage in high-quality interactions with their students. Therefore, it can be hypothesized that teachers' depression is one important variable which affects the outcomes of interventions for students' depression in schools.

Depression is a type of emotional disorder [29] and, according to the theory of emotional contagion, emotions, like infectious diseases, can spread through groups of people in social networks [30]. Teachers' mannerisms and emotional states may contribute to the class's emotional atmosphere, as well as the school's atmosphere. Therefore, based on the theory of emotional contagion, we surmise that teachers' depression may be transmitted to their students.

In the standard medical susceptible-infected susceptible (SIS) model, infection can only be contagious by having a contact of an infected and a susceptible individual [30]. Extrapolating from the SIS model, we believe that teachers' depression may more easily transmit to students who are vulnerable to depression. In this regard, an extensive body of research has demonstrated that vulnerable cognitions related to depression contribute to the onset and development in children and adolescents [31-33]. We hypothesize that vulnerable cognitions related to depression could have a role in the process of teachers' depression transmitting to students.

In addition, another study found that teachers' emotional labor moderated the influence of stressful life events on students' depressive symptoms [34]. Emotional labor is a term first coined by Hochschild [35] which refers to the act of regulating one's emotions to

satisfy organizational requirements. Emotional labor has two primary regulation strategies: surface acting and deep acting. Surface acting refers to people presenting the emotional state required by organization, but not experiencing the emotion internally; by contrast, deep acting involves not only displaying an emotional state, but also feeling and experiencing the emotion on a personal level [35, 36]. These two emotional strategies would generate different consequences [37]. Since a teacher's job requires effort to ensure appropriate emotional expressions during the course of their work, the act of teaching contains typical characteristics of emotional labor [38]. We believe that teachers may regulate depressive emotions through emotional labor and that this may affect the transmission or conveyance of teachers' depression to students.

The purpose of this study is to explore whether teachers' depression can be transmitted to their students, and, if so, how is it transmitted and what are its mechanisms? We hypothesize the following: (1) depression in teachers can undergo cross-level transmission to their students in the class group; (2) students' vulnerable cognitions to depression moderate or mediate the relationship between teachers' depression and their students' depression; (3) teachers' emotional labor cross-level moderates the relationship between teachers' depression and their students' depression.

Methods

Participants

Teacher samples. We investigated 529 teachers from 112 classes in 11 schools in the Hunan province, China. Among them, 166 were males, 290 were females, and 73 did not indicate their gender. Of the sample, 435 were married, 61 were unmarried, 1 was divorced, and 32 did not indicate their marital status. The average amount of teaching experience was 16.59 $\pm$ 8.75 years, the shortest being 1 year and the longest being 49 years. Of the sample, 97 were class head teachers and 15 classes had no information concerning the class head teachers.

Student samples. The total student sample from the 112 classes was 2,579, including 1,212 males (male coded "1") and 1,256 females (female coded "2"), while 111 did not indicate their gender. Only-children (coded "1") comprised 1,302 members of the sample while 1,120 had siblings (coded "2") and 157 did not fill in the relevant information. The average age was 13.35±1.01 years and the study sample included 1,232 students in the 7th grade, 842 in the 8th grade, and the 505 in 9th grade. The average number of students in every class investigated was 23.03±5.47, the minimum number was 9 and the maximum was 36.

Measures

Students' depressive symptoms. Students completed the Children's Depression Inventory (CDI), which was developed by Covacs [39] and translated into Chinese [40]. The scale consists of 5 dimensions: anhedonia, negative self-esteem, negative mood, ineffectiveness, and interpersonal problems, measured by 27 items. The total score range is 0～54, and higher scores represent a greater severity of depressive symptoms.

Students' cognitive vulnerability to depression. Students completed the Children's Cognitive Style Questionnaire (CCSQ) [41] and Children's Dysfunctional Attitudes Scale (CDAS) [42]. The CCSQ contains two parts. In the first portion, participants are given twelve hypothetical negative events and asked to circle which statement best describes their thought process following the event: *(a) This won't cause other bad things to happen to me; (b) This might cause other bad things to happen to me; (c) This will cause other bad things to happen to me; or (d) This will cause many terrible things to happen to me.* Each response is assigned a value from 0 to 3 with higher scores indicating a greater tendency to catastrophize the consequences of a negative event. For the second part of the CCSQ, participants are given a hypothetical, negative event and asked to circle which statement best describes their thoughts following the event: *(a) This does not make me feel bad about myself; (b) This makes me feel a little bad about myself; or (c) This makes me feel very bad about myself.* Each response is assigned a value of 0 to 2, with higher scores representing a tendency to view oneself more negatively following an event.

The CDAS is a self-report questionnaire designed to assess dysfunctional attitudes in children and adolescents. For each item, participants are asked to rate how strongly each statement applies to them (i.e., "*never true*," "*sometimes true*," "*mostly true*," and "*always true*").

Students' life events. Students completed the Adolescent Self-Rating Life Events Checklist (ASLEC) [43]. This scale includes 27 items describing a life event, and the participant selects an option according to his/her own judgment (1 representing "*no impact*" and 5 representing "*extremely serious impact*"). The scale has good properties for validity and reliability (Liu et al., 1997; Xin, & Yao, 2015).

Teachers' depressive symptoms. Teachers completed the Center for Epidemiologic Studies Depression Scale (CES-D) [44]. The scale is a 20-item self-report measure designed to assess depressive symptoms in the general population. For each item, participants were asked how

often they had experienced the symptom in the last week, with responses ranging from 1 ("*rarely or never*") to 4 ("*very often or always*"). Total scores range from 20 to 80 points, with higher scores indicating higher levels of depressive symptoms.

Teachers' emotional labor. Teacher participants completed Emotional Labor Scales for Elementary and Middle School Teachers (ELSEMST) [45]. The scale was consisted of four dimensions: emotional perception (13 items), deep acting (8 items), surface acting (9 items), and natural acting (3 items). Each item is scored from 1 ("*very inconsistent*") to 5 ("*very consistent*") and a higher score indicates a higher degree of individual emotional labor. The scale has been proven to be of good reliability and validity. The total scale and its four dimensions' test-retest reliability coefficients ranged from 0.84 to 0.92 and Cronbach α values were 0.64～0.85. Based on the criterion of the Positive and Negative Affect Schedule (PANAS) [46], one of the most widely used affect scales [47], it was possible to separate teacher participants into groups comprising as follows: (1) low positive affect (PA), high negative affect (NA); and (2) high positive affect (PA), low negative affect (NA). The groups were used to compare differences between the two types of ELSEMST total scores and the dimensions score. The results showed that ELSEMST had a good criterion validity based on scores from the PANAS [48].

Covariates. We controlled for the following covariates: number of siblings (only-child or child with siblings), age, gender, and the life events of students. These variables have been shown to correlate with depression [31, 49].

Data Preprocessing and Analysis

Computing weighted depressive symptoms in teachers. We matched teachers' and students' data of the same class. In order to reflect the influence of different disciplines teachers engaged with (e.g., Chinese, mathematics, physics), different weights were assigned based on the Hunan Province (China) compulsory education curriculum (experimental) plan setting table [50] and combined with the results of our interviews with the relevant schools. The weights were: Chinese, Mathematics, and English teachers assigned 0.3; Physics, Chemistry, Biology, History, Geography, and Politics teachers assigned 0.2; Music, Painting, and Labor Skills teachers assigned 0.1. The largest weight was 0.4 assigned to the head teacher[1]. The score for teachers' depressive symptoms of the same class is calculated according to the following formula:

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[1] Head teacher: A teacher who is not only responsible for the teaching of class courses (usually the main subjects such as language or mathematics), but also the daily management of class students.

$$\text{CTDSWS} = 0.4 \times \text{DSSH} + \frac{0.3 \times \sum_{i=1}^{n_1} D_i}{n_1} + \frac{0.2 \times \sum_{j=1}^{n_2} D_j}{n_2} + \frac{0.1 \times \sum_{k=1}^{n_3} D_k}{n_3} \qquad (1)$$

Note: CTDSWS: Class teachers' depressive symptom weighted score; DSSH: Depressive symptom score of the headteacher; D_i: Depressive symptoms score of a teacher who teaches Chinese, Mathematics, or English courses; D_j: Depressive symptoms score of a teacher who teaches Physics, Chemistry, Biology, History, or Geography; D_k: Depressive symptoms score of a teacher who teaches Music, Painting, or Labor Skill; n_1, n_2, n_3: Number of the three types of courses. Such as: If a class has only the depressive symptom score of the Chinese teacher, then n_1 is 1. If there is Chinese, Mathematics and English teacher's depressive symptom score, then n_1 is 3. n_2 and n_3 are the same as n_1.

Computing weighted emotional labor scores of teachers. The assignment of weight did not change. The score for teacher's emotional labor of the same class will be calculated according to Formula 2 and Formula 3:

$$\text{CTELSAS} = 0.4 \times \text{ESASH} + \frac{0.3 \times \sum_{i=1}^{n_1} ES_i}{n_1} + \frac{0.2 \times \sum_{j=1}^{n_2} ES_j}{n_2} + \frac{0.1 \times \sum_{k=1}^{n_3} ES_k}{n_3} \qquad (2)$$

$$\text{CTELDAS} = 0.4 \times \text{EDASH} + \frac{0.3 \times \sum_{i=1}^{n_1} ED_i}{n_1} + \frac{0.2 \times \sum_{j=1}^{n_2} ED_j}{n_2} + \frac{0.1 \times \sum_{k=1}^{n_3} ED_k}{n_3} \qquad (3)$$

Note: in Formula 2, CTELSAS: Class teacher' emotional labor surface acting score; ESASH: Emotional labor Surface Acting score of the head teacher; ES_i: Emotional Labor Surface Acting Score of a teacher who teaches Chinese, or Mathematics, or English courses; ES_j: Emotional Labor Surface Acting Score of a teacher who teaches Physics, Chemistry, Biology, History or Geography; ES_k: Emotional Labor Surface Acting Score of a teacher who teaches Music, Painting, or Labor Skills; n_1, n_2, n_3: as for formula 1; in Formula 3, CTELDAS: Class teacher' emotional labor deep acting Score; EDASH: Emotional labor Deep Acting score of the head teacher; ED: Emotional Labor Deep Acting Score of a teacher and the subscript "i, j, k" has the same meaning as formula 2.

Cross-level linear model analysis. Since the students and teachers are from the same class and form a hierarchical nested structure, the cross-level linear model analysis can be used to analyze the nested data. The teacher is as the upper level of the hierarchical structure and the student is as the lower level of the hierarchical structure. We used Statistical Analysis System (SAS, version 9.4) mixed procedure to analyze: (1) whether the teachers' depressive symptoms significantly affect the students' depressive symptoms; (2) whether the influence of teachers' depressive symptoms on students' depressive symptoms would be moderated or mediated by the students' negative cognition style and dysfunctional attitude; and (3) whether the

teachers' emotional labor would moderate the influence of teachers' depressive symptoms on students' depressive symptoms.

RESULTS

Descriptive statistics and correlations

We calculated the means, standard deviations, and correlation coefficients of the variables. The results showed that students' depressive symptoms were significantly correlated to students' age ($r=0.125$, $P<0.01$), life events ($r=0.349$, $P<0.001$), teachers' depressive symptom ($r=-0.075$, $P<0.01$), teachers' emotional labor surface acting ($r=-0.047$, $P<0.05$), and teachers' emotional labor deep acting ($r=-0.059$, $P<0.01$); Teachers' depressive symptoms were positively correlated to teachers' emotional labor surface acting ($r=0.601$, $P<0.001$) and deep acting ($r=0.717$, $P<0.001$). For details, see Table 1.

< Insert Table 1 here >

Cross-level influencing and moderating role

For the multilevel model analysis, the measured outcome variable data should meet the assumption of normal distribution. Therefore, we tested whether the students' depressive symptoms scores adhered to the normal distribution. The results showed that the data did not reflect a normal distribution (see Table 2). We attempted to transform the non-normal data using two common methods: log transformation and square-root transformation [51]. We tested the skewness and kurtosis coefficients of the original data and transformed data; the results showed that only the square-root transformed data met the requirement of the normal distribution since the 95% confidence interval of skewness and kurtosis coefficients included zero. Thus, we utilized the data transformed by square-root method for further analysis.

< Insert Table 2 here >

Following Wang, Xie, & Fisher's approach [51], we fitted an empty model and then examined the cross-level effects of teachers' depression on students' depression.

Empty Model:

Student level:　　$\sqrt{\mathrm{CDI}_{ij}} = \beta_{0j} + \varepsilon_{ij}$　　　(4)

Teacher level:　　$\beta_{0j} = \gamma_{00} + \mu_{0j}$　　　(5)

The output of the SAS restricted maximum likelihood (REML) estimation showed that the variance in the student level random intercept coefficients and the residual variance were as follows: $\hat{\sigma}_{\mu0}^2 = 0.059$ ($p < 0.001$), and $\hat{\sigma}^2 = 1.081$ ($p < 0.001$)

$$ICC = \frac{\hat{\sigma}^2_{\mu 0}}{\hat{\sigma}^2_{\mu 0} + \hat{\sigma}^2} = \frac{0.059}{0.059 + 1.081} = 0.052 \tag{6}$$

$$deff = 1 + (\text{groupmean} - 1) \times ICC = 1 + (23 - 1) \times 0.052 = 2.144 \tag{7}$$

As $\hat{\sigma}^2_{\mu 0}$ is statistically significant ($p < 0.001$), we concluded that the intraclass correlation co-efficient (*ICC*) was statistically significant. In addition, since the design effect (*deff*) was over 2, a multilevel model is necessary for data analysis [52; 53].

The cross-level influence of teachers' depression on the students' depression: According to the suggestions of Aguinis, Gottfredson, and Culpepper [54], in order to improve the interpretation of results when conducting multilevel analyses, we centered level 1 continuous variables by group mean and centered those of level 2 by grand mean. We then analyzed the cross-level influence, the teachers' depressive symptoms in level 2 as predictive variable, and the students' depressive symptoms as a dependent variable. In order to make the cross-level prediction more accurate, we set gender, age, siblings (only-child or child with siblings), and student life events as control variables. The model produced was as follows:

Student level:

$$\sqrt{\text{CDI}_{ij}} = \beta_{0j} + \beta_{1j} \times \text{gender} + \beta_{2j} \times \text{age} + \beta_{3j} \times \text{SN} + \beta_{4j} \times \text{T\_Events} + \varepsilon_{ij} \tag{8}$$

(*Note: SN: siblings; T_Events: total score of student life events.*)

The teacher level: $\beta_{0j} = \gamma_{00} + \gamma_{01}\text{CTDSWS} + \mu_{0j}$ (9)

Substituting Equation (9) into Equation (8) leads to combined model (10):

$$\sqrt{\text{CDI}_{ij}} = \beta_{1j} \times \text{T\_Events} + \beta_{2j} \times \text{age} + \beta_{3j} \times \text{gender} + \beta_{4j} \times \text{SN} + \gamma_{00} + \gamma_{01}\text{CTDSWS} + \mu_{0j} + \varepsilon_{ij} \tag{10}$$

The results (see Table 3) show that the teachers' depressive symptoms significantly predicted students' depressive symptom ($\beta = -0.089$, $Se = 0.031$, $F = 8.38$, $P = 0.005 < 0.01$). However, to our surprise, this prediction completely reversed our hypothesis. The regression coefficient of teachers' depression in the predictive model is a negative value ($\beta = -0.089$), which indicates that when the teacher's depressive symptoms were increasing, the students' depressive symptoms were decreasing. Because the study's first hypothesis was that teachers' depression can transmit to students was not supported by our data analysis, we did not explore the cross-level interaction of students' cognitive factors and teachers' depressive symptoms further. After skipping the verification of Hypothesis 2, we proceeded to examine Hypothesis 3 concerning the potential moderating effect of emotional labor.

< Insert Table 3 here >

The moderating role of teachers' emotional labor.

In order to explore the moderating role of emotional labor more clearly, we analyzed the two executive strategies of emotional labor: surface acting and deep acting. The results of the SAS mixed analysis are shown in Table 4. The interaction of teachers' depression with emotional labor surface acting was not significant (β = -0.075, Se = 0.048, F = 2.41, P = 0.123). However, the interaction between teachers' depression and teachers' emotional labor deep acting was significant (β = -0.016, Se = 0.009, F = 4.07, P = 0.046 < 0.05).

< Insert Table 4 here >

To further clarify the interaction CTELDAS × CTDSWS, using a SAS mixed estimation procedure, we estimated the students' depression score under the conditions of high teachers' depression versus low teacher' depression (plus or minus 1 between-class standard deviation) and high emotional labor deep acting versus low emotional labor deep acting (plus or minus 1 between-class standard deviation). The results show that (see Figure 1): for teachers with high levels of depressive symptoms, their emotional labor deep acting significantly affects the influence of teachers' depression on students' depression ($Slope$ = -0.162, Se = 0.054, t (107) = -3.01, P = 0.003 < 0.01). However, for teachers with low depressive symptoms, their emotional labor deep acting did not significantly affect the influence of teachers' depression on students' depression ($Slope$ = -0.042, Se = 0.052, t (107) = -0.81, P = 0.422). Comparing emotional labor deep acting of teachers with high depressive symptoms to those of teachers with low depressive symptoms, the former had a considerably larger effect on the influence of teachers' depression on students' depression ($Slope$ = -0.120, Se = 0.059, t (107) = -2.03, P = 0.044 < 0.05).

< Insert Figure 1 here>

Discussion

Is teachers' depression contagious to students?

According to the theory of emotional contagion [30], we hypothesized that teachers' depression would be transmitted to their students and that students' vulnerable cognitions, such as negative cognition style and dysfunctional attitude, might act as moderating or mediating variables in this process. However, the study results showed that teachers' depressive symptoms, cross-level, inversely predicted the students' depressive symptoms. This finding indi-

cates that the higher teachers' depressive symptoms, the lower the students' depressive symptoms. The results were directly contrary to our hypothesis and did not conform to the theory of emotional contagion. We suggest three reasons for this. First, teachers not only impart knowledge to students, but also have a responsibility to ensure that their students develop healthily. For this reason, most teachers with depressive symptoms would be likely to inhibit their depressive emotions while communicating with their students, thereby blocking the contagions of their depression to students.

Second, teachers with higher levels of depressive symptoms may reduce their involvement in work-related activities, which would reduce time spent with students. Therefore, the influence of their depression on their students would be decreased. Although there are few studies concerning the association between teachers' depression and their teaching activities, they consistently show that teachers who experience higher levels of depressive symptoms have decreased sensitivity and greater withdrawal in terms of interactions with their students [28, 55, 56].

Third, in order to achieve their own better teaching performance, the teachers with low depressive symptoms may spend more time encouraging their students to study. This, however, might increase the stress experienced by the students, thereby increasing their depressive symptoms. Huang, Wu, Hu, and Yang found that teachers' emotional overinvolvement had a significant effect on students' depression [57]. Considering that our study indicates that teachers' depression is not transmitted to students, we did not further verify the mediating or moderating role of students' depressive cognitive vulnerable factors.

The moderating role of teachers' emotional labor

In order to verify the third hypothesis of the study, we analyzed the moderating role of the teachers' emotional labor. The results showed that teachers' deep acting of emotional labor significantly affected the influence of teachers with high depression symptoms on students' depression symptoms. However, for the teachers with low depression symptoms, the influence of teachers' emotional labor was not significant (for detail, please see Figure 1). This result may illustrate that teachers' emotional labor deep acting blocks the contagion of their depression to students and potentially alleviates the influence of teachers' high levels of depressive symptoms on students. Hennig-Thurau, Groth, Paul, and Gremler found that the employees' deep acting emotional labor influenced the customers' emotions and perceptions [58]. In our study, we also found that the deep acting of emotional labor significantly moderated the in-

fluence of teachers' depression on students, but there is no significant interaction between the surface acting of emotional labor and the depressive symptoms of teachers. Although the study found that deep acting could moderate the influence of teachers' depression on students' depression, both deep acting and surface acting were positively correlated with teachers' depression significantly on the class level, meaning that emotional labor may be a double-edged sword: while buffering the impact of teachers' depression on students' depression, it will also inversely affect teachers' own depression negatively. As there are few studies on teachers' emotional labor and teachers' depression, further research is needed for confirmation.

Limitation

Using the nested model of class teachers and students, the study explored whether teachers' depression would be transmitted to students. As far as we know, maybe this is the first study focus on this issue. For this reason, it is inevitable that there are some limitations for this study. First, as all the data were self-reported and cross-sectional, causal associations cannot be identified. Second, whether teachers' depression would be contagious to students, largely depends on their contacting time, we just us class schedule as the basis of judging contacting time between teachers and students, and assign different weight to different discipline teacher, it may not reflect the real state. Third, From the research results, the influence of teachers' depression on students, and the moderating role of teachers 'emotional labor, may be related to teachers' professional ethics and school management. however, our investigation did not involve these contents, it makes us difficult to exactly answer some questions, such as why teachers' depression negatively affects students' depression. further study should consider the factors related to teachers' vocational ethics and teachers' management.

Conclusion

The depression of teachers does not appear to be not readily transmitted to their students. One of reasons may be that the deep acting of teachers' emotional labor play a role of alleviating the effect of higher levels of depressive symptoms on their students. However, the emotional labor surface acting and deep acting are positively correlated with teachers' depression, predicting that teachers' emotional labor may unsustainable. Considering this, better results may be generated for students' depression interventions based in school by including teachers in the intervention programs.

List of Abbreviations:

CDI: Children's Depression Inventory

CCSQ: Children's Cognitive Style Questionnaire

CDAS: Children's Dysfunctional Attitudes Scale

ASLEC: Adolescent Self-Rating Life Events Checklist

CES-D: Center for Epidemiologic Studies Depression Scale

ELSEMST: Emotional Labor Scales for Elementary and Middle School Teachers

CTDSWS: Class teachers' depressive symptom weighted score

DSSH: Depressive symptom score of the head teacher

CTELSAS: Class teacher' emotional labor surface acting score

ESASH: Emotional labor surface acting score of the head teacher

CTELDAS: Class teacher' emotional labor deep acting Score

EDASH: Emotional labor deep acting score of the head teacher

ICC: Intraclass Correlation Coefficient

DEFF: Design effect

REML: Restricted Maximum Likelihood

Declarations

Ethical approval and Consent to participate

All research procedures were approved by the Research Ethical Committee of Guizhou Normal University Psychological School according to the Declaration of Helsinki. All participants were given informed consent after they fully understand the study. And written informed consent was obtained from a parent for all participants under 16 years old.

Consent For publication

All authors know the manuscript and agreed to publish it.

Availability of Data and materials

The data are not released publicly; for information on access to the data, please contact with corresponding author. Email: wwfhsd@aliyun.com

Competing Interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

WW was involved in the design, conduct, analysis and writing of this paper; YL was involved in the data collection, and analysis; YW was involved in the data collection.

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variables	M（SD）	1	2	3	4	5	6	7
1. Age	13.35±1.01	1						
2. Gender	1.51±0.50	-.042[*]	1					
3. SN	.54±0.50	.091[**]	-.161[**]	1				
4. T_Events	47.69±26.24	.090[**]	.004	-.075[*]	1			
5. CDI	13.28±7.67	.125[**]	.01	-.033	.349[***]	1		
6. CTDSWS	36.64±9.03	-.061[**]	-.014	-.064[*]	.003	-.075[**]	1	
7. CTELSAS	3.10±0.59	-.002	.016	-.021	-.033	-.047[*]	.601[***]	1
8. CTELDAS	3.57±0.66	-.042[*]	.000	-.005	-.017	-.059[**]	.717[***]	.841[***]

Table 1. The variables' descriptive statistics and correlation coefficients

Note: SN=Only-child or Siblings; T_Events=Student's life events total score; CDI= Student's depressive symptom total score; CTDSWS =Class teachers' depressive symptom weighted score; CTELS=Class teachers' emotional labor score; CTELSAS=Class teacher' emotional labor surface acting score; CTELDAS=Class teacher' emotional labor deep acting Score. Gender: Male=1; Female=2.

[*] $P<0.05$; [**] $P<0.01$; [***] $P<0.001$.

Table 2. Students' depressive symptoms data normality tests

Data type	Coefficient	Statistic	Std.Error	Bootstrap		95%Confidence Interval	
				Bias	Std.Error	Lower	Upper
Original	*Skewness*	.920	.048	-.004	.087	.746	1.092
	Kurtosis	1.430	.097	-.024	.422	.602	2.276
Square-root	*Skewness*	.079	.048	-.001	.046	-.012	.170
	Kurtosis	-.197	.097	-.002	.098	-.382	.002
Base-10 Log	*Skewness*	-.881	.048	.001	.050	-.979	-.780
	Kurtosis	.965	.097	-.003	.150	.672	1.265

Note: Bootstrap results based on 6000 bootstrapping samples.

Table 3. Cross-level analysis for the multilevel model

Variables	$β$	Se	df	F	P
T_Events	.015	.001	2185	317.29	<.001
Age	.118	.033	2185	12.60	<.001
Gender	.045	.042	2185	1.19	.275
SN	-.071	.044	2185	2.66	.103
CTDSWS	-.089	.031	109	8.38	.005

Table 4. Cross-level interaction analysis of the multilevel model with emotional labor as the moderating variable

Variables	β	Se	df	F	P	Variables	β	Se	df	F	P
(1)T_Events	.382	.020	2355	356.56	<.001	(1)T_Events	.382	.020	2355	355.69	<.001
(2)Grade	.025	.039	107	.43	0.515	(2)Grade	.026	.039	107	.45	.505
(3) CTELSAS	-.001	.069	107	.00	0.989	(3)CTELDAS	-.076	0.075	107	1.01	0.316
(4)CTDSWS	.114	.141	107	.65	.423	(4)CTDSWS	.214	.154	107	1.93	.168
(3)×(4)	-.075	.048	107	2.41	.123	(3)×(4)	-.016	.009	107	4.07	.046

Note: CTELSAS represents class teacher' emotional labor surface acting score;

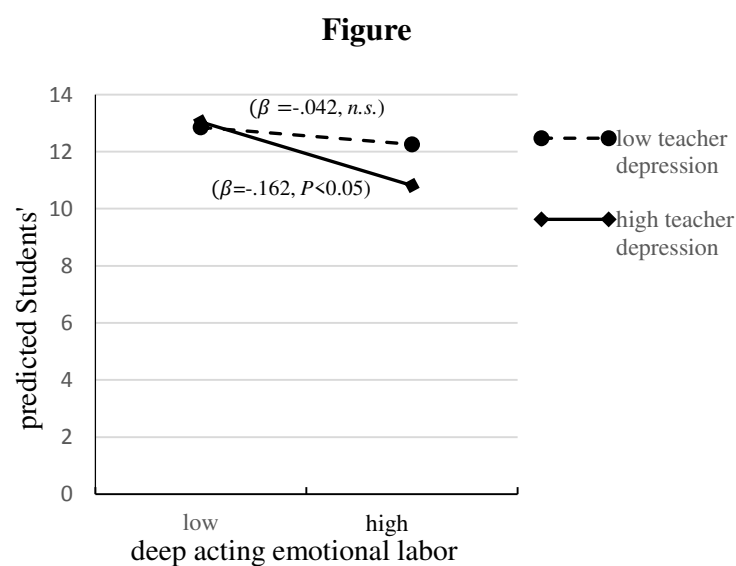CTELDAS represents class teacher' emotional labor deep acting Score.

Figure

Figure 1. The interaction between teachers' depressive symptom and emotional labor deep acting
Note: As the root squared values of the students' depressive symptoms was used as the dependent variable, we squared the predictive values of the students' depressive symptoms.
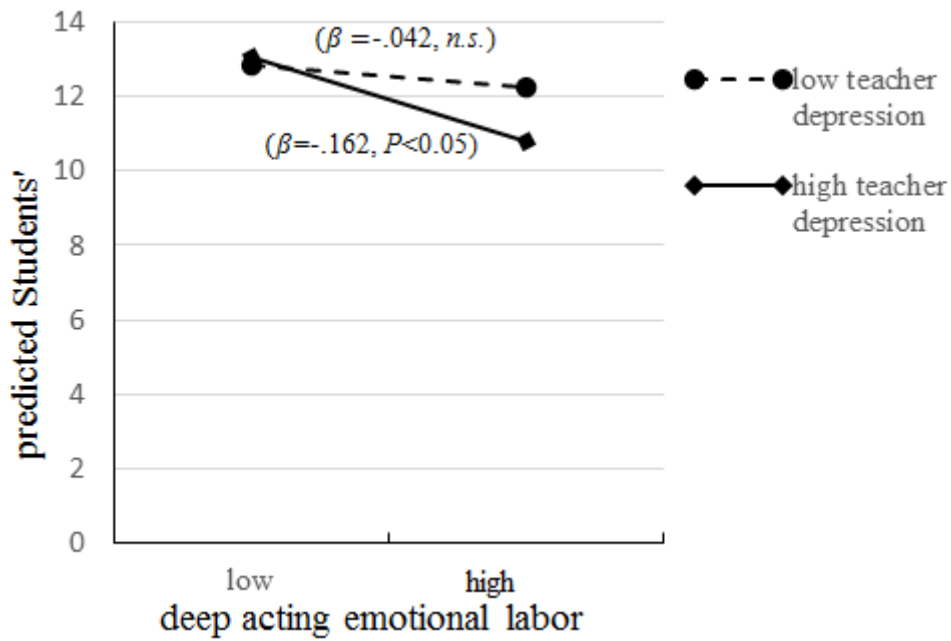
Figures

Figure 1

The interaction between teachers' depressive symptom and emotional labor deep acting Note: As the root squared values of the students' depressive symptoms was used as the de-pendent variable, we squared the predictive values of the students' depressive symptoms.