

Chinese Sociological Review

ISSN: 2162-0555 (Print) 2162-0563 (Online) Journal homepage: www.tandfonline.com/journals/mcsa20

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Yuying Tong & Jenny Xin Li

To cite this article: Yuying Tong & Jenny Xin Li (2024) Gender egalitarian attitudes toward family roles and ability, study time, and the academic performance of rural Chinese adolescents, Chinese Sociological Review, 56:1, 1-29, DOI: 10.1080/21620555.2023.2256022

To link to this article: https://doi.org/10.1080/21620555.2023.2256022

Published online: 14 Sep 2023.

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CHINESE SOCIOLOGICAL REVIEW
2024, VOL. 56, NO. 1, 1–29
https://doi.org/10.1080/21620555.2023.2256022

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Gender egalitarian attitudes toward family roles and ability, study time, and the academic performance of rural Chinese adolescents

Yuying Tong[a] and Jenny Xin Li[b]

[a]The Chinese University of Hong Kong, Shatin, Hong Kong; [b]The University of Hong Kong, Pokfulam, Hong Kong

ABSTRACT

Previous studies conducted in the West have documented the positive role played by gender egalitarian attitudes in determining the academic performances of girls. However, there remains a deficit of studies investigating whether and how different dimensions of gender egalitarian attitudes held by adolescents relate to their academic performance in rural settings. A study of this kind is important in contexts where it is more difficult for adolescents to transcend stereotypes and traditional gender roles. Using data collected from rural China and school-level fixed effect models, this study considers students' gender egalitarian attitudes along two dimensions: family and ability. Our results showed that egalitarian attitudes toward ability play a significant role in helping girls narrow the gap with boys in math. Further analysis showed that study time allocation partially explains the positive relationship between egalitarian attitudes toward ability and girls' math scores as well as their overall academic performance. Future policy initiatives could focus on enhancing gender equality awareness among rural children.

Introduction

One of the most important steps along the road to gender equality lies in achieving equality in education. This is particularly the case in Confucian-oriented societies such as China, where academic success is

CONTACT Yuying Tong yytong@cuhk.edu.hk The Chinese University of Hong Kong, Hong Kong.

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highly valued and viewed as a powerful predictor of social mobility (Roberts 2006). However, for most of Chinese history, girls were excluded from accessing formal education. It was not until more recent decades that their right to receive equal education was better protected by law. The 9-year compulsory education law and the free compulsory education reform in 2006 laid the structural and legal foundations for gender parity in schooling (Wei 2008). These education reforms have significantly enhanced the enrollment rates of school-aged children in primary and junior secondary school (Bao 2006). However, as education spending places a heavy burden on poorer rural families, girls still face some disadvantages in access to education beyond the compulsory level (Zeng et al. 2014). Children's current academic performance is a decisive predictor of subsequent school attendance (Zhang, Kao, and Hannum 2007), particularly for girls (Brown and Park 2002). Therefore, it is imperative to identify gender-specific factors that may encourage academic success among both rural boys and girls.

Moreover, recent research on rural Chinese students' academic performance revealed that gender gaps persist across subjects: boys excel at math while girls excel at Chinese (Gong, Ding, and Tsang 2014). Most studies examining gendered education outcomes have focused on family factors such as household economic resources, parental education aspirations, and parental gender attitudes (Hannum, Kong, and Zhang 2009; Zhang, Kao, and Hannum 2007). However, academic performance ultimately depends on students' efforts, which are often determined by self-concepts regarding their futures and competencies (Kobal and Musek 2001). It is possible that societal expectations relating to women's and men's roles and strengths can influence students' educational aspirations and confidence in different subjects, resulting in gendered outcomes. Indeed, there is increasing evidence that adolescent gender attitudes play a significant role in determining academic performance in the West (Ehrtmann and Wolter 2018; Leaper, Farkas, and Brown 2012; Salikutluk and Heyne 2017).

By far, little research has examined the role gender values play in determining academic outcomes in less developed societies. It is theoretically meaningful to investigate whether egalitarian attitudes at the individual level can overcome the negative impact of societal gender stereotypes in areas where traditional norms persist. In recent decades, the gender attitudes of rural Chinese adolescents have been influenced by multiple social forces. On the one hand, traditional gender ideologies and patrilineal values persist to varying degrees within the family (Hannum, Kong, and Zhang 2009; Zeng et al. 2014). On the other hand, large scale out-migration may result in the adoption of egalitarian values and the spread of modern social norms in rural villages (Hu

2016; Lu and Tao 2015). Adolescents may also be affected by the diffusion of egalitarianism through the education system and social media. Such circumstances make it imperative to examine whether and how gender attitudes affect academic outcomes among rural adolescents in China.

Researchers have also noted that gender ideology is multifaceted and that transitions in gender attitudes are uneven across public and private domains of life (Qian and Li 2020; Su and Ottervik 2023). As in many Western countries, China's gender equality development has been described as "uneven" and "conflicting" (Shu and Zhu 2012; Koo, Hui, and Pun 2020; Su and Ottervik 2023). The decline of traditional gender beliefs in one domain does not imply the rise of egalitarianism in another (Qian and Li 2020). For example, while the younger generation questions conventional division of labor in the family, gender stereotypes about work-related capabilities remain (Koo, Hui, and Pun 2020). Therefore, such unevenness in gender attitudes must be considered when exploring its relationship to academic outcomes. In this study, we distinguish two dimensions of adolescents' views about gender: (1) family roles and (2) abilities and competencies.

This study contributes to the literature in several ways. First, using data from multiple provinces, it provides additional evidence on whether gender differences still exist in academic performance among rural Chinese children. Second, it extends earlier studies by examining how gender attitudes relate to students' academic performances in a less developed setting undergoing rapid sociocultural change. A multidimensional approach is used to measure gender attitudes, which helps disentangle how values regarding family roles and ability are linked to academic outcomes for boys and girls differently. Third, we explore whether the relationships are explained by study time allocation. These objectives are addressed using a cross-sectional dataset collected in 2017 and 2018 that includes an analytical sample of approximately 2300 rural adolescent students in three provinces. We focus on adolescents in middle school, as this is a time of self-exploration and identity formation (Tong, Li, and Shu 2021). By distinguishing two dimensions of gender attitudes, our study contributes new insight to the scholarship on China's uneven gender revolution.

The rural Chinese context

The gender gap in education

There has been a narrowing of educational achievement gaps between girls and boys in rural China in recent years, and parental

investment in education has become more equal (Hannum, Kong, and Zhang 2009). Large-scale migration from rural to urban areas may have contributed to more egalitarian parental education expectation for daughters and sons (Zhang and Fussell 2017). However, due to a long-standing tradition of son preference, rural girls still face more disadvantages when competing for educational resources with male siblings (Zeng et al. 2014). Indeed, while the free compulsory education reform exempted all rural students from tuition, parents were more likely to reallocate disposable income to their sons (Tang, Zhao, and Zhao 2020). Consequently, the gender gap in educational investment may deepen and negatively impact girls' academic aspirations and performance. Moreover, studies have documented that the traditional gender gap persists in rural Chinese children's subject performance (Gong, Ding, and Tsang 2014). Thus, there is more a need to understand whether students' gender attitudes could play a role in closing the gender performance gap, if any.

The uneven development of gender equality in China

While many efforts were directed toward empowering women during the Mao era, the development of gender equality in China has become more contradictory following the economic reform (Attané 2012; Shu and Zhu 2012). On the one hand, globalization has accelerated the dissemination of Western ideologies of individualism that emphasize self-fulfillment and equal rights for men and women to education and employment (Qian and Li 2020). On the other hand, the decline of socialist gender equality ideology and the retreat of the social services that once facilitated women's employment have led to the return of traditional gender values in the workplace and home (Chen 2018; He and Zhou 2018; Koo, Hui, and Pun 2020; Tan, Ruppanner, and Wang 2021). Moreover, mainstream gender discourses also reinforce the notion that men and women have fundamental differences in family roles, strengths, and career paths (Qian and Li 2020).

Although younger cohorts disapproved of gender roles that confine men to work and women to families, they still tend to hold essentialist views about gender differences in work skills and capabilities (Koo, Hui, and Pun 2020). Moreover, rural youths tend to be more essentialist than their urban counterparts (Koo, Hui, and Pun 2020). As such, it is crucial to examine rural adolescents' gender values along family and ability dimensions, as well as how each might differ in relation to the academic performances of boys and girls.

Theoretical background

Attitudes about gender roles in the family and academic performance of boys and girls

A major dimension of gender ideologies consists of beliefs regarding family roles and the division of labor between husbands and wives (Davis and Pearce 2007; Yu and Lee 2013). Under traditional gender role expectations, boys often picture themselves as the future family breadwinner, while girls anticipate their roles as caregivers or secondary earners (Basu et al. 2017; Fulcher and Coyle 2011). Internalized gender norms and expectations could be particularly influential when adolescents plan for their future paths. They could shape the aspirations of boys and girls and their commitment to academic learning (Davis and Pearce 2007; McDaniel 2010).

Globally, gender role ideology has been shifting toward a more egalitarian stance, and individuals increasingly support "equal rights, roles, and responsibilities for men and women" (Davis and Greenstein 2009; Thijs et al. 2019). Previous studies have documented the positive effects of egalitarian attitudes toward women's roles on adolescent girls' academic aspirations and achievement (Valenzuela 1993; Galambos et al. 1985). Part of the explanation is that egalitarian values can translate into the personal belief that girls can make equal choices regarding families and careers as boys do when they grow up (Valenzuela 1993). It empowers adolescent girls by fostering self-esteem, motivation, and a desire to reach their full potential. Additionally, it assists them in navigating away from stereotypical paths that could impede their educational aspirations (Galambos et al. 1985; Valenzuela 1993). Accordingly, we hypothesize that *having more egalitarian attitudes toward gender roles in the family will be positively associated with the overall academic outcomes of girls (Hypothesis 1.1).*

Although egalitarian views of gender roles could improve academic outcomes for girls, their influence on boys is less clear. In China, it is common for families in rural areas to hold high expectations regarding the social mobility of their sons. When they reach adulthood, sons are often expected to take on more responsibilities as heads of households (Fuligni and Zhang 2004). In a society dominated by patrilineal family structures, it is likely that boys who conform to traditional gender roles are more adamant about their success and are under more pressure to excel (Gneezy, Leonard, and List 2009). Alternatively, egalitarian boys may be less pressured to fulfill normative gender roles, which include achieving high economic and social status and bringing honor to their families (Basu et al. 2017). According to this perspective, we expect that

having more egalitarian attitudes toward gender roles in the family would undermine the overall academic performance of boys (Hypothesis 1.2).

On the other hand, an opposing point of view is that conceptions of masculinity held by adolescent boys are often at odds with working towards academic success (Willis 1981). Hegemonic masculinity, as often sustained by traditional gender division of labor and patriarchal gender relations within the family, emphasizes traits like dominance and physical activeness, which are incompatible with the compliance and obedience required by schools (Salikutluk and Heyne 2017). Following this reasoning, boys may become more cooperative at school when they break away from traditional displays of masculinity, leading to potentially positive academic outcomes. Therefore, in a competing manner, we expect that *having a more egalitarian attitude toward gender roles in the family will be positively associated with the overall academic performance of boys (Hypothesis 1.3).*

Beliefs about gender differences in abilities and academic performance

Besides gender roles within the family, another dimension of gender beliefs that may directly affect students' subject performance is beliefs about gender differences in ability and competence (Crombie et al. 2005). Although biological-essentialist explanations of sex differences have been largely challenged, beliefs about innate abilities remain pervasive and are transmitted through socialization (Muntoni and Retelsdorf 2018). A stereotype that is widely held across many societies is that boys are naturally better at math, while girls are more proficient at language. Other common stereotypes about ability are that men are more rational, logical, and competent than women, and have more leadership skills and higher ambitions (Crites, Dickson, and Lorenz 2015; de Lemus et al. 2014). Gender stereotypes regarding ability can be detrimental to academic outcomes. In a society that endorses boys' overall competence and academic strengths, girls are inclined to believe that they are less competent or that their achievements in certain domains are not valued (Reilly 2012). Internalizing these deeply entrenched biases generates a "gender stereotype threat," which can cause both groups to underachieve due to fear of confirming negative stereotypes (Steele and Aronson 1995). Similarly, the expectancy-value theory suggests that cultural expectations may contribute to gender performance gaps by motivating students to focus on skills they value and expect to do well (Eccles and Wigfield 2002).

Having egalitarian views on men's and women's abilities could help both genders to overcome the adverse effects of gender stereotypes associated with academic performance. Liu (2020) showed that parental

cultivation of gender egalitarian values at home could result in a "de-stereotyping" process for girls in terms of math learning. Ehrtmann and Wolter (2018) found that egalitarianism promotes math competence in girls and reading development in both genders. Egalitarian students, especially girls, are not only more inclined to work hard on gender-stereotypical domains, but they also do better in tasks traditionally regarded as the exclusive domain of the opposite gender (Ehrtmann and Wolter 2018). Thus, *we expect that having more egalitarian attitudes toward the abilities of men and women will benefit the overall academic performance of girls (Hypothesis 2). In addition, it will also be positively associated with the math performances of girls (Hypothesis 2.1) and the Chinese language scores of boys (Hypothesis 2.2).*

Gender egalitarian attitudes, time allotted to studies, and academic performance

Girls and boys may allocate time between schoolwork and other activities according to gender role expectations (Mauldin and Meeks 1990). Previous studies have indicated a significant gap between rural Chinese girls and boys in regard to housework time, and that girls are more often asked to help with chores than boys (Hu 2018; Hannum, Kong, and Zhang 2009). The above sections have discussed the positive effects of egalitarian attitudes on the overall academic performance of both boys and girls and on subjects typically considered their "inferior" domains. In this process, a more egalitarian attitude could motivate students to spend more time studying, which could improve their overall performance and grades in their non-traditional strength subjects. Having more egalitarian attitudes may make girls more aware that they can bargain within the family for less domestic workload and devote more time to studying (Carriero and Todesco 2018).

The influence of gender egalitarian attitudes on boys' study time is, however, less straightforward. On the one hand, egalitarianism may reduce their study effort because they feel relieved of traditional family expectations. Alternatively, more egalitarian boys could dedicate more time to schoolwork rather than "masculine" activities such as sports and gaming (Legewie and DiPrete 2012). Considering these arguments, we hypothesize that *the positive relationship between gender egalitarian attitudes and overall academic performance will be partially mediated by students' time spent on studying, especially for girls (Hypothesis 3). This mediation effect will be more reflected in the relationship between egalitarian attitudes toward ability and the math performance of girls (Hypothesis 3.1), and the same goes for the language performance of boys (Hypothesis 3.2).*

Methods

Data

Our study is based on data collected from 26 rural middle schools in three provinces of China, including Anhui, Hunan, and Shaanxi. The three provinces are inland provinces located in China's East, Central and Northwest regions. All of them are ranked at the middle level in terms of economic development within the country (National Bureau of Statistics of China 2019). Within each province, three counties were chosen based on their respective economic development levels (lower, middle, and higher). For each county, three townships were identified for selecting schools. Therefore, nine schools were sampled from each province.[1] Within each school, one class was randomly selected from each grade (Grades 7–9).[2] In total, 76 classes were sampled. A structured questionnaire was administered in the classroom, and two to three research assistants were assigned to each class to facilitate the process. Given our sampling of migrant-sending provinces, about half of the students in our analytical sample come from families with at least one regularly absent parent. Partly due to their parents' out-migration and partly due to distance to schools, almost three-quarters of the students in the analytical sample board at school.

This dataset has several unique advantages for addressing our research questions. First, this survey was designed to understand rural adolescents' academic and educational experiences, physical and psychological well-being, and subjective attitudes. The questionnaire contains detailed questions on academic performance and gender values. Second, it includes items on students' self-reported individual and family backgrounds that enable multiple covariates to be controlled.

Compared with coastal regions, inland provinces tend to lag in terms of economic and social development, income, and educational resources, and are less influenced by globalization forces (Hao and Wei 2010; Xiang et al. 2020). Therefore, inland provinces are relatively more traditional in terms of cultural values. Meanwhile, all three provinces sampled are migrant-sending regions. With massive out-migration, migrants may bring back new ideas about gender expectations and ideology. Thus, we can capture the state of gender values in rural settings of a rapidly developing country amidst a complex process of societal change. However, our study did not find a statistically significant difference in egalitarian gender values among children in families with and without migrant parents. We discuss its implications in the Discussion section.

Dependent variable

The dependent variable in our study is academic performance. It is assessed by students' self-reports of their most recent Chinese, math, and English mid-term exam scores.[3] To address our research questions, we focus on students' subject-specific achievement in Chinese and math and use the average scores of the three core subjects to assess their overall academic performance. We transformed the test scores using a similar standardization method as the China Education Panel Survey (CEPS), a large-scale panel survey tracking middle school students in China (Wang, Hao, and Zhang 2015). In CEPS's method, the scores are standardized to a mean of 70 and a standard deviation of 10 (Wang, Cheng, and Smyth 2018).[4] The formula for calculating the standardized scores for each subject in the present study is as follows: $(\frac{Raw\ \ score\ -\ \ class\ \ mean}{Class\ \ SD}) * 10 + 70$. Students' overall academic performance is calculated by adding the standardized Chinese, math, and English scores and then dividing by three.

Key independent variables

The major independent variables of our analysis are the two dimensions of gender egalitarian attitudes and gender. Gender is measured using a binary variable, with "1" indicating female and "0" indicating male. The measurements of gender egalitarian attitudes are derived from a 12-item scale in the questionnaire that assesses students' perceptions of traditional gender beliefs and stereotypes. A list of the questionnaire items used to measure students' gender values can be found in Table A1 of our appendix. Many of the items are similar to those used in previous studies investigating gender attitudes (Ehrtmann and Wolter 2018; Koo, Hui, and Pun 2020; Qian and Li 2020; Zhang and Liu 2021) and reflect commonly held gender beliefs in China and around the world. Specifically, the gender egalitarian attitudes of students are assessed by their views about (1) gender roles in the family, and (2) gender-based beliefs regarding ability. The items were conceptually classified into two categories, and factor analysis was subsequently used to confirm beyond face validity. That is, whether the underlying structures of the items reflect the two pre-defined dimensions of gender values. The factor analysis shows that there are two factors with eigenvalues greater than 1. The cluster of items with the strongest factor loadings in Factor 1 focuses on the gender division of labor and family roles, and Factor 2 is mostly defined by gender beliefs about ability. We then used these results as a guide to create a scale for each concept by aggregating items with loadings higher than 0.5 after Varimax rotation in each factor (Hair et al. 1998).[5] Thus, only 10 of the original 12 items are used to generate the two scales.

The scale measuring students' attitudes toward gender roles in the family consists of five aggregated items. It includes items such as "men should prioritize their careers, whereas women should prioritize their families," "men should take greater financial responsibility in the family," "mothers should take on more housework than fathers," "most of the child-care work should be done by the mother," and "fathers should have greater authority in making major decisions in the household." Each item is rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). To assess egalitarian orientations, we reversely coded all the items before aggregating them. Scores on this scale range from 5 to 25, with higher scores indicating more egalitarian views. A Cronbach's alpha score of 0.80 demonstrates a high consistency among the items.

The second scale focuses more closely on students' views on stereotypical gender beliefs about ability and competence. The five items comprising this scale include "men are naturally more competent than women," "boys are better at math than girls," "boys are more rational than girls," "boys have better leadership skills than girls," and "boys should receive more education than girls." The items were also reversely coded before aggregation. Total scores range from 5 to 25, with a higher score indicating a more egalitarian attitude. The Cronbach's alpha score of 0.77 indicates a high level of scale reliability.

Mediation variable

The potential mediating variable, namely study time, comes from the questionnaire item which asks students how much time they spend daily on homework and studying on weekends. We focus on weekends since students' weekday schedules are more structured by schools than by individual priority, and this is especially true as our sample includes many boarding students. This item has four possible responses: zero hours, less than one hour, one to two hours, and more than two hours.

Control variables

We account for multiple individual and family variables that may influence gender values and academic performance. Specifically, we control for grade, whether the student is currently boarding at school, whether the student has local *hukou* status, ethnic minority status, whether the student repeated a grade in middle school, the highest education level among their parents (primary or below, junior high school, senior high school, college or above), students' perception of their family SES relative to

others in the same village or residential community (lower, similar or higher), parental absence status (both are at home, father absent only, mother absent only, both absent), number of siblings (only child, one sibling, two siblings, three siblings or more), and whether the respondent is currently co-residing with grandparents.

Analytical approach

Both gender values and academic performances could be influenced by school-level factors, such as gender attitudes held by teachers and peers, teachers' qualifications, and the school's learning and cultural environment. As a result, we control for these school-level cofounders by applying a series of school-level fixed effect models, which consider all the observed and unobserved factors influencing both gender attitudes and academic performance shared by all students in the same school. The school-fixed effect can be written as below.

$$Y_{is} = \alpha + \beta gendervalue_{is} + \gamma Gender_{is} + \boldsymbol{X}_{is}\delta + \phi_s + \varepsilon_{is} \cdots (1)$$

where Y_{is} is the academic performance of individual i in school s. The key independent variable of interest is gender and *gender value*$_{is}$. The coefficient of interest, β, captures the degree of association between gender attitudes and students' academic achievement. Vector $\boldsymbol{X}_{is}$ contains a host of individual and family characteristics. ϕ_s is a set of school dummies that control for non-random as well as unobserved school characteristics shared by all individuals within the same school. Finally, ε_{is} is the error term at the individual level.

Although school-level fixed effect models can alleviate the bias occurring from school sorting and regional context factors on gender attitudes, we should also note that this method cannot resolve the potential reciprocal effect between academic performance and gender attitudes. Students with higher cognitive abilities may be more proactive in adopting egalitarian values. Unfortunately, given the cross-sectional nature of our data, we are unable to tackle the potential reciprocal relationship between these two variables. As a result, we are cautious in using causal language in describing the relationship between gender values and academic outcomes.

We use Baron and Kenny's (1986) approach for establishing mediation. In this approach, a mediation is identified if the strength of the association between gender values and test scores reduces when including study time in the model.[6]

Results

Descriptive statistics

The summary statistics are presented separately for girls and boys in Table 1. Regarding academic performance, the mean test scores of girls are higher than those of boys, with the exception of math. On average, girls are more egalitarian than boys. For gender egalitarian attitudes in

Table 1. Descriptive statistics of analytical variables (by gender).

	Girls			Boys			
	Mean	S.D.	*N*	Mean	S.D.	*N*	Differences p-value
Dependent variables							
Average test score on the three major subjects	72.01	7.81	1182	68.73	8.28	1072	0.00
Chinese test score	73.00	9.01	1202	67.75	9.43	1088	0.00
Math test score	70.00	9.52	1184	70.80	9.90	1073	0.05
Independent variable							
Gender egalitarian attitudes – ability (5–25)	20.96	3.72	1202	16.67	5.04	1088	0.00
Gender egalitarian attitudes – family (5–25)	19.04	4.44	1202	15.65	4.78	1088	0.00
Mechanism							
Study time (%)			1202			1088	0.00
Zero hours	3.41	–		7.81	–		
Less than one hour	15.64	–		21.78	–		
One to two hours	35.44	–		36.31	–		
More than two hours	45.51	–		34.10	–		
Controls							
Grade (%)			1202			1088	0.65
7	33.61	–		34.10	–		
8	33.94	–		35.20	–		
9	32.45	–		30.70	–		
Currently boarding at school (%)	76.87	–	1202	69.58	–	1088	0.00
Local *hukou* holder (%)	94.18	–	1202	94.67	–	1088	0.61
Ethnic minority	9.32	–	1202	11.49	–	1088	0.09
Whether repeated a grade in secondary school (%)	1.50	–	1202	2.57	–	1088	0.07
Relative family SES (%)			1202			1088	0.00
Lower	25.54	–		22.15	–		
Similar	52.33	–		48.07	–		
Higher	22.13	–		29.78	–		
Highest education level among parents (%)			1202			1088	0.00
Primary or below	14.48	–		13.33	–		
Junior high school	64.81	–		58.92	–		
Senior high school	17.55	–		22.15	–		
College or above	3.16	–		5.61	–		
Parental absence status (%)			1202			1088	0.36
Both are at home	48.59	–		47.33	–		
Father absent only	21.30	–		22.33	–		
Mother absent only	5.66	–		7.26	–		
Both absent	24.46	–		23.07	–		
Number of sibling(s) (%)			1202			1088	0.00
Only child	9.90	–		17.00	–		
1 Sibling	57.90	–		60.39	–		
2 Siblings	21.55	–		14.06	–		
3 Siblings or more	10.65	–		8.55	–		
Co-residing with grandparent(s) (%)	56.16	–	1202	54.60	–	1088	0.45

Note: Descriptive statistics are generated using the largest analytical sample in our study ($N = 2,290$), and the sample sizes for subsequent models differ due to differences in the missing values in the dependent variables.

the ability domain, the mean score for girls is 20.96, compared to 16.67 for boys. While the mean scores on the family dimension are relatively lower, girls (19.04) are still more egalitarian than boys (15.65). More details on descriptive statistics for both key and control variables are included in Table 1.

Modelling results

The results from the school-level fixed effect models are presented in Tables 2–5. We begin by examining the first set of hypotheses, which focuses on the association between egalitarian attitudes toward gender roles in the family and students' overall academic performances. Results in Model 1 of Table 2 show that girls outperform boys in terms of average test score by 2.130 points, when all controls and school-level effects are accounted for. Both dimensions of gender egalitarian attitudes are positively associated with students' average test scores. The interaction term in Model 2 indicates that having more egalitarian expectations about family roles is not significantly associated with more benefits for the average test scores of girls. Further testing of these results separately by gender confirms the positive relationship in Model 3 for girls and Model 4 for boys. Overall, these results suggest that egalitarian attitudes about family roles benefit the overall academic performance of both genders, thus supporting Hypothesis 1.1 and 1.3. Conversely, we must reject Hypothesis 1.2, which expected having more egalitarian attitudes toward family roles to discourage boys from doing better due to the lower pressure to succeed.

As for the association between gender egalitarian attitudes toward ability and student's academic performance, Model 2 in Table 2 shows that the interaction between female and gender egalitarian attitudes regarding ability is positive and significant. Figure 1, which illustrates the interaction effect, shows a steeper slope of egalitarian attitudes regarding ability for girls compared to boys. At the most traditional end of the distribution, there appears to be a small gender gap favouring the average test scores of boys. However, this gap closes and reverses as the level of egalitarian attitudes toward ability increases. The by-gender results shown in Models 3 and 4 also indicate that being more egalitarian about ability is advantageous for the overall academic performance of girls, but this coefficient is insignificant among boys. Together, these results lend support to Hypothesis 2.

Next, we examine whether the associations between gender egalitarian attitudes regarding ability and academic performance for boys and girls differ by subject. The results for Chinese and math are presented separately in Table 3.[7] Results of Model 1 indicate that girls outperform boys

Table 2. Relationship between gender egalitarian attitudes and average test scores.

	Full sample		Girls	Boys
	Model 1	Model 2	Model 3	Model 4
Independent variables				
Gender egalitarian attitudes – ability	0.096*	0.019	0.260***	−0.005
	(0.046)	(0.060)	(0.072)	(0.062)
Gender egalitarian attitudes – family	0.223***	0.195**	0.236***	0.197**
	(0.044)	(0.063)	(0.060)	(0.066)
Female (ref. male)	2.130***	−2.931+		
	(0.382)	(1.666)		
Interaction terms				
Female* GEA – ability		0.225*		
		(0.095)		
Female* GEA – family		0.041		
		(0.088)		
Controls				
Grade (ref. Grade 7)				
Grade 8	−0.707+	−0.695+	−0.371	−1.219*
	(0.406)	(0.405)	(0.543)	(0.616)
Grade 9	−0.954*	−0.959*	−1.167*	−0.797
	(0.433)	(0.432)	(0.570)	(0.660)
Boarding at school (ref. not)	−0.324	−0.313	−0.596	−0.041
	(0.533)	(0.532)	(0.739)	(0.767)
Local *hukou* holder (ref. not)	−1.024	−1.034	−2.367*	0.695
	(0.755)	(0.753)	(0.977)	(1.173)
Ethnic minority (ref. Han)	1.000	0.920	1.299	2.171
	(1.432)	(1.429)	(1.753)	(2.456)
Repeated a grade (ref. not)	−3.790**	−3.718**	−7.185***	−1.379
	(1.195)	(1.193)	(1.837)	(1.603)
Relative family SES (ref. lower)				
Similar	−0.545	−0.562	−0.058	−0.802
	(0.426)	(0.426)	(0.556)	(0.655)
Higher	−0.843+	−0.847+	−0.966	−0.519
	(0.491)	(0.491)	(0.673)	(0.720)
Parents' highest education (ref. primary or below)				
Junior high	1.120*	1.108*	0.673	1.355+
	(0.519)	(0.518)	(0.674)	(0.799)
Senior high	1.522*	1.467*	0.614	2.124*
	(0.626)	(0.625)	(0.842)	(0.932)
College or above	3.523***	3.414***	1.297	4.562***
	(0.950)	(0.949)	(1.426)	(1.311)
Parental absence status (ref. both are home)				
Father absent only	−0.332	−0.328	−0.704	0.013
	(0.445)	(0.445)	(0.594)	(0.667)
Mother absent only	−0.776	−0.762	0.265	−1.812+
	(0.717)	(0.716)	(0.999)	(1.037)
Both absent	0.261	0.260	0.094	0.688
	(0.485)	(0.484)	(0.635)	(0.748)
Number of siblings (ref. only child)				
1 Sibling	1.947***	1.893***	0.946	2.739***
	(0.522)	(0.521)	(0.767)	(0.727)
2 Siblings	1.420*	1.355*	0.787	1.787+
	(0.636)	(0.635)	(0.872)	(0.958)
3 Siblings or more	0.904	0.880	−0.349	1.525
	(0.732)	(0.731)	(1.012)	(1.078)
Live with grandparents (ref. not)	−0.402	−0.385	−0.587	−0.276
	(0.368)	(0.368)	(0.490)	(0.553)
Constant	63.493***	65.288***	64.670***	62.663***

(*continued*)

Table 2. Continued.

	Full sample		Girls	Boys
	Model 1	Model 2	Model 3	Model 4
	(1.352)	(1.476)	(2.023)	(1.975)
School-level fixed effect	Yes	Yes	Yes	Yes
Number of schools	26	26	26	26
Observations	2,254	2,254	1,182	1,072
R-squared	0.090	0.095	0.084	0.049

Note: $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $+p < 0.1$; standard errors in parentheses.

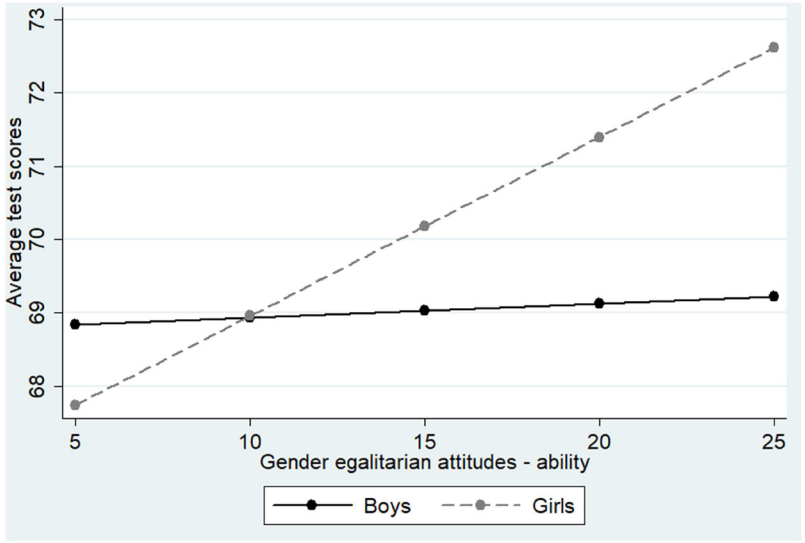

Figure 1. The moderating effect of gender on the relationship between gender egalitarian attitudes regarding ability and students' average test scores. *Note*: Figure based on Model 2 of Table 2.

in Chinese by 3.893 points, holding all else constant. The interaction term in Model 2 reveals a female advantage in having a more egalitarian gender attitude toward ability. Figure 2 shows a small gender gap in Chinese scores favoring girls among students with the most traditional gender attitudes regarding ability. With increased levels of egalitarian attitudes toward ability, the gender gap grows even larger. The results in Model 3 demonstrate that both dimensions of egalitarian gender values are positively associated with the Chinese test scores of girls, although the magnitude of the coefficient for ability is slightly bigger. However, the result for boys, as shown in Model 4, indicates the insignificance of the coefficient for ability.

Models 5–8 in Table 3 focus on math performance. Results in Model 5 show that girls' math scores are 2.083 points lower than boys, holding all

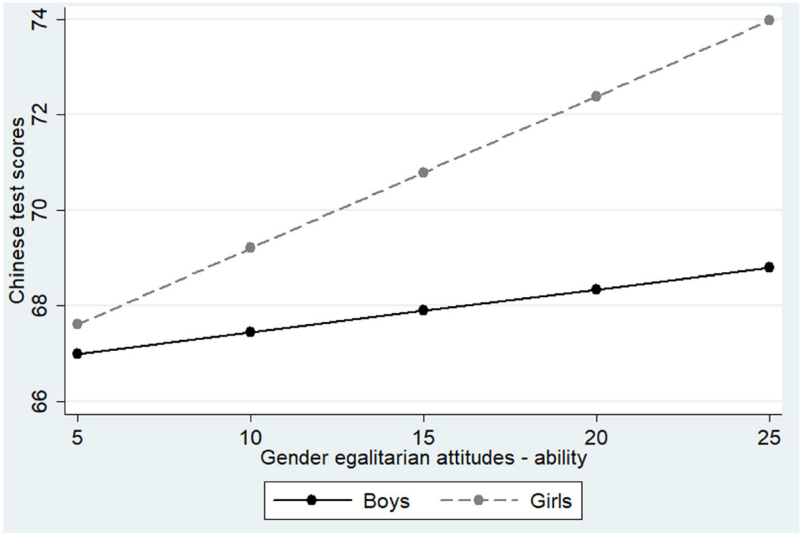

Figure 2. The moderating effect of gender on the relationship between gender egalitarian attitudes regarding ability and students' Chinese test scores. *Note*: Figure based on Model 2 of Table 3.

else constant. Again, the interaction term in Model 6 indicates that being more egalitarian about ability is more beneficial for raising girls' math scores. Figure 3, which illustrates this result visually, shows that among students with more traditional gender attitudes regarding ability, the gender gap in math is rather wide and favours boys. However, it narrows with increased levels of egalitarian attitudes and almost closes for those who are the most egalitarian. Model 7 further confirms the positive association for girls, whereas egalitarian attitudes about ability does not appear to relate significantly to math scores for boys (Model 8). Together, these results indicate that it is particularly important for girls to overcome gender stereotypes about competencies, thereby largely supporting Hypothesis 2.1. We did not find evidence to indicate that egalitarian views about ability can improve the language performance of boys. In contrast, increase in test scores for boys are explained exclusively by the family dimension. Thus, Hypothesis 2.2 is not supported.

We now examine whether study time is a potential mechanism underlying the relationship between gender egalitarian attitudes and academic performance. Tables 4 and 5 show the results for girls and boys, respectively. The first model in each set of results shows the direct relationship, whereas the second model includes the mediator. Model 2 in Table 4 shows that girls who spend one to two hours, or more than two hours per day studying have higher average test scores. When study time is

Table 3. Relationship between gender egalitarian attitudes and Chinese and math test scores.

	Chinese test score				Math test score			
	Model 1 Full	Model 2 Full	Model 3 Girls	Model 4 Boys	Model 5 Full	Model 6 Full	Model 7 Girls	Model 8 Boys
Key independent variables								
Gender egalitarian attitudes – ability	0.170**	0.090	0.339***	0.076	0.103+	−0.012	0.330***	−0.038
	(0.053)	(0.068)	(0.083)	(0.070)	(0.056)	(0.072)	(0.089)	(0.075)
Gender egalitarian attitudes – family	0.213***	0.192**	0.220**	0.185*	0.241***	0.206**	0.259***	0.205**
	(0.051)	(0.072)	(0.069)	(0.074)	(0.054)	(0.076)	(0.074)	(0.079)
Female (ref. male)	3.893***	−1.022			−2.083***	−9.325***		
	(0.436)	(1.896)			(0.464)	(2.017)		
Interaction terms								
Female* GEA – ability		0.229*				0.332**		
		(0.108)				(0.115)		
Female* GEA – family		0.028				0.046		
		(0.100)				(0.106)		
Constant	60.807***	62.566***	64.964***	58.598***	64.015***	66.572***	59.318***	64.331***
	(1.535)	(1.681)	(2.322)	(2.217)	(1.638)	(1.787)	(2.498)	(2.371)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School-level fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	26	26	26	26	26	26	26	26
Observations	2,290	2,290	1,202	1,088	2,262	2,262	1,186	1,076
R-squared	0.117	0.120	0.076	0.046	0.043	0.050	0.069	0.041

Note: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; + $p < 0.1$; standard errors in parentheses.

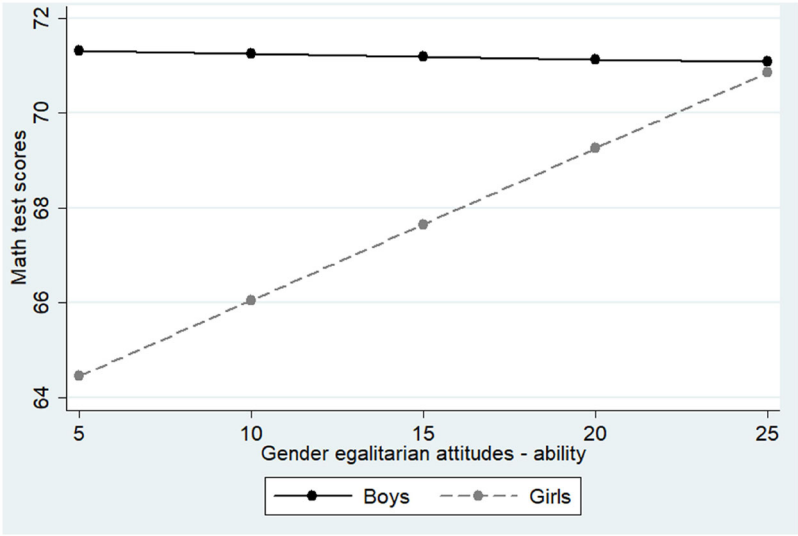

Figure 3. The moderating effect of gender on the relationship between gender egalitarian attitudes regarding ability and students' math test scores. *Note*: Figure based on Model 6 of Table 3.

included in the model, the significance and magnitude of the ability coefficient decrease, which suggests a partial mediating effect. Thus, while both components of gender values significantly contribute to the average test scores for girls, only having more egalitarian attitudes toward ability is positively associated with a translation of beliefs into action, which in turn explains their better performance.

For girls, there is no mediation in the Chinese score model. In terms of their math test scores, the results in Model 6 of Table 4 show that spending more than two hours per day on studying has a strong positive association with math scores. When study time is included in the math model, the magnitude and significance of the ability coefficient decrease, which also suggests a partial mediation effect.[8] In general, while both facets of gender values are beneficial for girls' academic performance, the results suggest that study time only explains the relationship between egalitarian attitudes toward ability and girls' math and average scores, lending support to Hypotheses 3 and 3.1.

For boys, results in Models 2, 4, and 6 of Table 5 indicate that while spending more time on studying does benefit test performance, this variable does not appear to mediate the relationship between gender values and academic outcomes.[9] Therefore, while having egalitarian views about gender roles in the family is beneficial for the test scores of all subjects for boys, this positive relationship is not explained by study time. Thus, for boys, Hypotheses 3 and 3.2 are not supported.

Table 4. Relationship between gender egalitarian attitudes, studying time, and student test scores (girls).

	Model 1 Average score	Model 2 Average score	Model 3 Chinese score	Model 4 Chinese score	Model 5 Math score	Model 6 Math score
Independent variables						
Gender egalitarian attitudes – ability	0.260***	0.205**	0.339***	0.276***	0.330***	0.269**
	(0.072)	(0.070)	(0.083)	(0.082)	(0.089)	(0.087)
Gender egalitarian attitudes – family	0.236***	0.244***	0.220**	0.227***	0.259***	0.268***
	(0.060)	(0.058)	(0.069)	(0.068)	(0.074)	(0.072)
Mechanism						
Study time (ref. zero hours)						
Less than one hour		2.127		3.133*		2.121
		(1.306)		(1.499)		(1.620)
One to two hours		3.513**		4.982***		3.503*
		(1.259)		(1.449)		(1.562)
More than two hours		6.713***		7.455***		7.366***
		(1.264)		(1.456)		(1.569)
Constant	64.670***	60.785***	64.964***	60.267***	59.318***	55.240***
	(2.023)	(2.268)	(2.322)	(2.620)	(2.498)	(2.813)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
School-level fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	26	26	26	26	26	26
Observations	1,182	1,182	1,202	1,202	1,186	1,186
R-squared	0.084	0.141	0.076	0.114	0.069	0.119

Note: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; standard errors in parentheses.

Table 5. Relationship between gender egalitarian attitudes, studying time, and student test scores (boys).

	Model 1 Average score	Model 2 Average score	Model 3 Chinese score	Model 4 Chinese score	Model 5 Math score	Model 6 Math score
Independent variables						
Gender egalitarian attitudes – ability	−0.005	−0.036	0.076	0.050	−0.038	−0.075
	(0.062)	(0.060)	(0.070)	(0.069)	(0.075)	(0.073)
Gender egalitarian attitudes – family	0.197**	0.185**	0.185*	0.173*	0.205**	0.191*
	(0.066)	(0.064)	(0.074)	(0.073)	(0.079)	(0.077)
Mechanism						
Study time (ref. zero hours)						
Less than one hour		1.055		1.045		1.157
		(1.043)		(1.181)		(1.260)
One to two hours		4.225***		3.947***		4.675***
		(1.039)		(1.178)		(1.254)
More than two hours		6.938***		5.502***		8.123***
		(1.060)		(1.206)		(1.280)
Constant	62.663***	59.708***	58.598***	56.085***	64.331***	60.924***
	(1.975)	(2.068)	(2.217)	(2.370)	(2.371)	(2.489)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
School-level fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	26	26	26	26	26	26
Observations	1,072	1,072	1,088	1,088	1,076	1,076
R-squared	0.049	0.120	0.046	0.079	0.041	0.110

Note: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; standard errors in parentheses.

Discussion and conclusion

Although much progress has been made toward gender equality in education, some recent studies conducted in rural China are less optimistic. Scholars have revealed that rural parents still prioritize sons when allocating educational resources, which may increase the gender education gap (Tang, Zhao, and Zhao 2020). Moreover, there remains a persistent gender gap favoring boys in math and girls in language (Gong, Ding, and Tsang 2014). Identifying factors that could reduce gendered outcomes in academic achievement is therefore imperative. A growing number of studies in the West have highlighted the positive impact students' gender norms and egalitarian attitudes have on educational aspirations and performance, particularly for girls (Davis and Pearce 2007; Ehrtmann and Wolter 2018; Leaper, Farkas, and Brown 2012). Nevertheless, minimal attention has been paid to how such personal values may determine academic outcomes in rural settings in developing countries, where traditional gender ideals remain relatively prevalent. This study addresses this gap by closely examining whether and how gender egalitarian attitudes shape rural Chinese boys' and girls' overall academic outcomes and subject-specific performance. We contribute to the growing research on the role of gender attitudes in determining academic achievements in two ways. First, we adopt a multidimensional understanding of gender egalitarian attitudes. Specifically, we disentangle how two dimensions of gender attitudes, namely those regarding gender roles within the family, and those regarding ability and competence, relate to the overall and subject-specific academic outcomes of boys and girls. Our second contribution lies in investigating the mechanism underlying these relationships.

Our study revealed that having egalitarian views about gender roles within the family could produce a win-win situation for both boys and girls, which is consistent with existing studies in the West (e.g., Davis and Pearce 2007). Although not examined directly, it provides suggestive evidence that such egalitarian expectations can benefit rural girls by giving them the belief that they can bypass gender-stereotypical paths when they grow up (Galambos et al. 1985; Valenzuela 1993). In addition, the results indicate that boys can also benefit from having more egalitarian views about the family roles that men and women occupy. Thus, our findings contradict the view that having traditional gender norms might pressure boys to work harder to achieve success and fulfill family provider role obligations (Gneezy, Leonard, and List 2009).

Second, the analyses by gender reveal differences in the efficacy of the two dimensions of egalitarian attitudes for boys and girls. Boys benefit exclusively from having more gender-egalitarian expectations about family roles. Girls, however, benefit most from having egalitarian attitudes

towards ability, which enhance their overall academic performance as well as reduce and even close the math gender gap. Growing up in an environment that praises boys' competence could reduce rural girls' incentive and confidence to study hard and reach their full potential, especially in their stereotypically weaker fields. Our results support existing research that egalitarian attitudes encourage girls to succeed not only in their gender-stereotypical domain, but also in a subject traditionally considered to be the strength of the opposite sex (Ehrtmann and Wolter 2018). In this sense, the benefits are greater for girls than boys, since an egalitarian view of abilities can narrow the math gap and further widen the language gap. As a result, our findings are similar to those of Ehrtmann and Wolter (2018), despite their use of a composite measure of gender-role orientation that did not distinguish family and ability dimensions.

Another key finding of our study is that study time plays a mediating role in partially explaining the positive relationship between egalitarian values regarding ability and the math as well as the overall performance of girls. This provides some evidence that egalitarian attitudes about ability can motivate girls to enact their beliefs by dedicating more time to studying, resulting in higher academic performance. This finding has important policy implications. That is, school curriculums should not only emphasize that men and women are capable of playing similar roles, but also provide de-stereotyping education about gender-specific skills.

There are several limitations to our study. The first limitation is that it covers only three provinces in China. All three are inland, migrant-sending regions with middle-level economic developments within the country. It is possible that gender values have become more egalitarian and that the academic gender gap has been closed in more developed rural areas in China. Second, we relied on cross-sectional data, which does not allow us to eliminate some potential cofounding effects. Although we controlled for possible individual and family confounders and employed school-level fixed effects, other unobserved individual factors, such as personal ability and personality, may affect both gender expectations and academic outcomes. This is a shortcoming of our study, but it is reasonable to assume that such unobserved factors affect boys and girls equally. Future studies may use panel data to solve the problem of unobservable confounding factors. Moreover, due to the study's focus on adolescents, we only examined gender attitudes along the dimensions of family and ability. It would be beneficial if future studies also focus on adolescents' attitudes toward gender equality in public domains such as the political arena, which would provide a more comprehensive comparison of rural Chinese adolescents' gender attitudes in both the public and private spheres. Lastly, in light of the benefits of egalitarian attitudes,

further research is necessary to review the factors that shape the personal values of rural adolescents. For instance, the country's massive internal migration provides a powerful impetus for value changes in rural areas (Lu and Tao 2015; Zhang and Fussell 2017). Our study did not find a significant association between parental absence status and students' gender values (results not shown but are available upon request). A potential reason could be that migration status is dynamic, and it is difficult to trace the migration experiences of parents without information on their migration history.

The study, despite its limitations, contributes significantly towards unraveling the gendered patterns of attitudes and academic performance in China's rural society. In this regard, our study has some important policy implications. First, considering China's rapidly declining working-age population, it is imperative to identify effective ways to motivate the next generation of workers – namely, adolescents – to maximize their potential. Our study provides evidence to show that endorsing gender egalitarian family roles is beneficial for both girls and boys, and that cultivating an egalitarian view of ability is notably helpful for girls. Policies designed to promote gender equality through school curriculums and the classroom could be an effective means of influencing adolescents' gender attitudes and educational aspirations, especially for girls.

Notes

1. Except for one county in Shaanxi province, where only two schools were selected.
2. Apart from two schools in Anhui province, where only two classes were selected.
3. If mid-term exam test scores were not available at the time of survey, students in some schools were asked to fill in their test scores from the final exams in the previous semester or from the monthly exams.
4. In CEPS, the scores were standardized in terms of school or grade. Since the data in our study only sampled one class from each grade, the scores were standardized in terms of class.
5. The item "men are naturally more competent than women" has a loading higher than 0.5 in both Factor 1 (family roles) and Factor 2 (ability). We decided to categorize it under ability so that each scale is composed of the five items with the highest loadings in the respective factor. Second, although the item has a loading higher than 0.5 in Factor 1, its loading is lower compared to the other five items.
6. Then we follow up with the Sobel test to determine whether the mediation is significant (the results are shown in Table A2 of the appendix).
7. We assess language performance using exclusively Chinese scores because it is a core and foundational subject. While English is also an important subject, it is a second language. The quality of English education in rural areas tends to be lower, and students' learning may be influenced more by other factors, such as family environment.

8. We conducted the Sobel test for the two sets of models as an extra step to verify the significance of the mediation (the results are shown in Table A2 of the appendix). Given that the Sobel test assumes that the mediator and outcome variables are continuous in nature, study time is treated as a continuous variable when conducting the test.
9. Although the significance of the coefficient for the family dimension decreases in Model 6 of Table 5, there is no mediation upon further checking.

Acknowledgements

The authors would like to thank the editor and the anonymous reviewers for their valuable comments and suggestions.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Research Grants Council of Hong Kong under the General Research Fund [project number: 14642816].

ORCID

Yuying Tong http://orcid.org/0000-0002-7797-5012
Jenny Xin Li http://orcid.org/0000-0003-1718-6510

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About the authors

Yuying Tong is a Professor of Sociology at the Chinese University of Hong Kong. Her research areas crosscut social demography, migration and immigration, family and life course, gender as well as population health/well-being. Her recent publications have appeared in *Journal of Marriage and Family, Social Forces, Social Science Research, Rural Sociology* and many others.

Jenny Li is a postdoctoral fellow at the University of Hong Kong. She graduated from the Chinese University of Hong Kong with a PhD degree in Sociology. Her research interests include migration, family and child development. She has published in *Journal of Ethnic and Migration Studies, China Review, and Child Indicators Research.*

Appendix

Table A1. Original 12-item scale assessing students' perceptions of traditional gender stereotypes.

a. Men should prioritize their career, whereas women should prioritize their families.
b. Men are naturally more competent than women.
c. Men should take greater financial responsibility in the family.
d. Mothers should take on more housework than fathers.
e. Most of the child-care work should be done by the mother.
f. Fathers should have greater authority in making major decisions in the household.
g. Boys are better at math than girls.
h. Boys are more rational than girls.
i. Boys have better leadership skills than girls.
j. Boys should receive more education than girls.
k. Girls should marry men who are more capable than themselves*
l. It is more important for girls to marry well than to have a good career.*

Note 1: Each item is rated on a Likert-scale ranging from 1 "strongly disagree" to 5 "strongly agree". In order to measure gender egalitarian attitudes, all items were reversely coded before aggregation.
Note 2: Our measurement only includes 10 items. Items marked with an * are not included in our measurement.

Table A2. Sobel test statistics for mediation of study time.

Dependent variable	Gender	Sample size	Sobel test statistic	Standard error	*p*-value
Average score	Girls	1,182	3.344	0.019	0.001
Math score	Girls	1,186	3.330	0.022	0.001

Note 1: Given that the Sobel test assumes that the mediator and outcome variables are continuous in nature, study time is treated as a continuous variable in this part of the analysis.
Note 2: The Sobel tests were conducted using the online calculation tool by Preacher and Leonardelli (2001).