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Cognitive Abilities Differences between Urban-Rural Students in Yunnan Province, China

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Abstract

The ONETARGET Institute for Educational Assessment (OTIEA), is a research-oriented assessment institute founded by Beijing ONETARGET Education Technology Ltd., promoting competency-based educational assessments. Each year, over 200 thousand students from primary and secondary schools are measured by assessment products and services of OTIEA.

It has long been a major concern that the unequal development of basic education in urban/rural areas in China. Recent research has found that cognitive ability, academic motivation, and social support are the critical factors affecting students' quality of academic performance (Stadler et al., 2016; Bong, 2009; Parameswari & Maharishi, 2015). Using one-way analysis of variance (ANOVA), therefore, this study was designed to examine the disparities and related factors in the cognitive abilities of primary and secondary school students in areas with varying levels of urban/rural settlements in Yunnan Province of China.

Cognitive abilities and related factors were measured at age 8-14 years (N = 6024 primary school students and 8690 junior secondary school students) with the Cognitive Assessment Battery II and the Social Support Self-Assessment II developed by OTIEA which including Memory Ability Test, Attention Test, Reasoning Test; Teacher-Student Relationship Scale, Parent Support Scale and Friendship Quality Scale.

Findings from five cities and counties in Yunnan Provinces revealed that: (1) rural students scored significantly lower on cognitive ability test than their urban counterparts; (2) urban students scored significantly higher on reasoning ability than on memory and attention. However, students in rural areas scored lower on reasoning ability than on memory and attention; (3) in general, parents in rural townships and mountain areas were less educated than parents in urban areas; there was a positive correlation between cognitive ability and external factors or social support (i.e. teacher-student relationship, parental support and friendship quality).

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Based on the findings above, it is suggested that reducing the gap in the cognitive ability between urban and rural students could enhance the all-round development of students, and thereby promote a balanced education in Yunnan. Moreover, parental support and encouragement to children's education have a positive effect on cognitive ability development and it is vital to cultivate strong parent-teacher partnerships to improve children's cognitive abilities. Therefore, it is recommended that the government should focus greater attention on allocating educational resources and improving the educational environment in decision making, to ensure equal educational opportunities for all children in rural areas.

***Keywords**:* cognitive abilities, urban-rural students, and equal educational opportunities

Introduction

In China, reforms in basic education have achieved remarkable success over the last three decades, especially, in terms of universalizing a 9-year compulsory education (six years of primary education and three years of secondary education), which placed basic education on a legal basis to make education more accessible. However, a recent study based on the data of thirty provinces in eastern, central and western China indicated that increased educational investment had even enlarged the gap between urban and rural areas in China's western regions, where ethnic minorities are commonly concentrated and are less economically developed (Liu & Liu, 2013). As one of the most ethnically diverse provinces, southwest China's Yunnan province with the second-largest rural population in poverty has long been regarded as one of the provinces with prominent disparities in basic education between urban and rural areas.

Indeed, the unequal development of basic education in urban and rural areas remains a critical issue in China due to various socio-economic factors. According to the findings of Zhang, Li, and Xue (2015)'s study, the potential factors of education inequality between urban and rural areas are income disparity, various institutional barriers, and different parenting styles. Despite most research on urban-rural education disparity in western China has largely focused on financial funding, the integration of urban-rural education (Chu, 2009) and resource allocation, no study has directly examined the profound impacts of urban-rural differences in education from the perspective of measuring the ability of students.

There is evidence that general cognitive ability has a significant relationship with academic performance (Rohde and Thompson, 2007). As the primary predictor of academic performance, cognitive ability also plays a restrictive role in children's and adolescents' academic success (Xu, 2015). Furthermore, recent research has found that except for cognitive ability, academic motivation and social support are also the critical factors affecting students' quality of academic performance (Stadler et al., 2016; Bong, 2009; Parameswari & Maharishi, 2015). Hence, the present study was guided by two major research questions: (1) Do rural/urban differences in children's and adolescents' cognitive outcomes exist in Yunnan province, where there are significant educational differences between urban and rural areas? What are the underlying factors that might have caused these differences? (2) If disparities exist in urban and rural students' cognitive abilities, how do we reduce the gap to improve students' academic performance and education quality?

To address these issues, this paper will draw on the evidence from Yunnan province to examine the disparities and related factors in the specific cognitive abilities (working memory, attention

and reasoning ability) of primary and secondary school students in areas with varying levels of urban/rural and mountainous settlements. The main purpose of this study is to provide a glimpse of research on educational inequality of cognitive abilities and other relative factors in urban and rural areas in Yunnan province, proposing future directions for research and policymaking.

Method

Participants

The participants in this study consisted of total 14,714 students, of which 36.3% were from urban areas, 57.2% from rural areas and 6.5% from remote Mountainous areas across Yunnan Province in China. They came from a variety of family environment and socio-economic backgrounds, of which 65.8% were of the Han ethnicity and 34.2% belonged to different ethnic minority groups.

The participants in grades 3-6 from 19 primary schools and in grade 7-8 from 27 junior secondary schools were, respectively on average, 11.18 years old (SD = 1.41 years; Range: 8 to 12 years) and 14.30 years old (SD= 1.01 years; Range: 11 to 14 years). These schools were designated to have a representation of schools in Yunnan. All 14,714 students' online assessments were completed and found to be valid.

Participants were characterized as urban or rural based on the definitions and classifications issued by the National Bureau of Statistics of the People's Republic of China (National Bureau of Statistics, 2002).

Table 1
Demographic distribution of participants

Category		Total N=14,714	Students in Urban areas (N=5348)	Students in Rural areas (N=8413)	Students in Mountainous areas (N=953)
Gender	Male	9406	4547	4359	500
	Female	10350	5454	4443	453
Grade	Grade 3	1244	589	563	92
	Grade 4	1511	574	849	88
	Grade 5	1574	585	910	79
	Grade 6	1695	580	1036	79
	Grade 7	4375	1534	2541	300
	Grade 8	4315	1486	2514	315

Measures

Cognitive Ability Test

The Cognitive Assessment Battery II (CAB II) is a computer-based adaptive test designed to assess different components of cognitive abilities in terms of working memory, attention and reasoning ability in primary and secondary students. With good reliability and validity, CAB

II was applied as an acceptable cognitive assessment battery in the Comprehensive Assessment of Educational Quality in Primary and Secondary Schools in Yunnan province.

The auditory and visual working memory was assessed using digit recall tasks including digit span sequencing which requires students to sequentially order the numbers, and digit span forward which requires students to recall numbers in the same order.

Attention was measured using coloured geometric figures or letters and a 25 x16 matrix with random arrays as the stimuli. The participants' performance was assessed by the number of correct or incorrect target stimuli identified, as well as the time to complete the tasks.

The reasoning ability test is composed of a situational judgement test and a diagrammatic reasoning test. The situational judgement test was assessed by presenting students with different real-life scenarios and asking the students to rank the responses in the sequence they believe is most logical. The diagrammatic reasoning test was adopted and revised from Raven 's Progressive Matrices in China (RPM; Zhang, 1989) and measured by asking the students to identify the missing pieces and complete a pattern or by requiring the students to choose the next figure in the series from several choices.

Parental Support

The Primary and Secondary School Student Social Support Scale is a 12-item questionnaire that measures the perceived parental support in terms of *Family Atmosphere, Psychological Security, Educational Resources and Financial Support*. The scale is scored on a 5-point scale (1= *Strongly disagree*, 5 = *Strongly agree*) with higher scores indicating higher levels of parental support. The scale has high internal consistency (Cronbach's alpha = .87).

Teacher-Student Relationship

The Teacher-Student Relationship Scale was an adaptation of Pianta's Student–Teacher Relationship Scale (STRS; Pianta, 1992). This 25-item questionnaire was designed to assess the relationship patterns between students and their teachers in terms of *Closeness, Conflict, Support and Satisfaction*. Responses are scored on a 5-point scale (1= *Strongly disagree*, 5= *Strongly agree)*. The scale has good internal consistency (Cronbach's alpha = .65).

Friendship Quality

The Friendship Quality Self-Assessment Scale (FQSS) is a 38-item questionnaire with five subscales. The questionnaire was designed to measure children's quality of their relationship with particular friends. Some items were translated, adopted and adapted from Parker and Asher Friendship Quality Questionnaire (FQQ) (Parker & Asher, 1993) and some items were changed after piloting. The five subscales are reported as *Help and Companionship*, *Intimate Exchange*, *Values Affirmation*, *Conflict and Betrayal*, and *Trust and Respect*. The items are rated on a 5-point scale ranging from Strongly disagree (1) to Strongly agree (5). The scale has good internal consistency (Cronbach's alpha=.79).

Results

Preliminary Analysis

First, the series mean method was performed to replace the missing values and then the scores of all items in the Cognitive Assessment Battery II had been converted to T-scores according to the norm of data collected from 46 schools with varying levels of urban/rural settlements

across Yunnan. Lastly, One-way analysis of variance (ANOVA) was conducted to test the disparities among the variables.

Differences in Cognitive Ability by Grade Level

The results of this analysis yielded a significant main effect for the grade level in all cognitive variables (see Tables 2 and 3). Post-hoc tests also revealed that significant differences were obtained on every two cognitive variables except for a marginally significant result of the attention in third grade and fourth grade of 46 schools in urban, rural and mountainous areas (p=.094). As expected, the scores for all cognitive variables increased with the grade levels of students, which were consistent with cognitive development trends.

Table 2
Mean (SD) cognitive ability t scores of primary school students by grade level and test of significance

Variables	Grade 3	Grade 4	Grade 5	Grade 6	*F*	*p*
Cognitive ability	45.20 (8.54)	47.28 (9.48)	51.81 (9.47)	54.27 (9.69)	289.09	0.000
Working memory	45.83 (8.66)	48.10 (8.95)	51.33 (10.01)	53.51 (10.31)	184.67	0.000
Attention	47.10 (8.96)	47.96 (9.90)	51.34 (9.66)	52.69 (10.19)	112.07	0.000
Reasoning ability	46.04 (9.59)	47.67 (10.35)	51.49 (9.28)	53.60 (9.01)	194.11	0.000

Table 3
Mean (SD) cognitive ability t scores of junior secondary school students by grade level and test of significance

Variables	Grade 7	Grade 8	t	*p*
Cognitive ability	44.65 (9.68)	48.00 (9.53)	16.24	0.000
Working memory	47.04 (9.47)	48.61 (9.89)	7.55	0.000
Attention	46.29 (10.45)	48.72 (10.12)	11.02	0.000
Reasoning ability	44.52 (10.22)	48.12 (9.60)	16.93	0.000

Differences in Cognitive Ability by Area Type

Table 4 and 5 explain all area type differences in overall cognitive ability scores and show that students in urban areas had significantly higher overall cognitive ability scores than students in rural and mountainous areas in Yunnan. Unlike the cognitive development of students in rural and mountainous junior secondary schools, there were no significant differences between rural area students and mountain area students in primary schools.

Table 4
Mean (SD) specific cognitive ability t scores of primary school students by area type and test of significance

Variables	Urban area	Rural area	Mountain area	F	*p*
Working memory	52.31(9.97)	48.59(9.76)	48.05(9.68)	105.77	0.000
Attention	52.25(8.51)	48.53(10.64)	49.08(10.10)	99.97	0.000
Reasoning ability	54.44(7.64)	47.30(10.24)	46.27(10.77)	429.01	0.000

Table 5
Mean (SD) specific cognitive ability t scores of junior secondary school students by area type and test of significance

Variables	Urban area	Rural area	Mountain area	F	*p*
Working memory	49.25(9.49)	47.20(9.71)	45.92(10.02)	55.87	0.000
Attention	49.38(8.78)	46.30(11.23)	48.01(8.47)	85.81	0.000
Reasoning ability	49.94(8.86	44.67(10.10)	41.90(10.30)	346.29	0.000

A significant main effect for area type in all cognitive variables in primary and junior secondary schools was found, $F_{(2, 6021)}$ =322.95, p=0. 000 and $F_{(2, 8687)}$ =243.85, p=0.000, respectively. Post-hoc results also showed that students, respectively, in urban primary and junior secondary schools had the highest scores of cognitive abilities (M=53.91, SD=8.59 and M=49.37, SD=8.44), followed by their counterparts in rural primary and junior secondary schools (M=47.57, SD=10.02 and M=44.79, SD=10.12), and the lowest was from mountainous primary and junior secondary schools (M=47.13, SD=10.24 and M=43.77, SD=8.90).

Furthermore, Figure 1 and 2 show the cognitive advantages of students in primary and junior secondary schools of different areas graphically. More specifically, urban primary students scored significantly higher on reasoning ability than on memory and attention. However, urban junior secondary students showed balanced development in overall cognitive abilities in terms of reasoning abilities, attention and working memory. While, students of junior secondary schools in rural areas scored lower on reasoning ability than on working memory and attention. Mountain area students' attention abilities were significantly better than their reasoning abilities which were better than their working memory.

Figure 1
The cognitive advantage of students in primary school schools of different areas

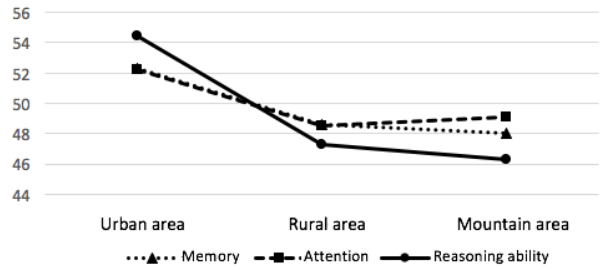
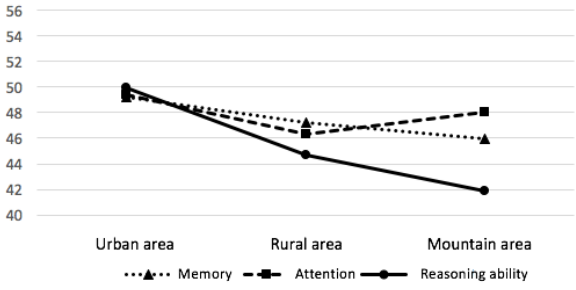


Figure 2
The cognitive advantage of students in junior secondary schools of different areas



Correlations

The result revealed that there was a positive correlation between cognitive ability of primary students and external factors or social support such as parental support, friendship quality and teacher-student relationship (see Table 6). Similarly, cognitive ability and friendship quality were positively associated with one another within junior secondary students in this study (see Table 7).

Table 6
Correlations between cognitive ability and external factors of primary school students

Area types	Variables	Parental support	Teacher-student relationship	Friendship quality
Urban	Cognitive ability	0.085**	0.017	0.191**
	Memory	0.089**	0.025	0.176**
	Attention	0.026	0.000	0.085**
	Reasoning ability	0.075**	0.011	0.171**
Rural	Cognitive ability	0.314**	0.286**	0.390**
	Memory	0.194**	0.178**	0.235**
	Attention	0.205**	0.191**	0.245**
	Reasoning ability	0.309**	0.274**	0.400**
Mountain	Cognitive ability	0.293**	0.259**	0.328**
	Memory	0.205**	0.190**	0.238**
	Attention	0.245**	0.212**	0.223**
	Reasoning ability	0.228**	0.199**	0.296**

Note: ** $p<0.01$, * $p<0.05$

Table 7
Correlations between cognitive ability and external factors of junior secondary school students

Area types	Variables	Parental support	Teacher-student relationship	Friendship quality
Urban	Cognitive ability	-0.046**	-0.006	0.073**
	Memory	-0.002	0.004	0.052**
	Attention	-0.034**	0.011	0.044**
	Reasoning ability	-0.071**	-0.031**	0.063**
Rural	Cognitive ability	0.074**	0.036**	0.173**
	Memory	0.061**	0.030*	0.117**
	Attention	0.050**	0.019	0.102**
	Reasoning ability	0.055**	0.032*	0.170**
Mountain	Cognitive ability	-0.016	0.016	0.193**
	Memory	0.020	0.025	0.138**
	Attention	-0.043	-0.017	0.082**
	Reasoning ability	-0.015	0.020	0.178**

Note: ** $p<0.01$, * $p<0.05$

In addition, to further explore the association between cognitive development of students and parent educational background, parents' education level of primary and junior students in urban and rural areas has been examined. It was found that parents in rural and mountain areas were less educated than parents in urban areas and the results suggested that the cognitive levels of students in both primary and junior secondary schools were in direct proportion to the educational levels of their parents (see Table 8 and 9).

Table 8
Percentage distribution of different education level of parents in19 primary schools

Area types	Parent	Education level	Education level	Education level	Education level
		Primary school	Junior secondary school	Secondary school	College and above
Urban	Father	8.9%	35.5%	22.5%	33.1%
	Mother	11.0%	39.0%	22.6%	27.4%
Rural	Father	26.4%	65.2%	6.5%	2.0%
	Mother	38.3%	56.4%	4.2%	1.2%
Mountain	Father	30.7%	62.5%	5.1%	1.8%
	Mother	41.9%	52.1%	5.1%	0.9%

Table 9
Percentage distribution of different education level of parents in 27 junior secondary schools

Area types	Parent	Education level	Education level	Education level	Education level
		Primary school	Junior secondary school	Secondary school	College and above
Urban	Father	21.6%	44.8%	19.2%	14.4%
	Mother	28.3%	43.2%	16.8%	11.6%
Rural	Father	29.9%	60.8%	6.5%	2.8%
	Mother	39.1%	53.7%	5.7%	1.4%
Mountain	Father	58.1%	39.2%	1.9%	0.9%
	Mother	77.8%	20.5%	1.2%	0.5%

Discussion

This paper seeks to understand the disparities and relative factors between primary and junior secondary students in urban and rural/mountainous areas of Yunnan province in terms of cognitive abilities that are important for many decisions and academic performance. The results of the present study suggested that there were huge differences in cognitive abilities including working memory, attention, and reasoning ability. Specifically, rural and mountainous students had poorer overall cognitive abilities, especially reasoning abilities, compared with their urban counterparts, which is consistent with the previous report on cognitive ability development of Chinses children and adolescents aged 6-15 (Xu, 2010).

Additionally, the findings in primary students from both urban and rural/mountainous areas of Yunnan showed that the cognitive abilities were associated with parental support, teacher-student relationship, and friendship quality. Likewise, the finding in junior secondary students indicated that cognitive abilities were strongly associated with friendship quality. Therefore, the higher cognitive ability scores of urban students are possible because urban students tend to have more equitable access to educational resources and better parental support as their parents tend to be better educated and utilize more strict parenting techniques (Smetana, 2000).

Since there is a large gap in the cognitive abilities of primary and junior secondary students in urban and rural/mountainous areas of Yunnan as found in this study, useful insights for policymaking and decision making are to be provided to reduce urban-rural education inequality. According to the disparities in cognitive abilities among urban and rural students, it is critical for the government to improve the teaching environment in rural schools by offering more customized educational opportunities and curriculum to rural and mountainous students. Meanwhile, the government should continue to push forward with the distance education project and "Dual-Teacher" programs to allocate high-quality education resources from urban areas to remote rural regions. On the other hand, differentiated instructions should be promoted following the cognitive features of urban and rural students. Finally, it is important to encourage parental involvement and support and cultivate strong family-school partnerships to improve children's cognitive abilities, which is line with the Guidance of Enhancing Family Education schools (MoE, 2015).

Overall, our findings highlighted the significant role of cognitive abilities in academic performance and explored the differences and features of cognitive abilities between urban and rural students. Nevertheless, it is still crucial to deepen our understanding of educational inequality between urban and rural regions and polices and further program interventions should be designed and implemented to reduce the gap and promote a balanced education.

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