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ABSTRACT

This study investigates the impact of sibling ranking and the number of siblings per family on student achievement in ninth grade science. Secondary analysis was conducted based on empirical data from a key project sponsored by the China State Commission of Education in the late 1980s. Findings indicate that the science achievement of students with one or no siblings was significantly different from those with two or more siblings based on an international measure of science achievement. No significant difference was found between a single child and a child with one sibling. A small but significant correlation was also noted between sibling rank and student achievement. These findings are discussed in terms of the social and economic background in China and around the world. Contains 27 references. (Author/JRH)

Running Head: Sibling Composition

The Impact of Sibling Composition on Student Science Achievement in P. R. China

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The Impact of Sibling Composition on Student Science Achievement in P. R. China

Abstract

Sibling ranking and the number of siblings per family were the sibling compositions investigated in this study according to their impact on student achievement in the ninth grade science. The secondary analyses were conducted on an empirical data from a key project sponsored by the China State Commission of Education in the late 1980s. Under the government single child policy, the number of siblings per family has been a factor varying across Chinese urban and rural communities. Students with 1 or no sibling were found significantly different from those with 2 or more siblings based on an international measure of science achievement. A small but significant correlation was also noted between sibling rank and student achievement. Contextual discussions were made on these findings in terms of the social and economic background in China and around the world.

The Impact of Sibling Composition on Student Science Achievement in P. R. China

The number of siblings per family has been declining in the west during the past 30 years (Roan, 1991; Steiner, 1984). Lam (1987) reported that "In industrialized countries, a fundamental shift in child bearing practices has resulted in an increase in the proportion of families with one child" (p. 1). Meanwhile, due to the single child policy, few children raised in the urban areas of China have two siblings, whereas "in rural families formed since 1979, most have two or three children" (Falbo & Poston, 1993, p. 19). The outcome of China's single child policy and science education has drawn strong interest in the research community. In part, this is because China will surpass the United States and become the world's largest economy within a few decades (Auchincloss, 1996; Buruma, Faison, & Zakaria, 1996; Mitchell, 1994). The projected result of the international competition mainly depends on the quality of education, particularly in the areas of mathematics and science.

The research literature on sibling shrinkage and school achievement has been reviewed extensively by many researchers (e.g., Chen & Goldsmith, 1991; Croll, Davin, & Kane, 1985; Falbo, 1984; Lam, 1987). Lam (1987), for instance, observed the lack of coherent theories and solid research on the shrinkage of family size in the west. On the other hand, Chen and Goldsmith (1991) concluded that "Although comparative studies of social and behavioral characteristics of Chinese only and non-only children have been numerous for over 10 years, the results are still far from definitive" (p. 132). The purpose of this study is to examine the sibling effects on science achievement using an empirical data base from a random sample of more than 12,000 students in China. Under the assumption that countries can learn from each other, it is expected that the empirical results from this study will not only facilitate the understanding of student science achievement in China, but enrich the existing knowledge base of child rearing practice for the entire humane beings.

Review of the Related Literature

The number of siblings per student family has been a confounding factor in many comparative studies. For example, having conducted research in China, Japan, and the United States for more than 10 years, Stevenson (1992) acknowledged that his student sample was selected from "five metropolitan areas: Minneapolis, Chicago, Sendai, Beijing and Taipei" (p. 70). Bracey (1994) contended:

> The work of Harold Stevenson and his colleagues is particularly flawed, and in some obvious ways. ... For example, in Chicago, the average student in Stevenson's sample lived in a home with two siblings; in Beijing, because of China's population-control policies, most students were only children. (p. 143)

The sibling number in China hinges on the urban restriction of Stevenson's samples. In fact, "Most Chinese (about 80%) live in rural areas, and most rural families formed since the one-child policy contain two or three children" (Falbo & Poston, 1993, p. 32). Hence, the study of sibling effect is still pertinent to the current situation in China.

Unfortunately, most comparative studies in China are confined in urban schools. In addition to those studies conducted by Stevenson et al. (Stevenson, 1992, 1993; Stevenson & Stigler, 1992), the Second IEA Science Study (SISS) was also restricted in three large cities, Beijing, Tianjin, and Taiyuan (Postlethwaite & Wiley, 1992). Since around 80% of Chinese population lives in rural areas, the survey results within large cities may not represent the complete picture of science education in China.

Another well-disseminated study is the International Assessment of Educational Progress (IAEP), a project parallel to the National Assessment of Educational Progress (NAEP) in the United States. But in the IAEP report, China was identified among those countries with population exclusions or low participation (Lapointe, Askew, & Mead, 1992). Consequently, in an NSF report, Suter (1992) noted that "IAEP countries excluded because of low response rates were China, England, Mozambique, and Portugal" (p. 37).

Meanwhile, the Chinese government has shown a strong interest in empirical assessment of student science achievement. Husen (1987) recollected:

> A few years ago, the minister of education of China visited Stockholm to learn, among other things, more about the IEA from its headquarters. In a long conversation, he spelled out to me that he wanted science competence among secondary school students in China to be evaluated according to the standards employed in the industrialized countries. Soon thereafter China joined the IEA SISS. (p. 44)

Shortly after the Second IEA Science Study (SISS), the State Commission of Education sponsored another SISS Extended Study (SES). The SES survey collected information from a random sample of more 12,000 ninth grade students using a two stage stratified sample design (Rosier, 1982). The English version of the science test was published in a widely circulated IEA SISS report (Postlethwaite & Wiley, 1992), and back-translation was made in China to ensure the equivalence of meaning between English and Chinese. Content validity of the instrument was established in SISS through science curriculum analyses (Rosier & Keeves, 1991). The reliability index reported by IEA was .755 for measuring student science achievement in China.

In addition, because China was unable to complete the Third International Mathematics and Science Studies (TIMSS), the SES data collected in 1988 remain one of the most recent and comprehensive sources of information about Chinese science education. In spite of the dramatic economic growth in China, no political reform has taken place in recent years, and education has been constantly under government control. The national course syllabi for secondary education were edited in 1986, and are still in use in the mid 1990s. According to an official report from the 1994 National Education Conference in Beijing, major problems in the late 1980s remain unsolved, and education in China must uphold the same principles addressed in Deng, Xiaoping's speech in 1985 (Bai, 1994). Therefore, the SES data collected in 1988 still maintain a high value of reference about the quality of science education in the contemporary China. Based on the extensive review of existing data bases, the SES data are employed in this study to examine the empirical sibling effect on student science achievement.

Research Questions

Falbo and Poston (1993) observed: "The presence of siblings has been assumed to be essential for a child to develop normally, and a child's position among his or her siblings has been thought to have profound effects on a child's outcomes" (p. 18). Black (1989) identified the sibling number and the birth order as two potential factors affecting student achievement. Accordingly, questions that guide this research are:

1. Are there any significant differences in student science achievement caused by the different sibling numbers?

2. Are there significant correlations between students' sibling ranking positions and science achievement?

3. How to interpret the statistical results in terms of the social and economic contexts in

China and around the world?

Methods

Because the single child is defined as a child with no siblings, the number of siblings is identified in this study by the total number children per family subtracted by 1. In question 1, the number of siblings is the independent variable and student science achievement is the dependent variable. One way ANOVA is employed to examine the effect of sibling numbers on student science achievement. In the cases significant sibling effects have been detected through ANOVA, the Tukey post hoc test is used to locate the sibling levels that accommodate those significant differences in student science achievement. In question 2, the Spearman ranking correlation coefficient is computed to assess the association between sibling ranking positions and science achievement. Since less than 0.4% students reported the number of children per family larger than 4, insufficient information exists in the SES data to ensure an informative comparison among students with 4 or more siblings. To avoid unfounded statistical artifacts, those 4 or more sibling cases were deleted from the data base. Empirical results from the aforementioned statistical analyses are interpreted in terms of a comparative perspective in education.

Results

The ANOVA results are presented in Table 1. The F test uncovers the existence of significant sibling effects on student science achievement.

Table 1 inserted around here

The result of the post hoc test indicates significant differences between students with 1 or no sibling and those with 2 or more siblings. In addition, no significant differences are found in science achievement between sibling numbers 0 and 1, or between sibling numbers 2 and 3.

With deletion of missing values in science score and sibling rank, a Spearman correlation coefficient was computed based on the information from 12,006 students. The correlational analysis has resulted in $r=-0.03$ and $p=0.0014$.

Discussion

An important feature of classroom instruction is the establishment of student peer relations in school. However, sibling influence is far more profound than the regular peer interactions in classroom. Martin (1982) noted:

> Sibling relationships differ from peer relationships because of their frequency and amount of interaction; the durability of the relationships; the existence of prescribed roles; accessibility; and the degree of common experience. (p. 1)

The ANOVA results in Table 1 can be composed into a statistical report of $F\ (3, 12113) = 17.29$, and $p=.0001$. Accordingly, the empirical study reconfirmed the assertion of significant sibling effect on student science achievement.

In addition, many studies reported a higher academic achievement with only children. Falbo (1983) reviewed:

> Studies of achievement with only children have shown that only children perform better academically than others. Parental expectation, financial abilities, and an uninterrupted relationship with the child are possible reasons for this high achievement. (p. 1)

Despite these positive accounts, no significant difference has been found in this study between the single child and a child with 1 sibling. In China, urban couples are allowed to have 2-children if the first one has genetic or other related health problems. Thus, among families with a higher social status, some young couples may use the policy default to have a second child, particularly when the first one is a girl. As the economy growth continues, some families are rich enough to afford the government penalty for having 2 children. Hence, children with 1 sibling exist in both rural and urban areas. But very rarely can these urban families get a third child under the government policy. Therefore, it is no surprise to find the significant differences between 1 and 2, or between 1 and 3, sibling cases due to the gap between urban and rural education.

Sibling ranking is another factor affecting student achievement. Black (1989) found a strong negative relation between the number of siblings and student achievement. White-Hicks (1980) elaborated:

> Research shows that firstborn children tend to excel in academic pursuits in comparison to those born later in the family constellation. A disproportionately high number of firstborns are present at the college level, and they are also overrepresented in medical and graduate schools. Firstborns score higher than those born later on a variety of measures of ability and achievement. In school, in comparison to their younger siblings, they obtain higher grade point averages. (p. 1)

Thus, in general, the larger the sibling rank, the lower the school achievement. This study seems to reconfirm this negative correlation between sibling rank and student achievement ($r=-0.03$). Under the population control policy, the small range of sibling numbers may have some contribution to the relatively small value of correlation coefficient. The p value of 0.0014 could be a result of the large sample size, which indicates the significance of the small correlation coefficient. Nonetheless, the coefficient of determination r^2 equals 0.0009, representing a weak association between student achievement and the sibling ranking (Heiman, 1996).

Chen and Goldsmith (1991) further pointed out: "To date, the phenomenon of single-child families in China has largely been treated implicitly as if it were independent of cultural context" (p. 135). In reality, the sibling composition has also been a concern in the west. Cooper, Grotevant, Moore, and Condon (1984) noted:

> For a variety of social, psychological, and economic reasons, American couples are now choosing to have fewer children than in the past. As this trend has emerged, both couples and social scientists have been concerned with the consequences to a child of growing up with few or no siblings. (p. 117)

The sibling shrinkage may have a two-fold implication. On the positive side, Bianchi (1990) pointed out that "Declining family size and recent American prosperity have created material well-being for most of today's children" (p. 1). On the opposite, Chen and Goldsmith (1991) cautioned: "There are far more single-child families in Western countries as a result of divorce than in China, where the vast majority of only children live in intact, two-parent families" (p. 135). Hence, while the sibling effect in China can be partly addressed through enhancement of equity between urban and rural education, in the west the public should place more concern on strengthening value of intact family.

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Table 1

ANOVA Table to examine sibling effect on science achievement

Source	df	Sum of Square	F value	p-value
Sibling	3	1009.03	17.29	0.0001
Error	12113	235628.77		
Total	12116	236637.80		

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