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The Learning Gap

*Why Our Schools Are Failing and
What We Can Learn from Japanese
and Chinese Education*

**Harold W. Stevenson
and James W. Stigler**

SUMMIT BOOKS

New York London Toronto Sydney Tokyo Singapore

Chapter 1

Introduction

It is no secret by now that American education is in crisis. Teachers work long hours for little reward. Our children's academic achievement is in decline. We pour more money into our schools, but we don't see a corresponding improvement in quality. Especially in mathematics and science, American children trail their counterparts in Europe and Asia, and they are losing ground.

The current educational crisis reverberates beyond the classroom, for a poorly educated work force directly hampers a nation's productivity and economic competitiveness. A modern, productive worker must be literate and must know basic mathematics and science. Unfortunately, in the United States fewer and fewer children learn much in our classrooms. American businesses now spend more than \$25 billion each year on remedial education for their employees—virtually all of whom are products of the nation's public schools.¹ The lamentably high percentages of our citizens who are illiterate, ignorant of government and geography, and unable to write clear and coherent sentences should cause deep concern in a democracy that relies on an informed popula-

tion. The very quality of life in a modern nation clearly reflects the educational level of its citizens.

Although articles describing the educational crisis appear almost daily in the nation's press, and although the 1989 summit meeting on education between the President and the nation's governors reflects an awareness of its immense proportions, discussions of the crisis seldom go beyond sober political pronouncements and hastily drawn, simplistic solutions.

It is evident that our schools are failing the American public. The important question this educational crisis raises is, How can we make changes that will reverse this process?

This book rests on the premise that the crisis in American education can be resolved only when all of us—parents, teachers, school administrators, and citizens—step back and examine our basic assumptions about the educational process. We must tackle difficult questions about the motivations, beliefs, attitudes, and practices that underlie the ponderous entity we call American education. This is not an easy assignment, but until we have a better grasp of these complex issues, we are unlikely to move any closer to solutions than we are today.

The two of us do not speak as educators. We are social scientists—psychologists by training—who have spent our professional lives studying children's growth and development. We have the audacity to write about education because we have been studying the development of Chinese, Japanese, and American children for more than a decade, and we see overwhelming differences in some aspects of these cultures that affect the educational process.

Our focus has been on elementary school children and their parents and teachers. We have studied the children's daily environments both in school and out. We have visited hundreds of classrooms, heard from thousands of parents and children, and observed scores of teachers in China, Japan, Taiwan, and the United States. Much of what we have discovered is new, for there were no comparative studies of such magnitude in these cultures before we began our work. With this background of experience

and with the scientific data to support our conclusions, we believe that we can improve our readers' understanding of the American educational system and suggest changes that should be made in the system.

THE BIG DEBATE

In the 1980s, Americans debated how to reform American schools. Committees and commissions churned out countless reports, books, and other documents throughout the decade. Often they proposed simple remedies—more money, choice of schools, smaller classes, higher standards, and merit pay—all of which sounded reasonable and stimulated changes in many states. In view of the meager outcomes that these changes have generally yielded, however, we think it is unlikely that any of them, singly or in combination, can produce enough improvement to reverse the process of deterioration in American schools.

Segments of our findings made their way into some of these discussions, but until now we have not had the opportunity to bring our results and conclusions together in a single publication. That is what we seek to do in this book. What we have to offer is a new slant on American life as we contrast what our culture has to say about children and schooling with what we found in China, Japan, and Taiwan.

MAKING THE FAMILIAR STRANGE

Our schools and families exist within the cultural context of American society. Without knowledge about how culture influences educational and child-rearing practices, it is difficult to perceive, let alone respond to, some of our most fundamental national characteristics. Paradoxically, the more widely practices and beliefs are shared within a society, the harder it is to see them.

We become accustomed to the aspects of our environment that we encounter frequently. Sheer familiarity dims the keenness of our perception, and we cease to notice a good deal of what goes on in our daily lives; what we do to teach our children becomes routine. In order to shake ourselves into awareness, we must experience new or contrasting conditions.

Meaning often emerges through contrast. We do not know what it means to work hard until we see how hard others work. We do not understand what children can accomplish until we have seen what other children the same age do. So it is with cultures. Cross-cultural comparisons can help us discover characteristics of our own culture that we fail to notice because we are so familiar with them. Through such comparisons, our perceptions become clearer and sharper. In fact, we are stunned at times to realize that what we have thought to be ordinary is actually very unusual in other cultures.

For example, several years ago we visited a mathematics class in a Japanese elementary school where the children were learning to draw cubes in three dimensions. One boy was having trouble. His cube looked crooked, no matter how carefully he tried to copy the lines from the teacher's model. Seeing the child's difficulties, the teacher asked him to go to the blackboard and draw his cube. After working for five or ten minutes, he asked the teacher to look at his work. Rather than judging the child's efforts herself, she turned to the class and asked whether the drawing was correct. The child's classmates shook their heads no. The teacher directed the boy to try again. He struggled until the end of the forty-minute class. As time passed, we began to feel more and more uncomfortable and anxious about the child at the board. What must he be feeling? Would he burst into tears? Yet he appeared to be undisturbed by his public exposure and gave no indication of crying. By the end of the class he had drawn a passable cube, and the class applauded.

Scenes like this are not unusual in Chinese and Japanese classrooms, and later we will show how this one fits into the broader

context of Asian education. For now, we want to focus on how the experience affected us. Because American teachers fear public failure might damage a child's self-esteem, they generally do not send children to the blackboard to display their errors to the whole class. Moreover, Americans conceive of errors as a possible precursor of ultimate failure. People should strive to avoid errors and to give only the correct response—a routine that fits our culture and has been strengthened by the writings of behavioral psychologists such as B. F. Skinner.

Japanese and Chinese teachers and students have a different view. They regard mistakes as an index of what still needs to be learned. They expect that with persistence and effort, people will eliminate errors and eventually make the correct response. In the Japanese classroom, the child struggling at the board was displaying a positive, not a negative characteristic. His errors were not a matter of great concern; what would be worrisome would be the child's failure to expend the effort necessary to correct them. This experience gave us a new appreciation of how errors, rather than being an index of failure, can be put to positive use in learning.

Melford Spiro, the anthropologist, in a phrase borrowed from T. S. Eliot, described good anthropology as that which "makes the familiar strange, and the strange familiar."² This phrase summarizes what we hope to accomplish in this book. Having compared teaching, parenting, learning, and academic achievement in several very different cultures, we found the most exciting revelations not in what we discovered in Asia, but in what was revealed in the United States. Despite the fact that we have spent all our lives in this country, we, as is likely true of most Americans, had never really understood the consequences of many American beliefs, attitudes, and practices until we began our studies in Asia. Many aspects of American education began to seem strange when we viewed them through lenses altered by our Asian experience. We have experienced the thrill—and the distress—of discovering new attributes of our culture.

OUR NATIONAL DEFENSIVENESS

If it was ever fashionable to study and learn from Asian cultures, it certainly is not now. Americans feel battered by comparisons with Asians, and with the Japanese in particular. We often feel justifiably defensive about such comparisons. But what are the costs of ignoring the global context in which we live? And what misconceptions of ourselves might we perpetuate by failing to look outward, toward sights that could illuminate our self-perceptions? It is unsettling to realize that Americans, on average, have little real interest in the study of other nations and cultures. As a consequence, our image of others often is cast in stereotypes.

The accompanying cartoon appeared in *The Chicago Tribune*.³ In the left panel, American observers, peering intently into the Japanese classroom, are recording every detail for presumed later analysis. In the right panel are Japanese investigators, howling with laughter outside the American classroom. The cartoon taps our worst fears.

But does it represent reality? We think not. In the first place, the depiction of Japanese laughing at the American educational system is in our experience entirely wrong. Japanese see weaknesses in our system, but they are not laughing at all. Rather, they view these weaknesses as a serious threat to the economies of both the United States and Japan. The problem, they believe, is to get Americans to take our weakened educational system as seriously as the Japanese do—and to do something about it. That was the message carried by the Japanese delegation to the U.S.-Japan bilateral trade talks in the fall of 1989. They argued that Japan cannot be held solely to blame for the enormous American trade deficit and that at least part of the problem must be traced to America's lack of the educated work force that is required for industrial excellence.

But Asians also see real strengths in the American educational



system, and they are serious about learning from its positive aspects. Three strengths in particular are often mentioned in our conversations with Asian educators and parents.

Wherever one goes in Asia, one hears the complaint that although Chinese and Japanese students show high levels of academic achievement, they lack creativity, a characteristic Asians believe is more prevalent in American students than in their own. Committees appointed by Asian ministries of education are frequently charged with finding ways to foster greater creativity among their students.

A related strength is that Americans seem to avoid the excruciating competition that Asian students appear to face in their quest for places in prestigious universities. The use of scores on entrance examinations as the sole criterion for admission to universities has led Asian high school students to spend inordinate amounts of time on their studies—attending regular classes and after-school cram schools and doing schoolwork at home. The apparently more easygoing American high school students seem to avoid this

trauma, and Asian educators have asked whether they should continue their strong reliance on entrance exams.

A third area of perceived strength lies in American universities. The large number of Asian students who seek admission to graduate schools in the United States indicates the high regard in which American higher education is held in Asia. Asians perceive their own universities as weak. Life at even the best universities, especially in Japan, is derided as a time of rest and recreation between the grueling battles that precede and follow the undergraduate years. Attendance at university classes is poor, expectations are low, and students regard the undergraduate years as a four-year vacation from the process of becoming a productive citizen.

But what about the other panel of the cartoon? How serious are Americans about learning from Asian cultures? That depiction is at odds with reality as well. If recent studies are an indication, many Americans can't even locate Asian nations on a world map,⁴ and they certainly have little interest in the possible benefits of studying these seemingly remote and exotic foreign cultures.

STEREOTYPES

Taking an interest in Asian education does not mean that we should, or can, adopt the successful aspects of Asian systems of child-rearing and education. They are adaptive for the cultures in which they exist, and our problems are not going to be solved by importing Chinese or Japanese culture. Instead, we must find the resources within our own culture that made America great in the first place. "If we have to out-cooperate and out-sacrifice the Japanese, we may as well quit. We need . . . to find our own tools," suggested James Fallows in his discussion of Japanese and American competitiveness.⁵ But if we perpetuate biased, stereotyped views of ourselves as well as of others, we won't accomplish this.

What are our biased views? Here are some examples of common stereotypes that Americans hold about Asians, especially with regard to their educational success:

- Asian children are under great stress from very early ages; they exhibit great tension and even suicidal tendencies because of the demands placed on them by their teachers and parents.
- Asian children are far easier to teach in school than American children because they are innately docile.
- Asian teaching methods stress rote learning, relying on endless, mindless drill of basic skills.
- Asian children do well in school because their parents push them, training them in academic skills beginning in early childhood.

These examples will suffice, although there are many others. As will become clear in the chapters that follow, these stereotypes are largely inaccurate, especially as they pertain to younger children. Americans have false ideas about both the investment required and the costs involved in attaining high levels of academic achievement. More important, these stereotypes allow us to maintain a view of ourselves as relaxed, successful, effective individualists who are creative, innovative, and independent. Such stereotypes at best are inaccurate and at worst undermine efforts to overcome our problems.

The first stereotype—that Asians put enormous pressure on their young children to learn academic skills—is an oft-cited indictment of the costs associated with high levels of academic achievement. As we will show, it is inaccurate. Although pressure builds during the high school years, when concerns about university entrance exams intensify, such pressure is not evident during the preschool or elementary school years, a time when levels of achievement already are high. Asian children work hard, but we know of no evidence that they suffer greater psychological distress or a greater incidence of suicide than exists in Western children.⁶ But that is not the point we wish to make here. Embedded in this stereotype of the unacceptable cost of high achievement in Asia is a widely held vision of America: We are a people, it says, who value play in childhood, who let children grow to fulfill their

unique potential rather than be fitted into a uniform national mold, and who have greater sources of personal fulfillment than learning a narrow set of academic skills.

But is this view of ourselves accurate? We will argue that our self-view is no more accurate than our view of Asians, and that our ignorance of other cultures is useful for maintaining a lack of self-awareness about our own cultural stance on issues relating to education and child development.

We can go through the other stereotypes listed above and see that each one is colored by some aspect of our self-view. In perceiving Asian children as docile, we impute to our own children the qualities of liveliness and assertiveness. In deriding Asian teaching methods as rote, we define our own methods as flexible and innovative. In suggesting that rote learning is pervasive in Asian classrooms, we exaggerate the levels of creativity that result from the American educational process. And in contending that Asian children are hurried into acquiring academic skills by their parents, we congratulate ourselves on preserving childhood for our children.

In a similar vein, we cite the fact that more Nobel Prizes have gone to Americans than to Chinese or Japanese as proof that we have little to learn from studying how Asians go about educating their children. These false notions about others and about ourselves serve to obscure from view the realities of our own behavior.

SEARCHING FOR SOLUTIONS

President Bush's education summit with the nation's governors issued yet another set of reform-oriented pronouncements,⁷ whose primary significance lay in their having been approved unanimously by the participants. The governors offered the nation six goals for improving schools by the year 2000. These goals included having all children entering school "ready to learn," decreasing the dropout rate, increasing adult literacy, and having

American students rank number one in the world in mathematics and science.

Stating goals is laudable, but we are far from achieving any of these. To hear them stated so glibly with no reference to how they would be attained jars us into facing the great gap between goal and accomplishment. Without a vast expansion of early childhood education programs, there is no way all American children can enter school in the year 2000 ready to learn the first-grade curriculum. The dropout rate will remain high as long as students perceive—correctly—that the minimal level of knowledge and skills required for graduation prepares them for little more than low-level service jobs. Reducing adult illiteracy requires programs that capitalize on techniques that appeal to adult students. And if we do not make profound changes in our mathematics and science curricula, the goal of becoming number one in the world in these areas is absurd.

We must gain a better understanding of the causes of our problems before we can even contemplate how to reach the governors' goals. Yet the public discussion that followed the governors' conference moved quickly to the question of who will pay for achieving the goals, without first deciding what would be done if money were available. Money has not solved the problems of education. Improving education may cost more money, but the truth is that educators charged with improving our schools do not know how best to spend our educational reform dollars. They lack the information necessary to make such decisions. The reason is not hard to find: In the United States, little money is spent on educational research—that is, on finding out which educational initiatives work and which do not. In fact, in a report issued in 1987, the U.S. General Accounting Office found that from the early 1970s through the mid-1980s—the period when American educational deficiencies began to be a topic of national concern—the U.S. Department of Education decreased its support for research more than 70 percent in constant dollars. During the same period, federal spending for education in general increased 38

percent.⁸ Figuratively, we are buying limousines for transport, without drawing any maps to show us which roads might lead us out of the morass.

School reforms initiated in Chicago and in Minnesota exemplify movements based on beliefs and hopes rather than on solid information. Political forces in Chicago believe local control is the key to school reform, and have restructured the school system by transferring significant power from the board of education to local school councils. Similarly, educational policymakers in Minnesota believe that parents should have the opportunity to choose the schools their children attend. Presumably, like businesses in a market economy, better schools will flourish and inferior schools will either close or improve.

These reforms may in fact lead to improvement in the schools of Chicago and Minnesota. But if they do not, resources and energy will have been wasted on experiments of enormous scale. In our zeal to initiate changes, we run the risk of evoking discouragement that anything can ever be done to solve our problems in education. This is further reason that we might benefit from looking at other countries, to see how they have succeeded—or how they have failed.

IN DEFENSE OF TEACHERS, PARENTS, AND CHILDREN

It might seem from the above that our concern is primarily with the schools, and indeed, ultimately it is. But schools exist in a society composed in part of teachers, parents, and children. It is to these three groups that we will direct most of our attention in this book. Just as it is easy to suggest that children's achievement would be improved if more hours were spent in school, it is equally easy to suggest that all our problems can be traced to the ineptitude of American teachers, parents, and children.

American teachers are especially likely targets of criticism.

They would be more effective, it is charged, if they were better educated. As we will see later, however, their levels of formal education are higher than those of Chinese and Japanese teachers. Another charge is that they come to class improperly prepared for each day's lesson. This criticism is particularly unfair, for as we will see, American teachers are allowed little time for preparation outside the classroom.

Parents, too, are often criticized as the source of children's poor achievement. They are portrayed as being uninterested, unresponsive, and so immersed in their own problems that they have little time to attend to or interact with their children. In some cases they are, but the complaint heard from most parents is that they feel estranged from their children's schools. They don't know what they should be doing or how they should go about doing it. Perhaps as a consequence of the introduction of new approaches to teaching mathematics and science more than twenty years ago, the gulf between home and school has widened. As we will see, American parents begin to abdicate responsibility for their children's education soon after the children enter first grade, and they place ever increasing demands on the school. The situation is probably the fault of neither the present-day schools nor the parents. Yet, at the same time, schools clearly cannot handle the job of education without the involvement, support, and encouragement of parents.

American children, it is claimed, are inattentive and unwilling to work hard in school, and they demand a fast-paced daily life and an easy resolution of problems that parallel what they see in the television programs that occupy so much of their time. Indeed, many people maintain that the inordinate amount of time American children spend in front of the television set is a serious impediment to their education. From our data, however, we will see that Japanese children spend even more time watching television—while greatly surpassing American children in their academic performance. The influence of television may not always be positive, but in itself it is not the menace that it is often painted to be.

Why might children be inattentive in school? One likely reason is that they are forced to remain in classes so much of the time they are there. Frequent breaks punctuate the elementary school day in Asia; in fact, after every forty- to fifty-minute period there is a recess during which children play vigorously. In contrast to the four or five recesses a day that are typical in Asia, American children often have no more than a single recess. Should we be surprised, therefore, if American children have greater difficulty paying attention than Asian children?

↪ If American children are not motivated to learn, could it be because they live in a society that does not recognize that its schools promote boredom and inattentiveness? Whether or not the discouragement about the nation's children is merited, both teachers and parents need to lure them into situations that will reveal the joys and satisfactions of knowing how to do things well.

↪ If we cannot blame teachers, parents, or students, then who is accountable for the conditions in our schools? The answer is: We are all responsible. We have become accustomed to levels of performance that seemed satisfactory within the context of our own culture but which turn out to be anything but satisfactory compared with that of students from other cultures. Although the United States is among the countries expending the highest proportion of their gross national product on education, our elementary school and secondary school students never place above the median in comparative studies of academic achievement. We have allowed our schools to deteriorate because we failed to attend to what has been going on during the past several decades.

We begin this book with an analysis of cross-cultural differences in academic achievement. We have chosen to emphasize achievement in mathematics both because it is a fundamental subject and because it can be assessed objectively in diverse cultures.

We concentrate throughout the book on young children. The elementary school years are of profound importance not only in themselves, but also in helping us to understand the more complex

situations in secondary schools. We also place a special emphasis on the vitality, enthusiasm, and high motivation among Asian children, teachers, and parents, and how they are achieved.

Each of the following chapters focuses on a particular theme in American education that struck us as especially remarkable after studying Japanese and Chinese homes and schools. Many of our conclusions are controversial. Our purpose, however, is to stimulate discussion about the assumptions that underlie the structures and practices of the American educational system. Only through such discussions can our nation hope to reach some consensus about possible solutions to the fundamental problems in American education.

Chapter 2

Academic Achievement

We recently received a letter from a board member of a school district near Boston. "I have been searching for a way to open the eyes of our parents, teachers, administrators, and the general public to the gap between the actual math achievement levels in our schools and the level it takes to be competitive in the world community," the letter began. "So far I have been unsuccessful. Generally, people compare against American benchmarks which indicate 'No problem, we're OK.' Result? People simply do not understand that there is a significant gap, and a widening one."

This impression is in accord with what we have found in our interviews with American parents and children, who express the belief that American students are doing quite well in mathematics. We presented the following situation to several hundred mothers and fathers of Chicago elementary school children: "Let's say that your child took a math test with 100 points. The average score was 70. What score do you think your child would get?" The average score given by mothers was 82, markedly above the average score of 70 for the fictitious test, and only 26 percent of parents gave

their children a score of 70 or below. Children echoed the attitudes of their parents. When asked how well they thought they were doing compared to other kids in their class, less than 10 percent rated themselves as below average.

In another set of interviews, with mothers of first-graders and fifth-graders in Minneapolis, we asked each one whether her child had ever had problems with mathematics. Most mothers (i.e., mothers of 90 percent of first-graders and 72 percent of fifth-graders) said their children had never experienced problems.

In short, we have found little evidence that Americans acknowledge the academic weakness of our nation's children. Despite articles in the press and reports in other media, Americans persist in believing that nothing is seriously wrong—that there is no crisis. When they are confronted with data indicating that American children do poorly in academic subjects compared with children in other societies, they dismiss the results and criticize the studies.¹ Even some American scientists, such as Roald Hoffman, the Nobel prizewinner, have questioned whether American children really are behind in their academic achievement. In a column in *The New York Times*, he suggests that "Surveys that plumb the depth of our ignorance and that of our students are methodologically suspect. More importantly, the interpretation of these statistics in isolation is questionable."¹ Others, such as the columnist Jeff Greenfield, express even greater disdain for comparative studies: "Well, here we go again. Once more, for the 3,207th time an Officially Important Survey has revealed that our children are a bunch of morons. This time, the Officially Important Survey reveals, they have been proven a bunch of mathematical morons. And you know what? I don't think I care all that much."²

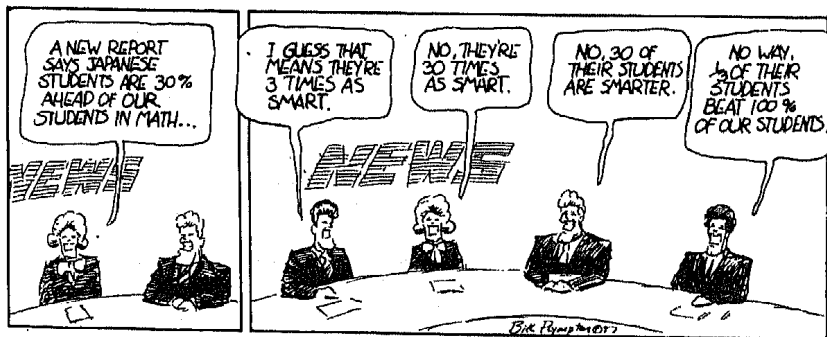
How, in face of this self-satisfaction, are we to persuade Americans that something is indeed wrong? What is the evidence that American children do poorly in mathematics? Parents' reactions demonstrate how easy it is to be positive when the only basis for comparison is one's own beliefs about what other American children are doing. Cross-national studies of achievement offer more

convincing evidence. In such studies, identical tests are given to large samples of students from different countries, and scores are compared. When these studies are properly conducted, they provide external standards against which we can gauge the achievements of American students.

In this chapter, we compare American children's achievement scores in mathematics and reading with those of Chinese and Japanese children, and then we broaden our focus to ask whether the differences are limited to academic achievement or whether they include more general differences in the ability to handle abstract concepts. Answers to these questions will be central in explaining the performance of American children.

MATHEMATICS

The list of cross-cultural studies of children's academic achievement is short. In mathematics, apart from our own research, there have been two major studies and several smaller ones. The International Association for the Evaluation of Education Achievement conducted the first large-scale study in 1964.³ The same organization completed a similar study in the early 1980s.⁴ Both studies tested the knowledge and skill of eighth-graders and twelfth-graders with a wide variety of mathematical problems, ranging from arithmetic to calculus and number theory.



The general trend of the results was very clear. According to a succinct summary appearing in the National Research Council's report "Everybody Counts":

Average students in other countries often learn as much mathematics as the best students learn in the United States. Data from the Second International Mathematics Study show that the performance of the top 5 percent of U.S. students is matched by the top 50 percent of students in Japan. Our very best students—the top 1 percent—scored lowest of the top 1 percent in all participating countries.⁵

On no test did American students attain an average score that fell above the median for all of the countries. On tests given to students from twenty countries, American eighth-graders ranked tenth in arithmetic, twelfth in algebra, and sixteenth in geometry. Twelfth-grade American students fared just as badly. When compared to students from fourteen other countries, they were in the lowest quarter in geometry, and in algebra they were second from the bottom.

An even more recent study assessed the mathematical competence of thirteen-year-olds in Korea, Spain, the United Kingdom, Canada, Ireland, and the United States.⁶ Students from the United States had the lowest average scores of all the children.

These studies would seem to convey an unmistakable message. Nevertheless, some critics have argued that the results are not as clear as they first appear. For one thing, the percentage of teenagers who are enrolled in high school may vary greatly from country to country, since access to secondary education is not universal. We should not be concerned, the critics suggest, if a representative sample of American students performs more poorly than highly selected groups of students from other countries. We pride ourselves in providing a popular education for all students, and not just an education for a select few.⁷ It should be no surprise, therefore, that the more representative American samples obtain lower average scores.

Critics also argue that even when comparisons are based on comparable populations within each country, the results do not give sufficient consideration to differences in the mathematics curricula of different countries. If Japanese high school students do well merely because their courses present topics in greater depth and students are required to take more mathematics courses, this argument runs, we should find little basis for concern. After all, the content of a curriculum is a matter of choice, and such choices often involve tradeoffs among competing goals. We have a diverse society, and we may value many things other than mathematics. According to this argument, American schools are not necessarily at fault; raising scores is simply a matter of reordering priorities so that students are required to spend more time learning mathematics.

A Focus on Children

The critics' alternative interpretations, as well as our desire to understand the genesis of the differences among secondary school students, led us naturally to consider the performance of younger children from different countries. Are cross-cultural differences as striking at the elementary school level as they are among secondary school students? If the answer is yes, then we need to search for deeper interpretations. Differential rates of enrollment in school, for example, could not explain the difference in performance, for elementary school education is compulsory in all industrialized countries.

The first effort to compare mathematics achievement of relatively large samples of elementary school children in different cultures was the study we and our colleagues conducted of Japanese, Chinese, and American elementary school children in 1980.⁸ Since then we have completed several other large comparative studies of children's achievement.⁹ The results provide consistent and sobering indications of inferior performance by American children. Further, the results dispel any doubt that the poor

performance of American high school students could be explained solely by faulty comparisons of subjects or test items.

The studies completed in 1980 and 1987 were similar in basic design. In each we included both first-grade children and fifth-grade children, to give us information about what children knew when they were just entering school as well as after several years of instruction. Rather than attempting to include a large number of cultures, we chose three for intensive study: Chinese, Japanese, and American. Selecting the two Asian cultures was logical because they are among the world's most successful in producing students with high levels of achievement in mathematics. The highest scorers on the second of the international high school mathematics tests were students from Japan and Hong Kong. In advanced algebra, twelfth-graders in Japan and Hong Kong had mean scores of nearly 80 points; that of the American students was a little over 40. Similarly, the mean scores for elementary functions/calculus were over 60 points for the Chinese and Japanese students, but only around 30 points for the American twelfth-graders.

We chose one or two cities within each culture, then sampled schools and children within these cities. Cities in the different cultures were matched as closely as possible for size, economic, and cultural status within their countries.

The settings for the 1980 study were the metropolitan areas of Sendai, Japan, a city 220 miles northeast of Tokyo; Taipei, the capital of the Republic of China (Taiwan); and Minneapolis, Minnesota. The American research site was shifted from Minneapolis to the Chicago metropolitan area in the 1987 study, and Beijing, China, was added as a fourth city.

Falling Far Behind

In tests of mathematics achievement, for both grade levels and in both studies, the scores of American children were far lower than those of their Japanese and Chinese peers.

The magnitude of the difference emerges dramatically when we look at the results separately for each of the schools we visited. A graph of the data from our first study appears in Figure 2.2.1, where each point represents the average score of the children in each of the schools included in the study. The scores of the American first-graders and the first-graders from the other cities overlap somewhat. By the fifth grade, however, the groups have diverged. The full range of the population was represented in all of the metropolitan areas sampled, yet even the best American schools were not competitive with their counterparts in Asia on mathematics achievement. The *highest*-scoring American school falls below the *lowest*-scoring Asian schools. These patterns also emerged in the second study, when the research site was shifted from Minneapolis to Chicago (see Figure 2.2.2).

Although American students obviously lag behind Chinese and Japanese students, perhaps the range of students in the United States is greater. Low average scores do not preclude the possibility that the U.S. produces a disproportionate number of very high achievers. To check this possibility, we identified the one hundred students who made the highest scores. In fifth grade, one of these was an American student, eleven were from Taiwan, and eighty-eight were from Japan.

Samples and Tests

These results are dramatic. But we must explain in some detail how we went about conducting the studies, for the power of our findings would be eroded if our procedures were open to serious criticism. Two main questions must be raised: How were the samples of children obtained? How were the samples of items chosen for the tests? If we had not used the same method to select the children in each city, or if we had used test items with cultural biases, it would have been difficult to interpret the findings.

Whom we studied. No cross-national study can be better than the samples of individuals on which it is based. No sampling

FIGURE 2.2
Mathematics achievement for each school
in the 1980 study (2.2.1) and the 1987 study (2.2.2)

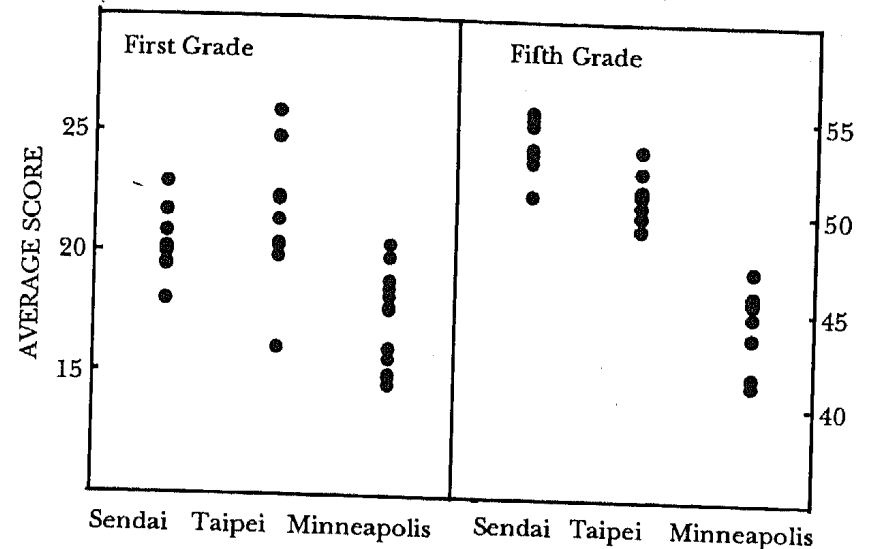


Figure 2.2.1

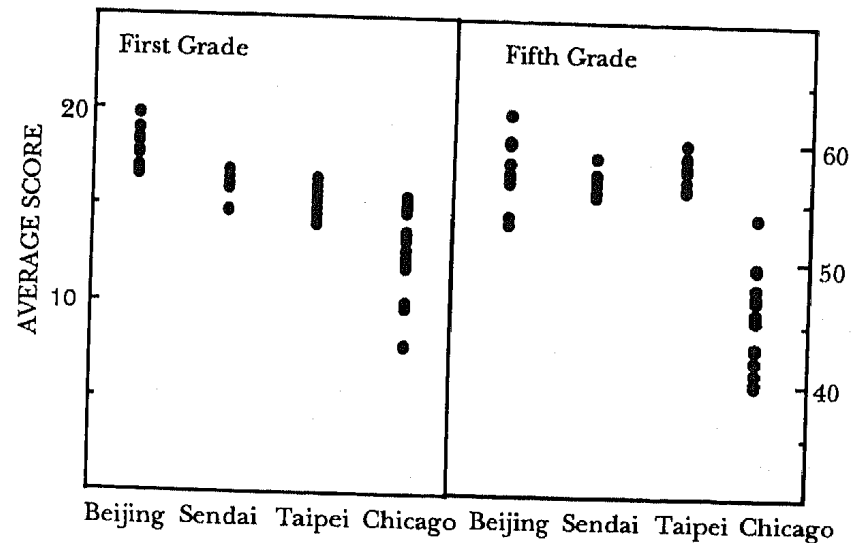


Figure 2.2.2

procedure is perfect, for matters of convenience and cost are always important considerations in any research. Nevertheless, we tried as far as possible to anticipate and minimize the potential sampling problems. We used large samples of children in our studies, and we took great care to select subjects who were representative of the children in the locations where we were working.

No single city can adequately represent a nation. Fortunately, we were able to conduct our research in two quite different American cities, which together do represent a large segment of the American urban population. In our first study, since we suspected that American children might perform poorly compared to their Asian counterparts, we wanted to avoid the possible criticism that our sample contained an unusually large proportion of educationally disadvantaged children. Minneapolis has few of the problems besetting other American cities; it ranks high nationally in indices of educational status, such as students' scores on college entrance tests (where, in 1989, it ranked fourth in the nation), and in the expenditure per pupil at the elementary and secondary levels (where it ranked sixteenth in 1989–90). If children in the Minneapolis metropolitan area performed poorly on our tests, we could expect that children in other large urban areas would be unlikely to fare better.

For our second study we decided to use a markedly different, and in many respects more representative, American city: Chicago. The Chicago metropolitan area includes not only traditional big-city schools, but also inner-city schools, private schools, and suburban schools often praised as being among the nation's finest. Selecting an area with such a diverse population meant, however, that we had to have a larger sample of schools than we included in our first study. Whereas ten schools in each city participated in the 1980 study, in the 1987 study we sampled ten schools each in Taipei and Sendai, eleven in Beijing, and twenty in Chicago.

Sendai was chosen to be our Japanese city because we and Japanese experts considered it to be most comparable to Minneapolis, among representative Japanese cities, in its general demographic and cultural characteristics. Taipei, in 1980, was the

only large Chinese city with a traditional Chinese culture that was open to researchers. By the mid-1980s, mainland China had become more open to the West, and it was possible for us to study children in Beijing.

We were careful at each step not to introduce bias into the selection of the children. We relied on local educational authorities and researchers to provide us with information about the schools in each city, and on the basis of their suggestions we were able to select representative samples that included schools in neighborhoods of high, average, and low socioeconomic status. We then randomly chose two first-grade classrooms and two fifth-grade classrooms at each school. The first study included a total of 120 classrooms, and the second, 204.

We are aware that when we speak of "cultures" we are describing what we found in these 324 classrooms in the five large cities included in our studies. We also realize that what we found in Beijing or in Minneapolis does not tell us what we would find in rural Mongolia or in rural Mississippi. What we can say with confidence is that within the cities selected for the studies, the samples of children were chosen in as comparable a manner as possible.

Culture-fair tests. Our research group in the United States, in collaboration with our colleagues in China, Japan, and Taiwan, constructed all the tests used in the research. We undertook this time-consuming and demanding task because we wanted to be sure that the tests were fair and that they covered the knowledge and skills to which the children in each of the cultures had been exposed.

Our first step was to analyze the mathematics textbooks used in each city.¹⁰ In these analyses, we categorized each concept and skill according to the semester and grade in which it was introduced. By comparing the analyses for the different cultures we were able to devise a test that contained the types of items that should have been familiar to children in all three cultures.

Testing the children. Children may not do well on tests for many reasons other than lack of knowledge. They may misunderstand the instructions, be unable to read the problems, or lose motivation when the problems start to get difficult. A skilled examiner, giving the tests one-on-one, can anticipate such possibilities and apply the appropriate correctives by being sure the instructions are clear, reading all of the problems aloud to the child, and attempting to maintain the child's interest in the tasks.

With two exceptions, all of the tests in our studies were given in one-on-one sessions, with an examiner testing each child individually. The two exceptions were the computation and geometry tests used in the 1987 study. We sacrificed the advantages of individual testing in these two cases to the goal of obtaining large samples of children. These two tests were administered to whole classrooms at a time. In all, more than seven thousand children took the computation test.

We had to limit the rest of our testing to more reasonable numbers of children, for it was not possible to have one-on-one sessions with thousands of children. We restricted the numbers by randomly selecting subsamples of boys and girls from each classroom.¹¹ These procedures yielded totals for the two studies, respectively, of 1554 and 1673 first-graders and fifth-graders. These children and their families are the ones who were studied in depth and on whom most of the information in this book was based.

All the cities have compulsory attendance rules for elementary school, and children enter school at roughly the same age in all of the cities. Because testing was scheduled at the equivalent point in the school year in each location, the ages of the children in Taiwan, Japan, and the United States at the time of testing were virtually identical: nearly 6.8 years for the first-graders and nearly eleven years for the fifth-graders. Some children begin school slightly later in Beijing; at the time of testing, the children were several months older than the children in the other cities.

Beyond Computation

One question that might be raised about the data we have presented so far concerns the content of our tests of mathematics achievement. The 1980 test included a combination of computational problems and standard word problems. For the 1987 study, we constructed a battery of tests. The data we have described were from the computation test in this battery.

It is true that computation and word problems represent some of the goals of elementary mathematics curricula, but mathematics educators, and the rest of us, have other goals as well. Children must also understand basic mathematical operations and be able to apply their knowledge creatively. Before we judge the American educational system too hastily, we should be certain that deficiencies demonstrated by American students are not compensated for by strengths in areas more highly indicative of an understanding of the structure and operations of mathematics.

Thus, in addition to testing computational skills in our 1987 study, we also tested children for their understanding of basic mathematical operations, their ability to apply their knowledge to solving meaningful problems, their facility with number concepts, their comprehension of information contained in graphs and tables, their skill in estimation and measurement, and their spatial reasoning abilities. We developed all these tests in consultation with psychologists from each of the cities included in the study and with mathematics educators. The tests covering these areas are described briefly in Table 2.1.

Although some were typical mathematics problems, others were much more novel. Here are some examples:

Pretend that some Martians came to visit you and they had never heard of addition. If they asked you to tell them all the ways you could use addition, what would you tell them?

There is a Ferris wheel with four people on it. Point to the person who will be at the highest point in the Ferris wheel

TABLE 2.1
A Brief Description of Tests Used in the 1987 Study

- (1) *Word problems:* Both standard and novel problems were included, some of which were more complex than those found in the textbooks of any of the cultures.
- (2) *Number concepts and equations:* Questions were designed to probe children's understanding of some of the basic number concepts that lie at the foundation of elementary mathematics. Topics included place value, negative numbers, the meaning of equations, and the concept of fractions.
- (3) *Estimation:* Children's ability to map numbers and arithmetical operations onto real-world objects and events was assessed.
- (4) *Operations:* The test measured children's understanding of the basic arithmetical operations, focusing on their ability to explain the uses of the operations and to describe situations in which the operations could be used.
- (5) *Geometry:* Many aspects of basic geometry were included in the test, ranging from vocabulary of geometric terms to problems requiring students to find the area of various regular and irregular two-dimensional figures.
- (6) *Graphing:* Children were asked to extract and use information contained in conventional tabular and graphic representations of data.
- (7) *Visualization and mental folding:* These two tasks assessed visual problem-solving skills that are hypothesized to be important in mathematical problem solving.
- (8) *Mental calculation:* Children were presented with problems that required mental solution of both simple and complex calculations.
- (9) *Oral problems:* First-graders were read statements that assessed, without requiring calculation, their ability to reason about quantity, frequency, ordinal position, and other fundamental mathematical concepts.

after it has gone around three and a half times? (A picture of the Ferris wheel is displayed with the four persons seated at 0, 90, 180, and 270 degrees.)

What two numbers multiplied together would give an answer closest to the target number of 75?: 2, 18, 50, 37.

What is another way to say one half?

Draw a circle around one half the stars. (Two lines containing twelve randomly arranged stars were placed before the child.)

An overview of children's performance on the individual tests, plotted on a common scale, appears in Figure 2.3. It is obvious that the American children's deficiencies in mathematics were pervasive. In nearly every instance the mean scores for the American students were the lowest. The Asian students' superiority was not restricted to a narrow range of well-rehearsed, automatic computational skills, but was manifest across all the tasks. Our data do not support the stereotype of Asian children as successful only in performing what they have learned rather than in applying what they know.

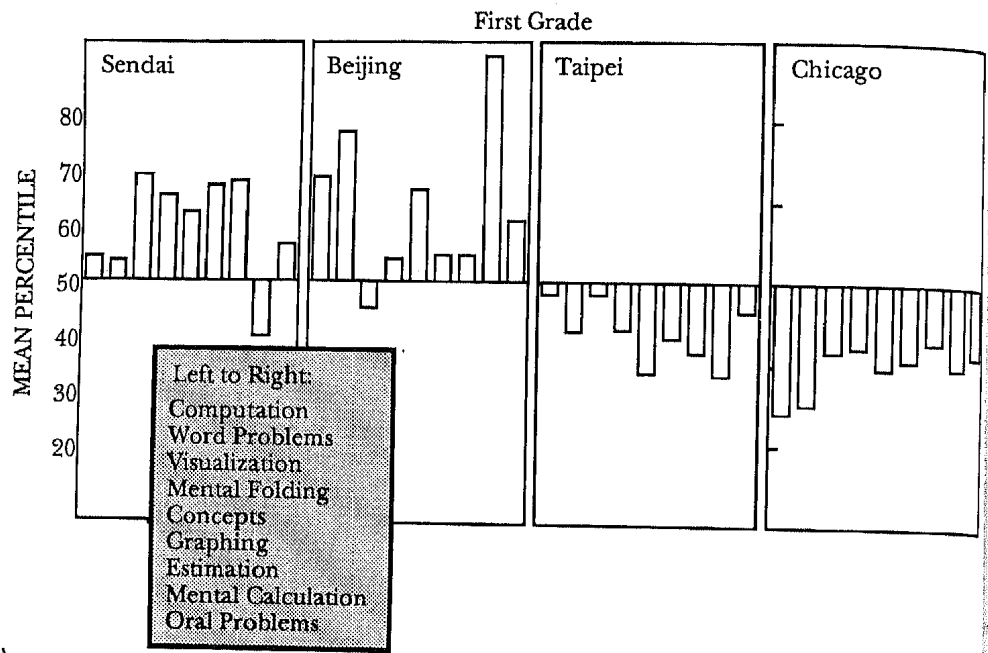
Before First Grade

If cross-cultural differences appear in first grade, would they also be evident even before formal instruction in mathematics begins? To answer this question, we conducted an additional study, in 1984, this time of kindergarten children. If cross-cultural differences were found among kindergarteners, it would be very hard to attribute the poor performance of the older American children solely to their schooling. A full explanation would have to involve the children's homes and their parents.

We visited seventy-two kindergarten classrooms, twenty-four from each city, for this study. All Minneapolis children and nearly all of the Sendai children attend kindergarten; in Taipei, more than 80 percent of the children do so. All children in attendance at the schools were given a mathematics test based on analyses of workbooks from kindergarten and textbooks from first through third grade. We tested children's understanding of such concepts as counting, larger and smaller, place value, ordering, addition, and subtraction. Again, in order to be sure that the children

FIGURE 2.3

Children's performance on the battery of mathematics tests in the 1987 study.



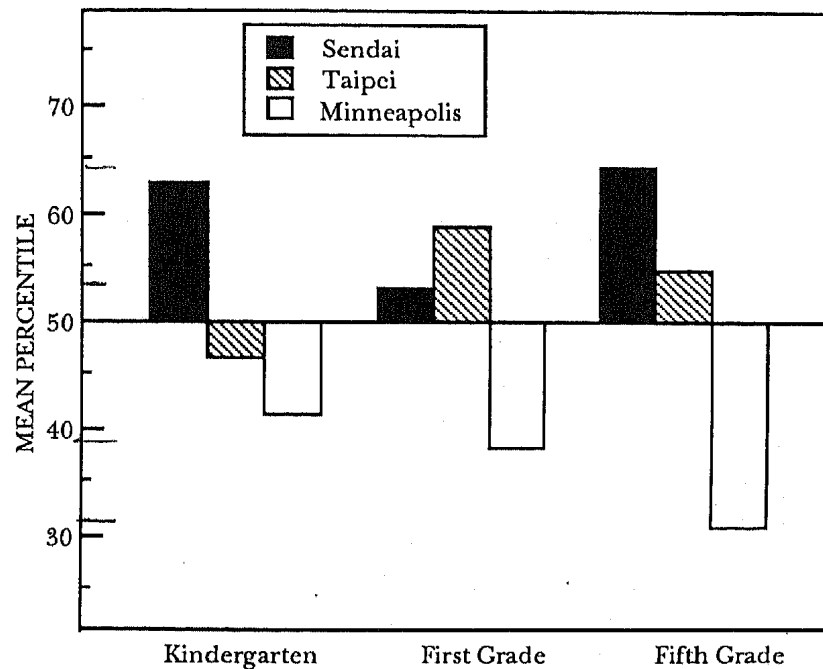
Academic Achievement

understood the questions, we tested each of the nineteen hundred children individually.

As in our earlier results, Japanese children showed consistently superior performance from kindergarten through fifth grade. (For comparative purposes, the data for the first- and fifth-graders from the 1980 study are also graphed in Figure 2.4.) The inferiority of American children compared to Japanese children obviously begins early and grows worse as they pass through elementary school. Chinese children, on the other hand, perform not much better than American children in kindergarten, but show rapid improvement in their scores.

FIGURE 2.4

Children's performance on the mathematics test.



READING

We must next ask whether American children's difficulties are limited to mathematics, or whether they are more widespread and include other subjects, such as reading. There are indications, as we will see, that Americans value reading and literacy much more highly than they do mathematics. Moreover, elementary school students in the United States spend a huge proportion of their school day learning to read—significantly more time than their Asian peers. If American students were to excel in any subject, it is likely that it would be reading.

Comparing reading ability of children in different cultures is a bit more problematic than comparing children's abilities in mathematics. Math has a universal language; the numerals, notation systems, and concepts and operations are common to all modern cultures. This is not true in reading. Languages and writing systems differ, and certain concepts may be represented in one language and not another. Nevertheless, we constructed reading tests with a high degree of comparability for both the 1980 and 1987 studies.

We went about constructing the reading tests as we did the mathematics tests. Members of our research group analyzed the elementary school readers used in the Beijing, Sendai, Taipei, Minneapolis, and Chicago schools, entering each word into a computer, along with its English equivalent and the grade and semester in which it was introduced. We also summarized each story and kept a record of the types of grammatical structures employed at each grade. All of this information was used for devising two tests, one in Chinese, Japanese, and English for our first study, and one in Chinese and English for the second study.

It is easy to construct Chinese, Japanese, and English equivalents of simple sentences like "The kitten is sitting under the table" or "The day we went on a picnic was a cloudy day." These words

appear in the textbooks at about the same times, and the syntax is uncomplicated. During the first three elementary school grades, when such simple sentences are likely to appear, the content of the reading tests for the three cultures was identical. In tests in the upper grades, it was impossible to use only identical sentences. American fifth-graders may find a story about the repair of the Statue of Liberty interesting, but such a story is not especially appealing to children in Beijing. Nevertheless, with the careful selection of words of equal levels of difficulty, a comparable story can be written about the repair of a section of the Great Wall. A great deal of time was required for developing these reading tests, but in the end highly reliable estimates of reading and comprehension were developed.

Learning to Read in Three Languages

Any meaningful discussion about comparative reading scores necessarily presumes some knowledge of what is involved in reading English, Chinese, and Japanese. Writing systems based on an alphabet, Chinese characters, and a Japanese syllabary pose different demands on children learning to read.

After Americans learn the alphabet, they must learn how to pronounce the combinations of letters that constitute words. This is not easy, for in English what the reader sees corresponds imperfectly to what he says. Most letters have several pronunciations, depending on the combination of letters in which they appear.

Learning to read Chinese is entirely different. During elementary school, Chinese children must learn approximately three thousand individual characters and the many thousands of words that are formed by combining them. Some researchers believe this task is vastly more difficult than learning to read English; others argue that the irregularities between sounds and spellings make English more difficult to learn to read.

Learning to read Japanese poses still other problems. Four scripts are used in written Japanese: *hiragana*, a cursive script that

can be used for writing any Japanese word; *katakana*, an angular script representing the same sounds as *hiragana*, but used most frequently for writing words borrowed from other languages; *kanji*, consisting of Chinese characters and their combinations; and the English alphabet (*romaji*), which is used in scientific notation, titles, and signs.

Which of these three languages poses the most daunting obstacles for beginning readers is a matter of debate. Certainly it is not immediately obvious that English is the most difficult.

Good and Poor Readers

American students tended to be overrepresented among both the best and the worst readers. If children in the three cities perform comparably, approximately thirty-three children from each city should be among those receiving the top one hundred scores. Similarly, there should be approximately thirty-three children from each city among those receiving the lowest one hundred scores. But in our study the number of American children among the worst readers greatly exceeded the number we would expect, if reading skills in the three cities were equivalent. Among first-graders, forty-seven American children were in the bottom group according to their scores on vocabulary tests, and fifty-six American children were in the bottom group in scores measuring their comprehension of what they had read. Corresponding numbers for the fifth-graders were forty-four and forty-seven.

The group of top readers also tended to include a greater number of American children than would be expected. In reading vocabulary, forty-seven American children were among those receiving the top one hundred scores at first grade (although in scores on reading comprehension there were thirty-two American first-graders). The corresponding numbers for fifth-graders were forty and fifty-six.

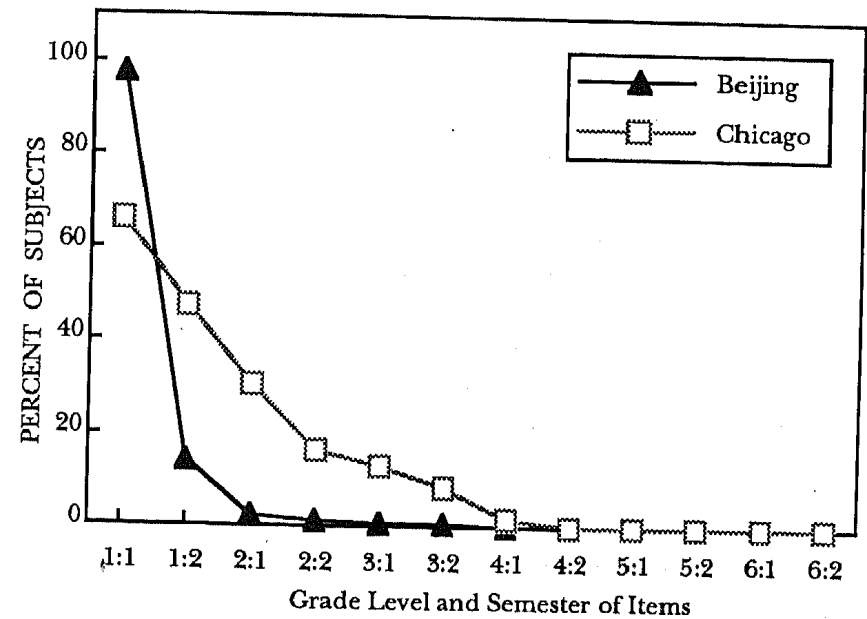
The trends were repeated in Beijing and Chicago. At both first and fifth grades, a higher percentage of Beijing children were able

to read words at their grade level, but more Chicago children were able to read words above their grade level (see Figure 2.5).

The explanation for American students' overrepresentation both below and above their grade level in reading may be related in part to the possibility of breaking down English words by sound. Children who fail to catch on to this possibility tend to be poor readers; children who do learn to break down words by sound are able to read words of high complexity. This characteristic of alphabetic writing systems is not shared by written Chinese or Japanese, where the pronunciation and meaning of characters must be taught and memorized.

Another explanation may be that the division of classrooms in the United States into reading groups gives some students the

FIGURE 2.5
Chinese and American first-graders' ability to read words at and above their grade level.



opportunity to learn to read words beyond their grade level. Since all children in Chinese and Japanese classrooms must adhere to the national curriculum, they have little opportunity at school to learn characters at a higher level than the reading curriculum for their grade.

In conclusion, American children do not display exceptional problems in reading achievement. They are, however, overrepresented among the poor readers. A final sobering statistic emphasizes this point: 31 percent of the American fifth-graders, 12 percent of the Chinese, and 21 percent of the Japanese were judged to be reading at the third-grade level—as evidenced by their failure to meet the criterion of reading three fourths of the test items at the fourth-grade level.

THE RETREAT TO GENETICS

Despite the denial by some Americans that our children are lagging behind children in other countries, we believe that our studies, along with the other ones we have described, clearly establish widespread weaknesses in American children's academic achievement. One popular interpretation of these findings is that Asians simply are smarter than Americans. According to this view, superior academic achievement indicates superior underlying abilities to handle abstract concepts and problems. A closely related explanation is that Asians possess some innate skill in mathematics. Neither of these interpretations makes much sense to us.

The claim that Japanese students are more intelligent than American students has been made by the Irish psychologist Richard Lynn, whose work was publicized several years ago in the cover story of a national magazine.¹² Using American norms, Lynn computed Japanese children's scores on a commonly used test of intelligence. On this scale, Japanese children's average IQ was significantly above the American average. Lynn's claims, if correct, would add greatly to our understanding of cultural dif-

ferences in achievement, but as another publication has pointed out, they are wrong.¹³ Asian children may learn more during their school years, but their *capacity* for learning—which is what intelligence tests attempt to measure—does not differ from that of American children.

The fundamental flaw in Lynn's report was his failure to consider two important variables: location of residence (urban versus rural) and socioeconomic status of the children's families. One of the consistent findings since intelligence tests were devised nearly a century ago has been the large differences between IQ scores of city children and children living in remote villages, and between children from upper-income families and from disadvantaged homes. Lynn did not gather any of his information himself, but instead relied on the norms of the test that were published in the test manual. His choice was unfortunate. Because intelligence tests in Japan are used primarily in large cities, only urban children had been tested to establish the norms. Moreover, no attention had been paid to the necessity of selecting a representative sample of children from each Japanese city. The norms for the American test, by contrast, were based on a truly representative sample of urban and rural children of all socioeconomic levels.

We can do more than criticize Lynn's methodology. Data we obtained from an intelligence test given to the children in our 1980 study contradict his claims. The test, constructed especially for use in Japan, Taiwan, and the United States, included items tapping the children's vocabulary, general information, memory, spatial, and perceptual skills, ability to use a code, and so on—all topics not explicitly taught in school. As with the mathematics tests, we developed these items with a team of researchers from each of the cultures.

Contrary to what would be expected if cross-cultural differences in general intelligence could explain the striking differences in achievement, we found little overall difference in the levels of cognitive functioning of children across the three cultures.¹⁴ American children did not display lower intellectual abilities than

Chinese and Japanese children. Scores for the individual children from each culture on the different types of items were not identical, but by the fifth grade the scores for the total test did not differ significantly from one culture to another. Children in each culture displayed slightly different cognitive strengths and weaknesses, but by the time they were enrolled in the fifth grade, the most notable feature was the similarity of their performance.

DEFINING THE PROBLEM

A close examination of American children's academic achievement rapidly dispels any notion that we face a problem of limited scope. The problem is not restricted to a certain age level or to a particular academic subject. Whether we look at the average scores for schools or at the scores for individuals, we find evidence of serious and pervasive weakness. In mathematics, the weakness is not limited to inadequate mastery of routine operations, but reflects a poor understanding of how to use mathematics in solving meaningful problems. Nor is mathematics the only subject in which American students do poorly. We have presented evidence of the overrepresentation of poor readers among American children, and American students have fared badly in international studies of achievement in science.

The hypothesis that the academic weakness of American children is due to deficiencies in innate intellectual ability is without merit. American children obtained scores highly similar to those of the Asian children on a culturally fair test of intelligence, and we have found no sound evidence that American children's academic problems stem from a deficiency in handling abstract concepts.

Similarly, we see no substantial basis for positing differences among the races in innate mathematical ability. How could a genetic hypothesis account for the remarkable improvement shown by children in Taiwan between kindergarten and fifth

grade? During kindergarten their scores were little better than those of American children; by fifth grade the Chinese children had greatly surpassed them. Moreover, American children's shortcomings are not limited to mathematics. Would lack of specific innate abilities also be posited to account for low scores in tests of reading, geography, or science?

The puzzle lies in trying to understand the poor performance of American children. If explanations that rely on innate endowment are unsatisfactory, then we must look to children's everyday experiences. The most likely locales are those where children spend most of their time: home and school. Just as cross-cultural comparisons help to expose the academic weaknesses of U.S. children, so should such comparisons help to identify those aspects of American homes and schools that contribute to poor academic performance.