

Those We Leave Behind

Anyone who has traveled to a foreign country and been unfamiliar with the language knows the frustration involved in communicating. All of a sudden, so many things that were taken for granted are beyond reach. Asking a waiter if the entrée is highly salted or cooked in animal fat becomes a drawn out, uncertain affair; simple directions to the neighborhood grocery or drug store become live theater; knowing phrases like “*good morning*,” “*no thank you*,” and “*how much?*” help to create the illusion of fluency.

My first encounter with this type of “verbal illiteracy” occurred while visiting a friend in Ecuador, South America. Armed with remnants of two years of high school Spanish, I motioned and gestured my way through the country. While lost among the hills and labyrinths of Quito, I saw a movie theater with an advertisement for an English movie. I decided to escape my alien world for a couple of hours. As it turned out, the film had been dubbed into French and had Spanish subtitles; I took my chances back on the streets.

We are spared these feelings and experiences through the familiarity and insulation of our own culture. But language takes many forms, one of which is mathematics. Newspapers print percentages and fractions; recipes are cut in thirds for smaller portions; seamstresses and carpenters insert numbers in formulas that give appropriate lengths for spacing patterns correctly on dresses and on floor tiling. Health officials authoritatively tell the public what percentage of fat in their diet is optimum. Colorful graphs are shown relating such things as

fat consumption with various cancers. Linear and nonlinear trends are cited ranging from mundane hourly pay rates to the horrific figures of the human population explosion.

But graphs and statistical results cited in articles are rarely elaborated upon. Newspaper and magazine writers do not remind readers how a percentage is calculated, nor do they carry out the multiplication or division which leads to the result they quote. These skills are deemed to be in everyone's possession. Using them freely is considered part of a shared literacy inherited from our educational system.

Many calculations do not involve equations with esoteric symbols reserved for the mathematician and scientist. They belong to the realm of the seventh-grader—straight forward manipulations with simple numbers that help clarify or explain the deficit, national defense spending, or health care expenditures. The purpose of mathematics is to help the general public navigate through the uncertain eddies and currents of society. But who out there is seaworthy?

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The scene is a public school built in the early part of this century. In better days it housed the Italian, Jewish, Irish, and Polish children of immigrants. It was a symbol of social justice and social evolution, a reaffirmation of the child labor laws that made the schoolroom, not the factory, the second home for a new generation of children. Today, fifteen hundred children are crowded into this same building that was intended to accommodate only one thousand students. The roof leaks, there are no doors on the stalls of toilets, many do not work, there is no toilet paper or soap. Textbooks are in short supply and those that are available are out of date. Classes are held on stairwell landings and in cloakrooms; there are more students than desks.

The air outside is noxious and the ground is poisoned. Industrial complexes, easily within sight of the school, produce chemical waste and solid pollutants; run-off seeps into the ground and stagnates on the concrete. The companies that produce the toxins have incorpo-

rated as a separate city and pay no taxes to the city where the school is located. Though the citizens pass local laws for higher taxes to supplement education, property values are too low and welfare and unemployment too high to correct the problem.

The federal government assures each district in the country minimum foundation funding. This is a sum of money that has been estimated to be sufficient to maintain each school. But no school system relies on this money as its sole support. Affluent districts can pass property tax laws with lower percentages than poor districts and still raise more money. This means the more wealthy pay proportionately less of their income for better schools and presumably a better education. Yet minimum foundation funding is considered fair because everyone gets an equal piece of the pie; but when it comes to the rest of the meal, each community is on its own.

In another inner city the school building is in the same state of disrepair, but crowding is not a problem. Truancy rates, as with all inner city schools, are high. Many of the students are truant more often than they are in school. By the seventh or eighth grade many of them will have dropped out. They will fill the jails and welfare lines, victims of a failed system and a failed home life. They will become the illiterate parents of a new generation of children who will be society's future disposables.

This grim picture is not an exaggeration. Jonathan Kozol gives a graphic portrayal of inner city schools in his book, *Savage Inequalities*. It is highly recommended reading.

Kozol cites many disheartening statistics. Drop out rates in some inner city middle schools are between 10 and 20 percent.¹ Of those who do reach high school, an average of 50 to 60 percent will drop out.² In particularly bad areas the drop out rate can shoot above 80 percent.³ There is no doubt that society has left these people behind. It has employed the same mind-set with human beings as with garbage—out of sight, out of mind. But refuse returns, washed up on beaches, poisoning the air and water, and degrading the quality of our lives. Similarly, it is impossible to live in a polarized society of

haves and have-nots without the inevitable outpouring of crime and injustice spilling into our lives and poisoning our souls.

Ultimately, all of society is victimized. Millions of dollars are spent every year on a penal system to correct a problem that should never have begun. It costs New York City, \$60,000 a year to maintain just one inmate in its jails. It is sobering to note that nine out of ten of the male inmates are public school dropouts.⁴

A few new buildings and good teachers will not solve this problem, though they would certainly be a flare in the darkness offering hope. Mandatory Head Start programs with compulsory parental involvement and a restructuring of social welfare laws, coupled with economic and environmental justice, are crucial. Drug education, family planning, and prenatal care are essential as well. But without education, there is no solution and there is no hope.

If the past is the key to the future, society could learn much from Caliph Hakam II, who lived in Cordoba Spain over a thousand years ago. He had a library containing over 400,000 manuscripts and maintained twenty-seven public schools for impoverished students.⁵ It is not surprising that the Arabs were the most powerful and affluent people at a time when Western Europe was immersed in the Dark Ages.

Few inner city citizens will be ready for the twenty-first century. In truth, a large number of our "educated" population may not fare much better than the destitute of today. A large percentage of America's jobs are shifting from manufacturing into the service and information fields. Most of the remaining jobs in the manufacturing and service sector will increasingly become automated. Present jobs in factories, retail shops, supermarkets, and the fast food industry will vanish. Even the newspaper boy may be facing extinction. When home computers become as common as telephones and data base systems become more universal and versatile, the printed word will decline. Why waste the resources to produce millions of newspapers and employ all the people to produce the physical item, when many people will subscribe to the paper by computer? When a hard copy of

an article is desired it can easily be printed. As technology and computers improve, even people with skilled and white collar jobs will join the unemployed. One striking example of this will be in the field of computer technology itself. Many professionals make their living by instructing others how to use computers, in both the business and home environment. But one of the research goals for artificial intelligence is to make the computer as user friendly as possible. These young professionals who train others on computer systems, may find, in 20 or 30 years, that they will be as employable as a horse salesman would be today. Consider an example from the past.

The year is 1890 and Zeke makes a modest living by selling horses in the New York City area. Automobiles are, at best, experimental. But over the next 30 years the automobile will transform the American city. Depending on how old our friend Zeke is, he may be put out to pasture with his horses.

Our world is undergoing an incredible information and technological revolution. The good jobs of today may be nonexistent in two or three decades. To paraphrase author, teacher, and artist Paul Hewitt: In today's changing world we need to cultivate our ability to learn; learning how to learn is fundamental to our survival.⁶

Our work force is comprised of people who have not been taught problem solving skills or critical thinking in school. They were given rules and formulas, and dates and names to memorize from grade school through college. How many fertile imaginations have been abandoned to rote instruction? Mathematician and writer Tobias Dantzig realized this problem over sixty years ago when he wrote: "...our school curricula, by stripping mathematics of its cultural content and leaving a bare skeleton of technicalities, have repelled many a fine mind."⁷ Both Dantzig and Caliph Hakam would be disappointed in our progress.

Numerous studies report the poor performance of high school students in the United States. Every four years a congressionally mandated program through the National Assessment of Educational Progress (NAEP), is administered to school children. The 1990

NAEP Report Card stated:

All the high school seniors demonstrated success with third-grade material. However, [only] 91 percent showed mastery of the fifth-grade course, indicating that not all students are graduating from high school with [even] a grasp of how to apply the four basic arithmetic operations to solve simple problems with whole numbers. Fewer than half ... demonstrated a consistent grasp of decimals, percents, fractions, and simple algebra, and only 5 percent [even lower than in the 1986 NAEP] showed an understanding of geometry and algebra that suggested preparedness for the study of advanced mathematics.⁸

According to the NAEP test only 46 percent of twelfth-graders could operate at a seventh-grade level in mathematics.⁹ Bear in mind that this does not represent 46 percent of all 18 year-olds, since a good many drop out before twelfth grade.

If these statistics are not startling enough, consider the fact that the top 10 percent of American students competed in an international math and science test and placed thirteenth out of a total of fifteen.¹⁰ Taiwan and Korea were in first and second places respectively for the math test and exchanged places for the science test. America managed to beat out Jordan and Spain in math and Jordan and Ireland in science. Japan did not compete. Considering the present economic status of America compared to that of Jordan, Spain, and Ireland, it comes as no surprise that The Carnegie Commission on Science, Technology, and Government would state that our present educational status is, “a chronic and serious threat to our nation’s future.”¹¹

There is, of course, the possibility that only the best from our top group will seek college and graduate degrees. And that our universities and colleges will act as filters assuring America of well educated teachers, scientists, doctors, and lawyers.

In an effort to see how true this might be, I conducted my own informal survey. The survey was really a test composed of 10 basic arithmetic problems. Since I was curious to see how much of the

mathematical manipulations adults retain after leaving school, no calculators were permitted. Anyone with at least four years of college and U.S. educated could participate, except those holding degrees in math, physics, or engineering. (It seemed too ludicrous to assume this group would lack arithmetic skills.) The study was conducted at several of the coffee houses in the New Orleans area. Most of the persons frequenting coffee houses are college graduates, with a fair number of medical doctors, lawyers, teachers, and PhDs thrown in for good measure. Another advantage is that many of these people are transplants from all over the country, thus providing for more of a national, rather than regional, sampling.

All the surveys were completed in my presence. A small number of people refused to participate. (It was interesting to note how their body language abruptly became closed and frightened when they were told the purpose of the survey.) Most, however, though assuring me of poor results, were kind enough to take the test. Some of the parameters and results of the test are as follows:

1. 57 women and 45 men participated for a total of 102 people.
2. 56 of the participants (32 women and 24 men) had completed more than four years of college.
3. Ages ranged 21-72
4. 46 could not add two fractions with unlike denominators.
5. 42 could not divide one fraction by another.
6. 40 out of 99 could not compute a “fraction of a fraction.”
7. 25 could not work with simple percentages.

(A complete description of this study, including the test and the answers, can be found in Appendix B.)

This is frightening. Those who took part in the study are among the most educated in America. In 1987, less than 20 percent (1 in 5) Americans had completed four years or more of college.¹² If the assumption is made that those adults who completed college are more mathematically literate than those who did not, it implies that

as many as 9 out of 10 adults in America cannot add two fractions with unlike denominators. (This worst case scenario is estimated by assuming that roughly one-half of all college graduates cannot do the operation—according to my study. Since only 1 out of 5 people are college graduates, half this number gives one out of ten who can perform the operation, or 9 out of 10 who cannot.) The implication is that of those twelfth-graders who can perform seventh-grade arithmetic, according to the NAEP test cited previously, few will retain such skills as adults.

It could be argued that since people do not add unlike fractions on a daily basis, they merely “lose what they do not use.” To a degree this makes sense since their ability to perform the needed operations extends no further than the steps they had memorized to solve the problem—that is, no **real** learning was ever done. However, the above reason does not explain the fact that a significant number of educated people cannot compute simple percentages which are needed regularly at supermarkets and restaurants.

Many books are published today to keep the layperson informed in math and science. Some are excellent renditions of difficult subjects without the rigor that would accompany the work in a professional setting. Because of this, the author or reviewer will assume the book is easily within reach of most people. But few, if any, of these books are really suited for the typical college graduate, let alone the “average man on the street.”

An excellent book written by John Allen Paulos titled *Innumeracy* has received a good deal of exposure and acclaim. Paulos informs us in the introduction that: “The approach throughout (the book) is gently mathematical, using some elementary ideas from probability and statistics which, though deep in a sense, will require nothing more than common sense and arithmetic.”¹³ True as this statement is, my experience has shown that unless the reader of this book has some math/science background, too many basic arithmetical skills are assumed. A large number of college educated people would find *Innumeracy* a sizable challenge. Paulos is not unaware of this fact and

states, “... I’m convinced that a sizable minority of adult Americans wouldn’t be able to pass a simple test on percentages, decimals, fractions, and conversions from one to another.”¹⁴ I would differ with the phrase, “sizable minority”, preferring “sizable majority” for the overall adult population and “sizable minority” (at the very least) for the college educated population. This is not a trivial point. For as good as *Innumeracy* is, the majority of “innumerates” will be left behind.

Ian Stewart is a British mathematician who often writes articles and books for the general public. In his delightful book *Game, Set and Math* he writes:

To me, mathematics is fun, ... Mind you, I can understand **why** most people find that statement baffling. To see why mathematics is fun, you have to find the right perspective. You have to stop being overawed by symbols and jargon, and concentrate on **ideas**; you have to think of mathematics as a friend, not as an enemy. I’m not saying that mathematics is always a joyous romp; but you should be able to enjoy it, at whatever level you operate.¹⁵

Perhaps the British are more mathematically astute than we are. But I can’t help wondering—Does Stewart realize just how remedial most American’s mathematics “levels” are?

One final quote, an excerpt from the jacket cover of *Relativity* by Albert Einstein reads: “Here is a book, however, by the originator of the theory himself explaining the theory in simple words that anyone with the equivalent of a high school education can understand.” Perhaps this statement is true in theory, but not in practice! All joking aside, a theory is a very substantial statement, not to be confused with opinions or hypotheses.

It is not my desire to be a detractor for any of these books. They are all excellent. The point is to recognize that what are called “popular math and science books” (which are written to help us stay current in a quickly changing world) are reserved for a small minority of our population. They will not be read by the poor illiterates who fill our inner cities, nor will they be read by the numerous college graduates we have left behind.