



# The Emergence of Numeracy

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“The Case for Quantitative Literacy” substantially advances our thinking in at least four ways. It identifies various components (“elements”) of this style of thinking that together give us a comprehensive and appropriately complex definition of quantitative literacy. It then gives a multitude of examples of actions and behaviors (“expressions”) occurring in daily life that call for this kind of thinking, from the simple to the esoteric. It next distinguishes the bundle of skills that constitute quantitative literacy as an academic subject. And finally, the case statement makes clear that quantitative literacy and mathematics are really two quite different things.

I wish I had possessed such a precise and nuanced statement a quarter century ago when I wrote a Ph.D. dissertation in the field of American history about something I vaguely termed a *quantitative mentality* (Cohen, 1977). My use of the term *mentality* drew on the work of a French historical school prominent in the 1960s and 1970s (led by historians Jacques LeGoff and Lucien Febvre) that championed the study of *l’histoire des mentalités*, meaning deep mental structures that persist in cultural groups over time. In contrast to the more typical historical focus on events, this kind of study explored the mental equipment, *l’outillage mental*, characteristic of a particular culture. The study of *mentalité* was sometimes thought of as the intellectual history of common people, the study of the thought patterns and fundamental attitudes of the members of a culture comprehended in the aggregate. But I found that *mentalité* was an inherently slippery concept to apply.

My interest was drawn to the subject by the realization that in early nineteenth-century America, quantitative description and numerical reasoning seemed to blossom. These were the early years of a vast transformation in the economy, and I suspected there was a connection between the market revolution, improved delivery of arithmetic education, and the propensity to use numbers to support arguments of all kinds in the realms of politics, economics, social reform, and the like. My goal was to describe and explain an important piece of mental equipment just at the moment that it was coming into prominence, but without definitional precision it was hard to draw boundaries around my study.

### Numeracy in History

By the time I had moved from a dissertation to a revised book (Cohen, 1982), I had happily come upon the word *numeracy* in a British dictionary. That word, because of its parallels to literacy, helped enormously to crystallize my thinking about what constituted a quantitative mentality. The word turned my focus to the history of a skill and the specific, everyday contexts in which it was manifested, and finally clarified that I was not writing a history of mathematics. The aim of my book was to investigate selected areas in which this new comfort and familiarity with numbers supplanted previous approaches to similar problems where non-numerical thinking had once prevailed.

There was of course no single moment in time when American society moved from being prenumerate to being fully numerate. Instead, my book traced the gradual extension of numeracy to a host of specific activities: taking censuses for military and political uses, evaluating medical outcomes using simple statistics, revamping arithmetic teaching to gear it to a new commercial order, compiling numerical facts about the state (“statisticks” as in descriptive statistics) to help statesmen govern, collecting voting statistics to improve the management of party politics in a democracy, and finally, mounting numerical arguments in the service of the reform movements of the 1820s to 1840s. Through it all, I was alert to the growing sophistication of numerical argument and to the cultural lags that held some parts of the population back from full participation in this new style of thinking.

The case statement greatly sharpens our ability to investigate the status of numeracy in modern as well as past societies. The distinction it draws between mathematics and quantitative literacy is an important one, and to the extent that our schools emphasize the former and not the latter, we fail to equip our citizenry with essential skills.

Certainly that distinction, between numeracy as a concrete skill embedded in the context of real-world figuring and mathematics as an abstract, formal subject of study, was sharply drawn in the eighteenth and early nineteenth centuries. The educated man who studied algebra, geometry, and trigonometry, and perhaps calculus in college, likely breezed through a book on the basic “rules” of arithmetic in a year’s time, often learning formulaic algorithms for manipulating numbers in a first-level college course. (And I do mean *man*; rare was the woman who could advance in formal mathematics training because all of higher education was closed to women.)

Even for men, precollege work emphasized Latin and Greek, the standard admission requirements for university. Harvard University did not even require basic arithmetic for admission until 1802. Courses in higher mathematics were similarly abstract and devoid of practical application. The individual who pursued this kind of learning was unusual, having the money and advantage to attend college plus the talent drawing him to higher mathematics; such a person likely had high aptitude for the subject in the first place and could pick up basic arithmetic in short order.

Around 1800 the far more common exposure to arithmetic consisted of the study of practical skills aimed at boys planning to enter the mercantile life. Students on this track would spend three or four years, between the ages of 10 and 14, working through commercial arithmetic texts and practicing on real-life problems such as calculating board feet to build houses, figuring discounts and interest rates, and manipulating the vast (and highly complex and confusing) array of denominate numbers used for measuring goods. In this second track, the teaching of arithmetic was so completely framed in terms of real-life examples that a student might not fully realize that the multiplication involved in the board feet problem was the same operation as the multiplication required by the infamous Rule of Three used to figure such things as cost per yard.

Instead of learning abstract rules capable of generalization in the real world, students memorized problem after problem rooted in real-world calculations, burdening the memory—or they inscribed a copybook carried into the countinghouse life—with examples of every conceivable kind of problem. At the higher ends of this study, texts taught things like the rule of fellowship (to figure out how to divide profits or losses in partnership contracts), the rule of discount, and the rule of barter. Higher branches of mathematics with practical applications included geometry and trigonometry as applied to navigation, surveying, and gunnery. Each of these fields had separate textbooks and followed the same style of problem-based memory learning as commercial arithmetic.

Neither the formal college-level mathematics nor the rote-learned commercial arithmetic of 1800 could be described as intuitive. In fact, commercial arithmetic was so completely context-specific that it probably retarded the development of quantitative literacy. With the intensification of market activity in the United States after the War of 1812, some educational theorists proposed entirely new ways to teach arithmetic: they simplified it, greatly reduced the number of “rules” by generalizing the operations, encouraged discovery methods of learning, rearranged the order of subjects taught, and started teaching it to 5- and 6-year-olds, instead of 10- to 12-year-olds. The particular methods of teaching the “new math” of the 1820s remained controversial for many decades, but the general outcome of this new educational theorizing was clearly highly beneficial to the nation. Via the common schools and the push for universal elementary education, the new math introduced many people, males and females, to the basics of quantitative literacy.

### Numeracy Today

Now, two hundred years later, we inhabit a society inundated with numbers. The number skills needed to carry on daily life activities have increased, and while we have developed workarounds to simplify some of them, for example, computers and calculators in place of the “ready reckoner” tables of 1800, the need for numerical understanding is ever greater. We particularly run a danger because of a lack of numerical sophistication in the political realm. Quantitative literacy is required to understand important political debates on issues such as Social Security funding, the

differential effects of various tax-reduction plans, and health insurance options. Relatively few Americans have the quantitative savvy (and maybe also the time) to work through these policy debates and evaluate all their implications.

So we take shortcuts instead, not all of them good. Thirty-second advertisements and the quest for the perfect sound bite for the evening newscast pressure politicians to reduce their take on a complex policy to a short, clear statement, which pictures the “typical” family and its projected tax savings under candidate X or a “typical” elder citizen and her projected savings on prescription drugs under candidate Y. Lacking the quantitative literacy to make sense of policies, voters substitute evaluations of the character and vision projected by candidates, trusting that the right person will delegate policy decisions to a team of experts sharing the general political ideology of the winner.

Are any lessons to be derived from studying the history of numeracy? One clear lesson is that the methods of teaching matter greatly. Benjamin Franklin, revered for his intuitive, commonsense genius, struggled mightily in the 1730s with his commercial arithmetic lessons, only to find at a later age that he could teach it to himself with ease (no doubt drawing on his superb intuitive intelligence and his real-world experience apprenticing in a printer’s business). Formal arithmetic instruction was postponed until students were 10 years old or older precisely because it was such a heavy study, as then taught. A 10-year-old would already know how to number and count before opening the text. The first wave of new math in the 1820s made it possible for children more average than Franklin (and much younger, too) to be successful in arithmetic.

Continued pedagogical improvements have enabled many students to improve their quantitative literacy. We have seen several revisions of the arithmetic curriculum in the last fifty years, and controversy now rages in states such as California over state-mandated standards. But it seems to me that the debate is still focused on the various methods of teaching number facts. The case statement moves beyond that debate in arguing that quantitative literacy matters well beyond the sphere of mathematics and science; it is indeed a basic thinking skill parallel to verbal literacy.

How then do we reposition arithmetic training to encourage a stronger emphasis on numeracy? We need to expand educational experiences

conveying the message that quantitative literacy is not only about arithmetic and higher mathematics but also about a general skill (or habit of mind) that is required in many subjects across the curriculum. Courses other than mathematics need to reinforce this skill by demonstrating, indeed requiring, its use.

Along with an enlarged application of numbers must come an appreciation for what it means to approach an issue or problem from a quantitative standpoint. What is gained, and what is lost? What does the numerical argument account for, and what does it fail to include? What are the uses and misuses of quantitative thinking? My own study of early American numeracy revealed that at different times certain types of quantification were embraced while others were ignored or rejected.

Numbers are not unimpeachable facts; they can be and often are contested. Rising nation-states in the seventeenth century saw the wisdom of enumerating population (to estimate military strength), but not all of the enumerated persons agreed, in light of a strict biblical prohibition on taking censuses. Twentieth-century economists have developed the GNP as a measure of gross national product, a quantitative measure of the productive capacity of the country, but recent critics have faulted the GNP for excluding forms of productivity such as women's household labor or for ignoring the environmental costs of productivity. Every act of social science quantification has built into it a set of decisions about what to count and how to categorize. Education in quantitative literacy has to make citizens sufficiently sophisticated to be aware of such issues.

The case statement persuasively argues that education in this style of thinking is essential in the modern world. It should spark a renewed debate about the adequacy of an arithmetic curriculum that, in its broad outlines, has been in place since the 1820s.

I am especially happy to see this debate now, because when I first took on this subject very little attention was paid to the problem of numeracy either as a historical topic or as a pressing educational problem. In the early 1980s there were books on the history of the census and demographic thought in past times, but only in the last decade has there been a real flowering of work about the history of numeracy (e.g. works by Crosby, Hobart, Swetz, Hadden, Porter, Stigler, Wald, Anderson, Alonso and Starr, Desrosieres, and Poovey). Most of these efforts have focused

on European thinkers and governments, but with the current spotlight on educational practices in the United States, I hope there will be renewed interest in reconstructing the history of numeracy in America.

REFERENCES

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