

HOW MANY DEATHS? EDUCATION FOR STATISTICAL EMPATHY

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Abstract

In this paper, we suggest the term "statistical empathy" for the ability to relate statistical data to the reality of what they stand for. To put the argument in stark terms, we use historical and contemporary examples of representations of mass killings. Alongside visual and literary artistic expressions, we exemplify mathematical tools designed to help convey the scale of such tragedies. We illustrate the political processes of managing information through analysis of two highly disputed issues, namely gun violence in the United States and the estimating of excess civilian deaths in Iraq attributable to the American invasion.

INTRODUCTION

*Yes, 'n' how many deaths will it take till he knows
That too many people have died?
Bob Dylan (1962)*

*It has been said that the mark of a truly educated person is to be deeply moved by statistics.
Bill Moyers (2006) (quotation attributed to George Bernard Shaw)*

Throughout history, including the present, there have been mass killings. In this paper, we discuss the mathematical procedures involved in counting, recording, or estimating death counts, analyzing the data statistically, and the mathematical and artistic means of representing them for the purpose of making an argument or conveying a sense of tragedy.

As we write, the media are reporting the loss of another 105 US military personnel in Iraq for the month of October, 2006. The losses on the Iraqi side – civilian and military – remain largely unmentioned in the US. There is no doubt that the world we live in is getting progressively more violent. The loss of life is often a result of intentional actions, as in a war or other sectarian violence. Besides the macro impact of intentional losses resulting from large-scale conflicts such as wars, there are innumerable instances of intentional killings that result from other conflictual interactions within societies, such as fighting among gangs.

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Discussions on death and dying as a part of human violence may be characterized as morbid but they relate to a stark part of our reality that we cannot deny and should not ignore. Many people, in their post-modern busy life largely spent engaged in multitasking, may (rightfully) point out that there is little time for discussion or reflection. Some argue that too much exposure to grim realities numbs our sensitivity. Others evade the responsibility for action by saying "I am just a single individual, what can do I alone!" Or even "I do not do numbers!". Many of these responses stem from the general apathy characterized by the "not in my backyard" attitude, and by an alienation from mathematics. In this article, our goal is to provoke a conversation on contentious issues of contemporary life conveyed by numbers on which mathematics can be employed as a tool. We contend with Frankenstein (in press) that "we do need to know the meaning of the numbers describing our realities in order to deepen our understandings of our world". Following the quote from Shaw used by Bill Moyers, we call such understanding "statistical empathy".

In the National Governors' Summit in 2005, Bill Gates (2005) defined anew the three R's, the basic building blocks of better schools, as *rigor*, *relevance*, and *relationships*. As we reflect on this simple and yet profound framework, we ponder how mathematics as a school subject is viewed. For people involved in mathematics education, it is a painful truth that a vast number of people do not have a favorable view of mathematics as a domain of knowledge. School mathematics is typically considered to be boring, irrelevant, and meaningless, by adults and children alike.

One of us [SM] is a mathematics educator working with predominantly elementary school teachers. I often hear from my students that mathematics is an important subject but they fail to provide convincing examples of where mathematics is important in our everyday lives. They say that they use mathematics almost every day for balancing their checkbooks, and also when cooking. Some point out also that they use mathematics when making purchases and in estimating their daily travel times. In these conversations, the procedure for solving quadratic equations, or the proof of the theorem attributed to Pythagoras do not make an appearance. Conversely, it is arguable that most of the knowledge needed to negotiate the everyday situations raised by the students is gained out of school. (Note that we are not negating other motivations for teaching/learning mathematics, just pointing out that importance for mundane everyday functioning is a weak justification.) As one final example, consider the teaching of fractions, a staple of elementary school. To stimulate discussion, I say things like: "Do we really need to learn any fractions other than $1/2$, $1/4$, $3/4$, $1/3$ and $2/3$? No recipe I have ever seen refers to $2/17$ of a cup, for example". This is generally followed by an uncomfortable silence.

The point of sharing these anecdotes is to ask how we can start a sustaining conversation on the role of mathematics in the lives of our students at a deeper level. To exemplify how mathematics can help us expand our understanding of social and political issues that impact people, we deal in this paper with literally life and death issues. Although it might be argued that the social realities that we address in these examples are morbid and depressing, and should therefore be avoided, we would say that these examples are critical for youth – middle and high school students – who are often the target, and sometimes the perpetrators, of brutal violence. By engaging them in these conversations we hope to help the students become critically aware of the socio-political ramifications of violence and death. This conception of (mathematics) education is rooted in principles of democracy and social justice (Hackman, 2005; Mukhopadhyay & Greer, 2002) whereby we hope that the students can be brought to the realization that they are capable of framing and voicing their opinions, and acting on them, based on critical thinking rather than remaining mere passive consumers of information. An additional advantage of this awakening of agency, we believe, is the way it can affect perception of mathematics. From characterizing mathematics as

"boring and useless", "hard", "I-am-not-good-at-it", students may start valuing mathematics as an essential and powerful tool for, in Freire's phrase, reading and writing the world.

Who gets killed?

On the twentieth anniversary of the death of John Lennon, his widow, the artist Yoko Ono, paid for the display of large posters in New York, Los Angeles and Cleveland, Ohio showing a photograph of blood-stained glasses and the New York skyline with herself in front, bearing the text "Over 676,000 people have been killed by guns in the U.S.A. since John Lennon was shot and killed on December 8, 1980." (Berger, 2001; BBC, 2000; Gurney, n.d.). Later, Ono commented, "The number of people who have died by gunshot since John's death is 10 times larger than the total number of American soldiers lost in the Vietnam War. It's like we are living in a war zone".

The starkly simple statement on the poster may have caught many by-passers' attention. Maybe the billboard was noticed because of John Lennon's celebrity status. But does the number in the statement provoke reflection and analysis? 676,000 people killed by guns in 20 years readily tells us that if the trend continues, over 30,000 people will die by gun deaths every year. Further computation converts this to about 93 gun deaths per day, roughly equivalent to 4 deaths per hour. In the most concrete terms, this equates to about one death every fifteen minutes.

The most recent published data from the US Centers for Disease Control and Prevention show that 2,827 children and teens died from gunfire in 2003. This figure amounts to "... one child or teen every three hours, nearly eight every day, 54 children and teens every week" (Children's Defence Fund, 2006, 1). By contrast: "The number of children and teens killed by gun violence in 2003 alone exceeds the number of American fighting men and women killed in hostile action in Iraq from 2003 to April 2006" (CDF, 2006, p. 2).

Although the latest data show a slightly downward trend (CDF, 2005), we learn a set of very alarming facts:

- The number of children and teens in America killed by guns in 2003 would fill 113 public school classrooms of 25 students each.
 - The number of children and teens in America killed by guns since 1979 would fill 3,943 public school classrooms of 25 students each.
 - Almost 90 percent of the children and teens killed by firearms in 2003 were boys.
 - The firearm death for Black males ages 15 to 19 is more than four times that of White males the same age.
 - A Black male has a 1 in 72 chance of being killed by a firearm before his 30th birthday.
 - A White male has a 1 in 344 chance of being killed by a firearm before his 30th birthday.
- (CDF, 2006. p. 2).

The cost of gun violence to society, through injuries as well as deaths, and the consequent extensive medical and social care, is an additional burden to the tax-payer. Admitting that precision in information is difficult to achieve, Cook and Ludwig (2002, p. 97) point out that:

...the national costs of gun violence are roughly \$100 billion per year, with \$15 billion or more attributable to gun violence against youth. The tangible costs to the victims

from medical expenses and lost productivity are only a small part of the overall problem. The real burden of gun violence comes from the cost of public and private efforts to reduce the risks, and the fear of victimization that remains despite these efforts.

Kids in the Line of Fire (VPC, 2001) provides an in-depth analysis of the link between children, handguns, and homicide. It is based on analysis of homicide data for the five-year period 1995 through 1999. (For a comprehensive timeline of worldwide gun violence in schools, see <http://www.infoplease.com/ipa/A0777958.html>)

The Violence Policy Center (2001) has problematized the assumption that gun violence among youth is primarily an inner-city problem associated with criminals, gangs, and people of color:

Recent school shootings have garnered greater publicity than in previous years, with one clear reason being the larger number of victims. Perhaps just as important is the demographic profile of the victims and shooters: mostly white, from either the suburbs or rural America. As a result of the high rates of violence seen among urban, primarily black, youths in the late 1980s and early 1990s, such violence came to be seen by many as solely a plague of the cities. Viewing the issue literally in terms of black and white, rural, white youth were portrayed as having "respect" for guns, using them only for hunting or other sporting activities. Shootings among black youths were often falsely portrayed as a virtually inevitable, almost normal, component of the urban environment. And when "good" kids go bad, the gun lobby is quick to blame virtually anything—television, movies, bad parenting, even an undefined "wave of evil"—except the one thing that comes up time and time again: the easy availability of handguns.

(Retrieved 10/31/06 from: <http://www.vpc.org/studies/wgunint.htm>)

On the other hand, the National Rifle Association, a very powerful group that lobbies for gun ownership, describes the Violence Policy Center as "the most effective ... anti-gun rabble rouser in Washington". We cite this statement here to illustrate the degree to which debate on gun control is polarized and politicized, leading to "furious politics, marginal policy" (Spitzer, 1998, p. 133). An interesting format reflecting this polarity is used in Haerens (2006) in which chapters are presented pair-wise, with one author in each pair on each side of the controversy. For example, a chapter entitled "Youth gun violence is a serious problem" is followed by another entitled "The problem of youth gun violence is exaggerated".

A fundamental question is: To what extent can such questions be decided by research? A review sponsored by the National Research Council concluded that: "While there is a large body of empirical research on firearms and violence, there is little consensus on even the basic facts about these important policy issues" (Wellford, Pepper, & Petrie, 2004, p. 1). Nevertheless, the report, in making a number of recommendations for future research, implies that properly done research could settle questions. Thus, at one point it is stated that: "Ultimately, it is an empirical question whether defensive gun use and concealed weapons laws generate net social benefits or net social costs" (p. 6). We believe that is missing a crucial point. No matter how well done the research, it will not settle the question since opinions will differ on how social benefits and costs are to be measured, which is a question of values.

In this context, we can illustrate our own praxis in mathematics education – putting ideology into action. Education for social justice, for us, is to encourage learners to actively participate in their own education so that they, with their teachers, identify and acknowledge issues of injustice and devise an action plan. For example, statistics education as data handling has been a part of school mathematics curriculum for a while but it seldom creates a context where the students are empowered to act on an issue that they are studying together. In lessons on statistics, children tabulate and graph modes of transportations to school, favorite cereal, and suchlike, hardly ever spending any discussion on the social context. In many cases, the successful students produce picture-perfect graphs without being able to articulate the deep underlying implications. Classroom instruction often emphasizes the procedure and the right answer without getting into the sense-making aspects of mathematics – a practice that is exacerbated by the current culture of standardized testing. Papert (1993), critiquing a similar practice of early and massive imposition on children of "letteracy", an impoverished form of literacy consisting merely of the ability to decode strings of alphabetic letters. By analogy with Freire's term for this activity, "barking at words", mathematics should not be reduced to pawing at symbols. Likewise, following Freire's emphasis on reading the word and the wor(l)d, we recommend moving mathematics instruction from mere symbol manipulation to the development of a sense of critical thinking.

Heather Hackman (2005), quoting Bell, points out that social justice education is both the goal and the process. Thus, "the process for attaining the goal of social justice should be democratic and participatory, inclusive and affirming human agency and human capacities for working collaboratively to create change." (p. 104)

Echoing Hackman, who identifies five essential components of social justice education: content mastery, tools for critical analysis, tools for personal reaction, tools for action and social change, and an awareness of multicultural group dynamics (p. 104), we present an approach to address social justice within the context of mathematization of the real world of violent death in Fig.1.

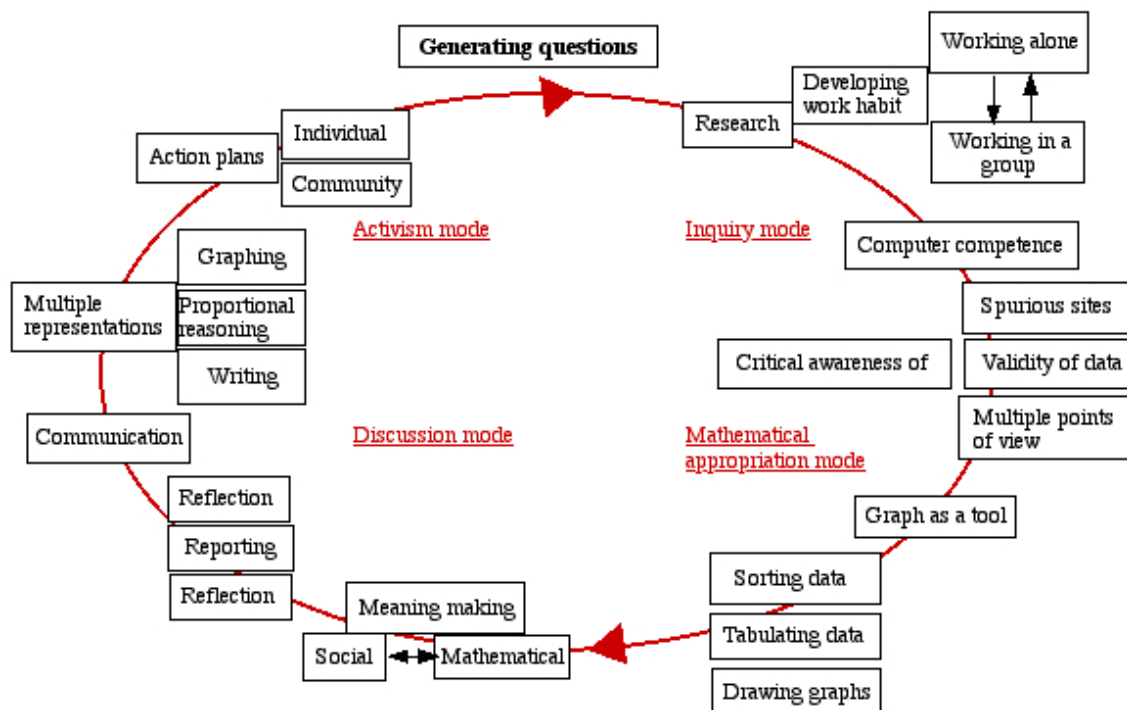


Figure 1: Cycles of discussions to foster statistical empathy

For us, from the perspective of teaching, generating questions for a situation (here, issues of gun violence) entails a four-stage cyclical process that refines itself as one goes through the cycles of inquiry mode, mathematical appropriation mode, discussion mode and activism mode. Granted, pedagogically it is a time-intensive process, and teachers are often forced to compromise for the sake of “covering” a curriculum that is characterized as a mile long and an inch deep. Accordingly, if we truly believe in educating for democratic citizenship, we have to embrace serious curriculum reform.

Communicating the outrageous

Part of struggling to change our world in the direction of more justice is knowing how to clearly and powerfully communicate the outrageousness.
(Frankenstein, 2006)

As pointed out by Frankenstein (2006) “statistical data can distance us from a deep empathy and understanding of the conditions of people’s lives. But, also, quantitatively confident and knowledgeable people can use those data to deepen their connections to humanity”. She further stresses that the form in which the evidence is presented can have a major influence on its effectiveness and the way in which it is interpreted. In this section, we mention two outstanding historical examples, briefly describe artistic attempts to convey the human tragedy of deaths in the Vietnam War and in the Rwanda massacres, and finally we present alternative representations of deaths of Mexicans trying to cross the US border.

Napoleon and Nightingale

Tufte (1983, pp. 40-41) describes a graph constructed by Charles Joseph Minard (1781-1870) depicting Napoleon's advance on, and retreat from, Moscow in 1812. The graph shows the size of the army (from crossing into Russia with 422,000 men to returning across the border with 10,000), its location on a two-dimensional surface, direction of the army's movement, and temperature on various dates during the retreat from Moscow. Tufte comments that "it may well be the best statistical graphic ever drawn" and quotes a description of its "seeming to defy the pen of the historian by its brutal eloquence".

Florence Nightingale (1820-1910) may have been responsible for the first use of statistical data to make a political case. In 1858, she devised a statistical diagram, labeled the "coxcomb" to depict changes over time in deaths, on the battlefield and in the hospitals, of British soldiers in the Crimean War. With this and other statistical data, she managed to convince the army authorities to make major changes in policy that resulted in substantial decreases in hospital deaths. The diagram may be viewed at www.florence-nightingale-avenging-angel.co.uk/Coxcomb.htm

The accompanying text explains:

The Government would not allow her to publish her most damning statistics which showed that hospital conditions were the main cause of death. In this published diagram, therefore, she tried to support her case for better hygiene by using published Army figures to show that the death rate decreased after the Sanitary Commissioners cleaned up the hospitals. Her opponents claimed that the reduction in death rate resulted from other changes that occurred at the same time.

Vietnam and Rwanda

A powerful piece by Frankenstein (2006) drew our attention to these examples, and should be consulted for more detail. The Vietnam Veterans Memorial in Washington, D. C., bearing the names of 57,939 Americans who died in that war, is well known (see, e.g. a description by Tufte (1990, p. 43) of its design effectiveness so that "we focus on the tragic information"). Less well known is *The other Vietnam Memorial* by artist Chris Burden, USA):

In this work, Burden etched 3,000,000 names onto a monumental structure that resembles a Rolodex standing on its end. These names represent the approximate number of Vietnamese people killed during U.S. involvement in the Vietnam War, many of whom are unknown. Burden reconstructed a symbolic record of their deaths by generating variations of 4000 names taken from Vietnamese telephone books. By using the form of a common desktop object used to organize professional and social contacts, Burden makes a pointed statement about the unrecognized loss of Vietnamese lives." (notes from the Museum of Contemporary Art in Chicago, IL, cited by Frankenstein, 2006).

Artist Alfredo Jaar (born in Chile, works in New York City) went to Rwanda in 1994 to try to understand and represent the slaughter of "possibly a million Tutsis and moderate Hutus" during three months of Prime Minister Jean Kambanda's term.

Even after 3000 [photographic] images, Jaar considered the tragedy to be unrepresentable. He found it necessary to speak with the people, recording their feelings, words and ideas....In Jaar's Galerie Lelong installation, a table containing a

million slides is the repetition of a single image, *The Eyes of Gutete Emerita*." The text about her reads: "Gutete Emerita, 30 years old, is standing in front of the church. Dressed in modest, worn clothing, her hair is hidden in a faded pink cotton kerchief. She was attending mass in the church when the massacre began. Killed with machetes in front of her eyes were her husband Tito Kahinamura (40), and her two sons Muhoza (10) and Matriigari (7). Somehow, she managed to escape with her daughter Marie-Louise Unumararunga (12), and hid in the swamp for 3 weeks, only coming out at night for food. When she speaks about her lost family, she gestures to corpses on the ground, rotting in the African sun.

The art review ends with a comment about the numbers: " The statistical remoteness of the number 1,000,000 acquires an objective presence, and through the eyes of Gutete Emerita, we witness the deaths, one by one, as single personal occurrences" (Rockwell, 1998).

Border crossings

A large number of people have died since *Operation Gatekeeper*, a program to seal the US-Mexico border, was introduced in 1994 (Fig. 2).

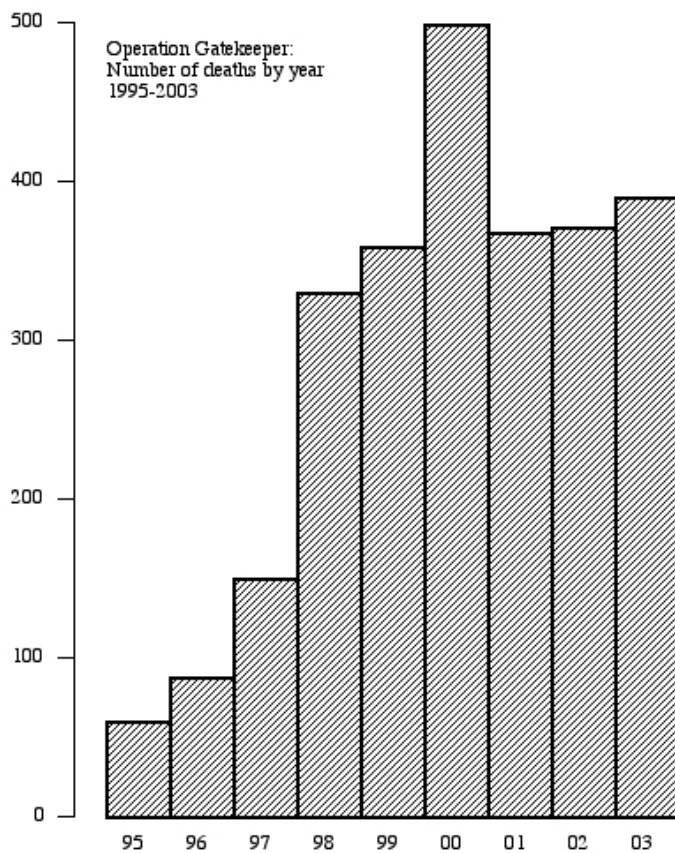


Figure 2: Number of deaths crossing US-Mexico border around San Diego, CA, 1995-2003

In February, 2005, one of us [SM] participated with a group of educators in a study tour organized by Global Exchange in the San Diego-Tijuana area on issues of border-crossing. (Bigelow, 2006). The outside walls of Tijuana airport, we noticed, were covered with elaborate "border art" depicting the violence and deaths that many ordinary Mexicans face as they attempt to cross the border illegally. Makeshift memorials were created as simple crosses with the names, age and origins of the dead (Fig. 3). Moreover, besides the individual crosses, there are displays of colorful and elaborately designed coffins, carrying the numbers of deaths, one for each year from 1995 to 2003 (Fig. 4).



Figure 3: Tijuana Airport, 2005: crosses (© Mukhopadhyay, 2005)



Figure 4: Tijuana Airport, 2005: coffins (© Mukhopadhyay, 2005)

These examples, as well as those described above, illustrate the power of powerful representations to mediate between bare statistics, numbers on paper, and the reality for which those statistics are referents.

Such representations may be uncomfortable. In February, 2003, David Cohen reported on Slate that:

Earlier this week, U.N. officials hung a blue curtain over a tapestry reproduction of Picasso's *Guernica* at the entrance of the Security Council. The spot is where diplomats and others make statements to the press, and ostensibly officials thought it would be inappropriate for Colin Powell to speak about war in Iraq with the 20th century's most iconic protest against the inhumanity of war as his backdrop.

How many Iraqi deaths?

Death has a tendency to encourage a depressing view of war
(Donald Rumsfeld)

On October, 2006, the British medical journal, *The Lancet*, published a paper (Burnham, Lafta, Doocy, & Roberts, 2006) in which the authors reported that:

We estimate that as of July, 2006, there have been 654,965 (392,979–942,636) excess Iraqi deaths as a consequence of the war, which corresponds to 2.5% of the population in the study area. (Retrieved 10/30/06 from <http://www.thelancet.com/webfiles/images/journals/lancet/s0140673606694919.pdf>)

Note that 654,965 is a point estimate, the number that the analysis identifies as the single most probable; the numbers in brackets are those for a 95% confidence interval. A longer report (Burnham, Doocy, Dzung, Lafta, & Roberts, 2006) provides more detail and context. In a similar study carried out in 2004 (Roberts, Lafta, Garfield, Khudhairi, & Burnham, 2004) the estimate of excess mortality during the 17.8 months after the 2003 invasion was 98,000, with a 95% confidence interval of 8000–194000 (excluding the data from Fallujah).

In both cases, the estimates were very much higher than others obtained using different methodologies, have been widely contested in the media, and dismissed as not credible by government leaders in the US and UK, and, in the more recent case, Iraq and Australia. For example, President Bush, questioned by Suzanne Malveaux of CNN at a White House Press Conference said that he did not consider the report credible, that the methodology had been "pretty well discredited" and that he stood by the number 30,000 that he had cited previously. He referred to the estimate in the *Lancet* report as "600,000, or whatever they guessed at".

(Retrieved 10/30/06 from www.whitehouse.gov). No further questions were asked on this topic during the press conference. Nevertheless, the President's statement was very widely quoted in the media, often in headlines. Richard Garfield, a public health professor at Columbia University who works closely with a number of the authors of the report commented:

I loved when President Bush said 'their methodology has been pretty well discredited'. That's exactly wrong. There is no discrediting of this methodology. I don't think there's anyone who's been involved in mortality research who thinks there's a better way to do it in unsecured areas. I have never heard of any argument in this field that says there's a better way to do it."

(Murphy, 2006)

The appeal to experts by journalists is deserving of analysis. Typically, articles following the publication of the report cite short comments by a number of such experts. The divergence in the opinions cited is typical of what happens when statistical experts give opinions on a complex study. It is the nature of statistical applications of this level of complexity that agreement is not to be expected. There are aspects of the methodology that represent potential weaknesses in the design – indeed, the authors themselves clearly identify and discuss several. To elevate such disagreement to a claim that the methodology has been discredited shows ignorance of the nature of statistical research.

There is an irony in that reporting on a study based on sampling, there is no mention of the samplings implicit in the above and similar examples of press coverage. First, the experts quoted are a sample – and probably what is technically called a "convenience sample", rather than one that is representative of the appropriate population. Secondly, the short quotations are, almost inevitably, sampled on the basis of the journalists' subjective criteria, from longer and more nuanced statements. Interactions with the experts are usually one-shot deals, with short quotations of what the experts say. It is not uncommon for the experts to want to clarify or correct statements attributed to them, but such an opportunity is rarely afforded. For example:

The *Washington Post*, perhaps most damagingly to the study's reputation, quoted Marc E. Garlasco, a senior military analyst at Human Rights Watch, as saying, "These numbers seem to be inflated."

Mr. Garlasco says now that he had not read the paper at the time and calls his quote in the *Post* "really unfortunate." He says he told the reporter, "I haven't read it. I haven't seen it. I don't know anything about it, so I shouldn't comment on it." But, Mr. Garlasco continues, "like any good journalist, he got me to."

Mr. Garlasco says he misunderstood the reporter's description of the paper's results. He did not understand that the paper's estimate includes deaths caused not only directly by violence but also by its offshoots: chaos leading to lack of sanitation and medical care.

(Guterman, 2005)

An example of a more extended interaction is provided by the website Media Lens (www.medialens.org). A professor of mathematics, well known for his books, including *A Mathematician Reads the Newspaper* (Paulos, 1996) wrote in the British newspaper, *The Guardian* (Paulos, 2004):

Given the conditions in Iraq, the sample clusters were not only small, but sometimes not random either... So what's the real number? My personal assessment, and it's only that, is that the number is somewhat more than the IBC's confirmed total, but considerably less than the Lancet figure of 100,000.

After Media Lens commented that they "had not found a single example anywhere in the British or US press of a commentator rejecting estimates of 1.7 million deaths in Congo produced by the same lead researcher (Les Roberts) and offering their own "personal assessment" in this way", Paulos responded:

I regret making the comment in my Guardian piece that you cite... I still have a few questions about the study (moot now), but mentioning a largely baseless 'personal assessment' was cavalier. I should simply have stated my doubts about the study's scientific neutrality given what seemed at the time like an expedient rush to publish it."

John Allen Paulos Math Dept, Temple Univ" (Email to Media Lens, September 7, 2005, retrieved 11/05/06 from

http://www.medialens.org/alerts/05/050906_burying_the_lancet_update.php)

The criticism that the timing of publication of the report was politically motivated (it came out shortly before the presidential election of 2004) is widespread. One of the authors of the report, Les Roberts, replied to Paulos giving the reasons for the timing of publication, the most important of which was his belief that if it had not come out until after the election, it would have been interpreted as a cover-up. Paulos then stated that "I understand now the situation surrounding the study's original publication". What is striking about this example is that an extended and logical debate led to some reasonable consensus. Another example of such an extended interchange facilitated by the Media Lens group included follow-up to a BBC programme whereby Les Roberts was given the opportunity to respond to listeners' questions.

Journalists, who cannot be expected to have the statistical expertise to evaluate technical reports, do not always take the obvious step of seeking expert advice. Again we turn to Media Lens for a fascinating and fully documented example (see the website for the full account). It began with an editorial that claimed that the Lancet findings had been reached "by extrapolating from a small sample... While never completely discredited, those figures were widely doubted".

(Leader, 'The true measure of the US and British failure,' The Independent, July 20, 2005)

David Edwards of Media Lens challenged the Independent's Mary Dejevsky, senior leader writer on foreign affairs to indicate the basis for the claim that the sample was small. Dejevsky responded:

... personally, i think there was a problem with the extrapolation technique, because – while the sample may have been standard for that sort of thing – it seemed small from a lay perspective (i remember at the time) for the conclusions being drawn and there seemed too little account taken of the different levels of unrest in different regions. my main point, though, was less based on my impression than on the fact that this technique exposed the authors to the criticisms/dismisal that the govt duly made, and they had little to counter those criticisms with, bar the defence that their methods were standard for those sort of surveys.

(Retrieved 10/30/06 from

http://www.williambowles.info/media/2005/ml_lancet.html)

Edward Herman, co-author with Noam Chomsky of the classic media study, *Manufacturing Consent*, commented:

Massive incompetence in support of a war-apologetic agenda. Dejevsky objects to the figures because they are vulnerable to discrediting for reasons that make no sense. I wonder if she finds sampling discreditable in all cases.

(Email to Media Lens, September 1, 2005, retrieved 10/30/06 from http://www.williambowles.info/media/2005/ml_lancet.html)

Media Lens commented that, operating on a shoestring, in allowing the right of reply and continuing the discussion they had performed a function almost totally abdicated by the media.

A simple search on the Internet will produce many commentaries on the two reports, in many cases predictable given the political stance of the authors and/or the publications (e.g., Hitchens, 2006; Moore, 2006). There is also abundant evidence of the relativization of opinion and democratization of ignorance that discussion groups on the Internet typically generate. We will restrict ourselves to a single example. Somebody contributed as follows:

That Lancet study is poorly done. The actual range of estimated civilian deaths was something on the order of about 10,000-100,000. That is a wide range that lends NO credence to the 100,000 number being selected over the 10,000 number. It was a politically biased article and never should have made it to print, at least in the form it was written.

(Retrieved 10/31/06 from <http://www.sport-groups.com/board/nextpost/93676/0>)

After another contributor pointed out that the report gave a 95% confidence interval of 8,000–194,000 with a point estimate of 98,000 the original contributor persisted as follows:

I didn't bother to look it up because the range was so varied. My point was in a range so large there is no way to pick one number over the other. That the article was flawed is true and that it should not have been published is true.

(Retrieved 10/31/06 from <http://www.sport-groups.com/board/nextpost/93676/0>)

It is to be expected that almost all people (including us) will react to these studies in alignment with their existing political views. This reality fundamentally challenges the notion of conclusions being reached, at least partly, on the basis of scientific evidence. Many criticisms of the reports claim that the political views of the authors and of the editor of the Lancet discredit the data. At least in the case of Les Roberts, the authors are anti-war, more specifically opposed to the invasion and war in Iraq, as is the editor of the Lancet, Richard Horton (and as, indeed, are the authors of this paper). What are the implications? Are people with such views considered incapable of carrying out studies of this sort and having the findings taken seriously? Such a position rests on the myth of science and mathematics being value-free, ethically neutral, and apolitical.

It is worth remembering that *The Lancet* is one of the most highly respected scientific journals, and that papers published in it are subject to the most stringent peer review. Apparently, however, it should not deal with deaths in war when those deaths are caused by "us". A June 23, 2005 editorial in the Washington Times lamented what it saw as an instance of "egregious politicization of what is supposed to be an objective and scientific

journal". Why is it unreasonable that a journal serving a profession whose members take an oath to protect human life should raise issues about the avoidable killing of human beings?

What does this all mean for mathematics education?

As we discussed in the introduction, a major reason for the alienation towards mathematics widespread in society is its lack of relevance to people's lives. Elsewhere (Mukhopadhyay & Greer, 2004, p. 201) we have proposed that a better slogan than "Mathematics for all" is "Mathematics of all":

By [mathematics of all] we mean, on the one hand, recognizing the diversity of human activity that is mathematical, and on the other, promoting the idea of every individual being a person who can meaningfully use mathematics.

Mathematics could be taught as, amongst other things, a tool for making sense, and then acting upon, issues that for the students, and the adults they will become, are of importance to them personally, to their communities, and to society in general. Adapting Freire's phrase, this is a vision of teaching mathematics "for reading and writing the world" (Gutstein, 2006).

In the current political climate of the United States, we perceive a chronic lack of the analytical tools that mathematics education ought to equip people with, a manifestation of what Macedo (2000, p. 5) calls "education for stupidification". As Chomsky (2000, p. 24) stated: The goal is to keep people from asking questions that matter about important issues that directly affect them and others". For too many students in the United States, these may literally be life-and-death issues.

It has been widely documented that people, in general, have a weak understanding of numerical data. In particular, it is difficult for many people to grasp the meaning of large numbers. Lack of numeracy is compounded by a lack of understanding of basic statistical principles such as sampling variation, randomness, margin of error (as is evident in our discussion above of the media treatment of the report on Iraqi deaths). For example, as we complete the writing of this chapter, the mid-term elections in the US are about to happen and the media are full of terms such as "statistical dead heat" which only a tiny fraction of the electorate understand. Shouldn't such understanding be part of what is considered an adequate mathematical education?

Beyond the basic statistical principles, there is the need for more sophisticated forms of argumentation. In the debate on gun control, it is common to see an argument (from either "side") formulated along these lines:

1. There are countries, such as Switzerland and Canada, where guns are readily accessible, yet homicide levels are low in those countries.
2. These facts prove that a high level of gun violence is not caused by access to guns.
3. Therefore attempts to reduce gun violence in the US by blocking access to guns will not work.

The conclusion may be true, but the argument is not valid. It rests on a simplistic assumption of a deterministic single cause/ single effect model, ignoring the clear reality that the causes of gun violence are multiple, and arguably deeply socio-cultural in ways that are extremely difficult, if not impossible, to quantify. We argue, accordingly, that mathematics education should convey some of the complexity of mathematically modeling social phenomena and a sense of what demarcates questions that can be answered by empirical evidence from those that depend on value systems and world-views. The interaction between statistics, politics, modeling of social phenomena, and views of people

(e.g. Hacking, 1975; 1990) is a major part of the social history of mathematics and of modern political history, virtually absent from mathematics education at all levels.

Technological advances mean that the amount of information available is swamping people's intellectual and analytical tools for making sense of, and critically evaluating, opposing claims. An interesting approach is in the *Opposing Viewpoints Series*, the volume of which that deals with gun violence we referred to above. In the introduction (Haerens, 2006, p. 9) points out that "the more inundated we become with differing opinions and claims, the more essential it is to hone critical reading and thinking skills to evaluate these ideas".

A contributory factor to weak understanding of the evaluation of evidence in the modeling of social phenomena is inadequate cultural support, in particular from the media. In many cases, it is possible to go beyond vague assertions of bias through the use of relatively simple analysis. For example, in relation to our own local newspaper:

From May-November 2004, 116 Palestinian children and 8 Israeli children were killed. The *Oregonian* reported all but one of the Israeli children's killings in a headline while reporting only 2 (under 2%) of the Palestinian children's deaths in headlines.

(Retrieved 11/05/06 from <http://www.auphr.org/oregonian.php>)

Tools that search databases enable simple yet powerful analyses that lend support to assertions such as that the newspapers did not adequately report the 2006 *Lancet* paper. During the week following its publication, a search in LexisNexis found the following frequencies (Jack Straw, a British minister, had recently made statements that British Muslim women should not wear veils, and the pop star Madonna had just adopted an African baby):

Jack Straw + veil	348
Madonna + adoption	219
Iraq + <i>Lancet</i>	44

The issues that we have raised in this paper speak to central questions. Munir Fasheh (1997) asked the startling question "Is mathematics dead?". We interpret this to mean that mathematicians too often adopt a stance of neutrality, distancing their work from its impact on people's lives, and that mathematics education does not deal with students' lived experience. In this chapter, we have used the example of numeration of mass deaths to argue that mathematics could be brought back to life as a tool for communicating outrageousness and provoking outrage. As mathematics educators, we seek ways to expand statistical empathy through the imaginative reframing of numerical data, through ingenuity in the design of statistical diagrams and schematic representations, and through simulations (see Petersen & Gutstein, 2005, for several examples), standing alongside expression through the visual and literary arts, such as the work seen in Mexico, the Rwanda genocide portrayal, John Donne's famous passage that begins "No man is an island", Bob Dylan's song "Blowin' in the wind". Such attempts address the question posed so passionately by Ubiratan D'Ambrosio, in this volume and elsewhere, namely what are the ethical responsibilities of mathematicians and mathematics educators as we seek survival with dignity?

REFERENCES²

- BBC News. (2000, December 6). Yoko's anniversary peace call. Retrieved 10/30/2006, from <http://news.bbc.co.uk/2/hi/entertainment/1056493.stm>
- Berger, M. (2001). Times Square photo project. Retrieved 11/01/2006, from <http://www.w42stnyc.com/stock02/words/gunskill.htm>
- Bigelow, B. (2006). *The line between us*. Milwaukee, WI: Rethinking Schools.
- Burnham, G., Doocy, S., Dzeng, E., Lafta, R., & Roberts, L. (2006). The human cost of the war in Iraq. Retrieved 10/11/2006 from <http://www.thelancet.com>
- Burnham, G., Lafta, R., Doocy, S., & Roberts, L. (October 21, 2006). Mortality after the 2003 invasion of Iraq: A cross-sectional cluster sample survey. *The Lancet*, 368(9546), 1421-1428.
- Children's Defense Fund (2005). Protect children not guns. Retrieved 1/25/2005 from <http://www.childrensdefense.org>
- Children's Defense Fund (2006). Protect children not guns. Retrieved 10/28/2006 from http://www.childrensdefense.org/site/DocServer/gunrptrevised_06.pdf?docID=1761
- CNN.com (2000, February 29). First-grader shot dead by classmate in Michigan school. Retrieved 11/02/2006, from <http://archives.cnn.com/2000/US/02/29/school.shooting.03/>
- Cook, P. J., & Ludwig, J. (2002). The cost of gun violence against children. *The Future of Children*, 12(2), 87-99. Retrieved 11/02/06, from http://www.futureofchildren.org/pubs-info2825/pubs-info_show.htm?doc_id=154414
- Dylan, B. (1962). Blowin' in the wind. Retrieved 11/01/2006, from <http://www.bobdylan.com/songs/blowin.html>
- Fasheh, M. (1997). Is mathematics in the classroom neutral – or dead? *For the Learning of Mathematics*, 17(2), 24 - 27.
- Frankenstein, M. (in press). Quantitative form in arguments. In J. Spring, H. J. Silverman & D. A. Gabbard (Ed.), *Knowledge and power in the global economy*. Mahwah, NJ: Erlbaum. http://www.media.pdx.edu/Mukhopadhyay/Frankenstein_062206.aspx
- Gates, B. (2005). National education summit on high schools [Electronic Version]. Retrieved 10/31/2006 from <http://www.admin.mtu.edu/ctlfed/Ed%20Psych%20Readings/BillGates.pdf>
- Gurney, S. (n.d.). In December 2000, The Times. Retrieved 10/01/2006, from http://a-i-u.net/antiquun_b.html
- Guterman, L. (2005, January 27). Researchers who rushed into print a study of Iraqi civilian deaths now wonder why it was ignored. Retrieved 10/31/2006, from <http://chronicle.com/free/2005/01/2005012701n.htm>
- Gutstein, E., & Peterson, B. (Eds.) (2005). *Rethinking mathematics: Teaching social justice by the numbers*. Milwaukee, WI: Rethinking Schools.
- Hacking, I. (1975). *The emergence of probability*. Cambridge: Cambridge University Press.
- Hacking, I. (1990). *The taming of chance*. Cambridge: Cambridge University Press.
- Hackman, H. (2005). Five essential components of social justice education. *Equity & Excellence*, 38, 103-109.
- Haerens, M. (2006). *Gun violence*. Farmington Hills, MI: Greenhaven Press.
- Hitchens, C. (2006, October 16). Epidemiology meets moral idiocy. Retrieved 10/31/2006, from <http://www.slate.com/id/2151607/fr/rss/>
- Infoplease (n.d.). A time line of recent worldwide school shootings. Retrieved 10/31/2006 from <http://www.infoplease.com/ipa/A0777958.html>

² Most of the papers retrieved from the Internet have been archived by the authors as Word files, and are available on request.

- Macedo, D. (1994). *Literacies of power: What Americans are not allowed to know*. Boulder, CO: Westview Press.
- Macedo, D. (Ed.). (2000a). *Chomsky on MisEducation*. Lanham, MD: Rowman & Littlefield.
- Macedo, D. (2000b). Introduction. In D. Macedo (Ed.) *Chomsky on MisEducation* (pp. 1-14). Lanham, MD: Rowman & Littlefield.
- Moore, S. E. (2006, October 18). 655,000 War Dead? A bogus study on Iraq casualties. Retrieved 10/31/2006, from <http://www.opinionjournal.com/editorial/feature.html?id=110009108>
- Moyers, B. (2006). America 101. Retrieved 11/01/2006 from <http://www.commondreams.org/views06/1101-33.htm>
- Mukhopadhyay, S. & Greer, B. (2002). Mathematics for socio-political criticism: The issue of gun violence. In S. C. Agarkar & V. D. Lale (Eds.), *CASTME-UNESCO-HBCSE International Conference on Science, Technology and Mathematics Education for Human Development* (Vol. 2, pp. 195-199). Goa, India: Homi Bhabha Centre for Science Education/ Tata Institute of Fundamental Research.
- Mukhopadhyay, S., & Greer, B. (2004). Teaching mathematics in our multicultural world. In A. M. Johns & M. K. Sipp (Eds.) *Diversity in College Classrooms: Practices for Today's Campuses* (pp. 187-206). Ann Arbor, MI: University of Michigan Press.
- National Research Council (2005). *Firearms and violence: A critical review*. Washington, D.C.: The National Academy Press.
- Papert, S. (1993). Obsolete skill set: The 3 Rs. Retrieved 11/04/2006, from http://www.wired.com/wired/archive/1.02/1.2_papert.html?topic=&topic_set
- Paulos, J. A. (1996). *A mathematician reads the newspaper*. New York: Anchor Books.
- Spitzer, R. J. (1998). *The politics of gun control* (2nd Ed.). New York: Chatham House Publishers.
- Tufte, E. R. (1983). *The visual display of quantitative information*. Cheshire, CT: Graphics Press.
- Tufte, E. R. (1990). *Envisioning Information*. Cheshire, CT: Graphics Press.
- Violent Policy Center (April, 2001). Where'd they get their guns? Retrieved 11/02/2006 from <http://www.vpc.org/studies/wguncont.htm>

