

QUANTITATIVE FORM IN ARGUMENTS

Marilyn Frankenstein

College of Public and Community Service, University of Massachusetts/Boston

Changing the form in which numerical information is presented can help us make sense of quantities whose significance we cannot grasp. Changing the form through basic calculations can allow us to feel the impact of those quantities through better understandings. Further, knowing the most meaningful quantitative form in which to express information is necessary in order to understand what's going on, and to make arguments for changing what's going on. This paper will develop these general ideas, including specific examples of arguments with quantitative evidence and discussions of the various ways in which that evidence can be presented, and the consequences of those various presentations.

INTRODUCTION

Many people argue that too much data about the injustices in our world make us numb to the realities of those situations in people's lives. Wasserman's editorial cartoon about the Israeli occupation of Palestine makes this point:



However, I argue that we do need to know the meaning of the numbers describing our realities in order to deepen our understandings of our world. One of my proudest academic moments was when *The Nation* published an edited version of the following letter I wrote responding to an article by Howard Zinn in which he argues that the numerical descriptions of the deaths from the USA war on Afghanistan can

obscure those horrors.

February 11, 2002

To the Editor:

Howard Zinn's article ("The Others," February 11) is a powerful reminder of the horrors that are perpetrated in the world on all the days in addition to 9/11. I, too, cried as I saw the portraits of the 9/11 victims. I, too, was crying not only for them, and not only for the victims of the wars the USA and other powers create, but also for the millions who die every year because of economic terrorism—from unsafe working conditions that kill 'by accident', to unjust working conditions that result in death from preventable causes such as hunger.

Binu Mathew reports in *Z* magazine (January 2002) that at this point in time the original death toll of 8,000, caused by the Bhopal gas leak at Union Carbide's factory, has increased to 20,000, growing every month by 10-15 people succumbing to exposure-related diseases. Union Carbide management delayed sounding the public siren for 15 hours, and continues to obstruct full revelations which would have

helped decrease some of this horrific toll. I, too, wondered, if detailed, in-depth TV and newspaper portraits of these victims, and of, say, the 12 million children who die from hunger every year (Food First Backgrounder, “12 Myths about Hunger,” Summer 1998), would wake up our collective consciousness.

Zinn makes another important point that I stress with my Quantitative Reasoning classes at the College of Public and Community Service (University of Massachusetts/Boston): statistical data can distance us from a deep empathy and understanding of the conditions of people’s lives. Of course, the data are important because they reveal the institutional structure of those conditions. But, also, quantitatively confident and knowledgeable people can use those data to deepen their connections to humanity. Those 12 million children are dying faster than we can speak their names.

In essence, the quantitative point of my letter is about the form in which we put numerical information. Changing the form can help us make sense of quantities whose significance we cannot grasp. Changing the form through basic calculations can allow us to feel the impact of those quantities through better understandings. Further, knowing the most effective form in which to present those quantities in arguing for creating a just world, is an important skill to teach in a criticalmathematical literacy curriculum. I would go so far as to argue that knowing the most meaningful quantitative form in which to express information is necessary in order to understand what’s going on.

CHANGING THE FORM TO UNDERSTAND LARGE QUANTITIES

In the *Globe Magazine* article “Playing with Billions” (Denison, 2002) the author did not use my favorite ways of making sense of the size of one billion. Try to guess, without calculating, the answers to the first two questions to get a sense of how little sense we have about the meaning of large numbers.

- About how long, at the non-stop rate of one number per second, would it take to count to one billion?
- About how long, at the non-stop rate of \$1000 per hour, would it take to spend \$1,000,000,000?

And, the *Globe Magazine* article certainly did not use a more political and real meaning of these numbers by asking us to think about such questions as the following: What human services programs we could fund from various items in the military budget of the USA. In 1997, was “a B-2 bomber worth more than twice the \$800 million currently being saved by cutting 150,000 disabled children with insufficiently severe disabilities? Is \$248 billion for the military and \$31 billion for education a proper balance in the use of federal funds?” (Herman, 1997, p. 43)

Domestic Program	Military Program
Home-heating assistance for low-income families (\$1 billion)	Cost of 1 Arleigh Burke destroyer (\$1 billion)

Raise Pell grants to \$3000 (\$1.7 billion)	Cost of 1 B-2 bomber (\$2.1 billion)
Head Start for young children (\$4.3 billion)	Cost for 1 Seawolf attack submarine (\$4.3 billion)
Drug prevention programs (\$2.2 billion)	Request for F-22 fighter program (\$2.2 billion)

Key domestic programs vs. Major military programs. Fiscal 1998 Budget (Center for Defense Information, quoted in Herman, 1997, p. 43)

Further, other seemingly large numbers are not so large when placed in context, in a different quantitative form. Dean Baker (2005) even argues that without proper context, people’s lack of quantitative understanding results in their voting against their own interests. For example, in the mid-90’s a Kaiser poll found that 40 percent of people ranked welfare for those with low incomes as one of the two largest items in the federal budget—the number, even according to the government statistics that mislead in a way that underestimates human services, was under 4 percent. Baker blames this on the way these numbers are reported--\$16 billion sounds gigantic, but in context it is only 0.6 percent of total federal spending. He feels that when people have such an exaggerated view of current welfare spending, they are unlikely to support increases in programs for those with low incomes.

QUANTITATIVE FORM IN ARGUMENT

One consideration in understanding, evaluating and constructing arguments whose claims are supported by quantitative evidence, is the form in which this evidence is presented. Is it clear, or is it misleading? Is it powerful, or is it likely to be ignored? In this section of the chapter, I am going to focus on examples in which the latter question is explored. Below are a number of examples from my curriculum which illustrate various ways I ask students to reflect upon how the forms of quantitative data affect the meanings we take from information.

(1) We discuss the table below from *The Nation* (1991): is the numerical form of this counter to the first Bush’s claim about our former wars, in particular our war on Vietnam, powerful? What might be more powerful forms in which to express the numbers supporting this counter-argument?

<p><u>WHAT DOES HE MEAN?</u></p> <p>“Our troops...will not be asked to fight with one hand tied behind their back.”</p> <p>—President Bush, national address, January 16 [1991]</p> <p>Tons of bombs dropped on Vietnam by the U.S.: 4,600,000¹</p> <p>Tonnage dropped on Cambodia and Laos: 2,000,000²</p>

¹ Jim Harrison, “Air War in Vietnam,” recent conference paper

² Jim Harrison, “Air War in Vietnam,” recent conference paper

Tonnage dropped by the Allies in World War II: 3,000,000³

Gallons of Agent Orange sprayed: 11,200,000⁴

Gallons of other herbicides: 8,000,000⁵

Tons of napalm dropped: 400,000⁶

Bomb craters: 25,000,000⁷

(2) As part of understanding Helen Keller’s argument below, students are asked to discuss how she uses numbers to support her claim, to evaluate whether that support makes her claim convincing, and to reflect on the form of her data—why she sometimes uses fractions, other times uses whole numbers, and whether there are alternative ways of presenting her quantitative evidence that would strengthen her argument.

In 1911, Helen Keller wrote to a suffragist in England: "You ask for votes for women. What good can votes do when ten-elevenths of the land of Great Britain belongs to 200,000 people and only one-eleventh of the land belongs to the other 40,000,000 people? Have your men with their millions of votes freed themselves from this injustice? (Quoted in Zinn, 1995, p. 337)

(3) In another argument we study about the globalization of workers in the garment trades, Gonzalez (1995, p. 148) compares the Leslie Fay company’s Honduran workers’ earnings with the company’s sales receipts. Specifically, he expresses the quantities as a “grand total of \$300” that all assembly line workers in Honduras cost Leslie Fay for one day (and he includes the information that this comes from 120 workers paid \$2.50 per day), and \$40,000 in retail sales that the company takes from the skirts those workers make in that one day. He does not say how many skirts they each make (another quantity which could reveal a different aspect of the exploitation). He does not calculate the workers’ yearly pay and compare it to the yearly retail sales of those Leslie Fay skirts.

One of the points brought out on our discussions is that if he had just focused on the average worker’s daily pay and the average amount the company made from selling the skirts she made, he would have compared \$2.50 to \$333. We speculate that he felt, even though the numbers for one worker are in the same proportion as the numbers for 120 workers, the \$333 figure would not appear as outrageous to the reader as the \$40,000. Also, most readers can relate to \$40,000 in terms of their yearly income—most would have a yearly income that is somewhere between half and double that figure. Since Leslie Fay is grossing that amount of money in one day, that adds to the outrageousness Gonzalez wants us to feel. If he had calculated the

³ Howard Zinn, author, *A People’s History of the United States*

⁴ Jim Harrison, “Air War in Vietnam,” recent conference paper

⁵ Jim Harrison, “Air War in Vietnam,” recent conference paper

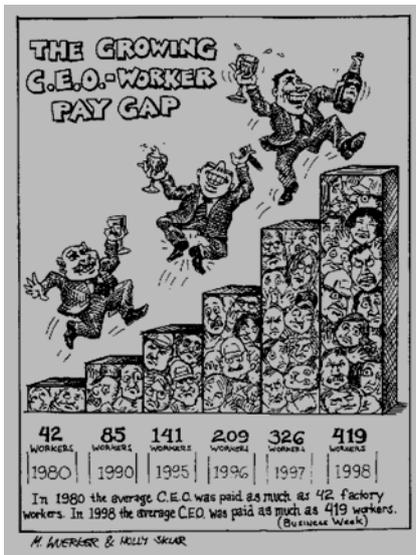
⁶ Jim Harrison, “Air War in Vietnam,” recent conference paper

⁷ Marilyn Young, *The Vietnam Wars*

yearly sales—\$14,600,000—since most readers could not deeply grasp the meaning of such a giant number, its impact would have been less than when readers can think “Leslie Fay makes more in one day than I make in a year!” And, even minimum-wage workers in the USA could think, “In one day, they are paying their workers less than I make in half an hour—could it cost that much less to live decently in Honduras?”

(4) Following is an argument supported by quantitative evidence, and four forms of similar quantitative information that could have been used to support the claim. Students are asked to identify the claim, the reasoning and the evidence Wuerker and Sklar are making in their editorial graph below. Then we compare the different forms of the quantitative evidence given in each of the related arguments. Students reflect on which quantitative form provides the most powerful support for the claim? What other kinds of numerical data would further strengthen the claim? What data or reasoning would a counter-argument present?

(a) The graphic argument from Sklar (1999):



(b) Another presentation of similar quantitative evidence from Jackson (2001): If the minimum wage had risen at the same level pace as executive pay since 1990, it would be \$25.50 an hour, not \$5.15; if average pay for production workers had risen at the same level as CEO pay since 1990, the annual salary would be \$120,491, not \$24,668.

(c) Another presentation from United for a Fair Economy (Sklar, 1999. p. 63): “If the real 555-foot Washington Monument reflects average 1998 CEO pay, then a scaled-down replica representing average worker pay would be just 16 inches tall—5 inches shorter than

in 1997. Back in 1980, the Workers Monument was over 13 feet tall—reflecting a CEO-worker wage gap of 42 to 1.”

(d) and (e) Two presentations from Wasserman (1996):



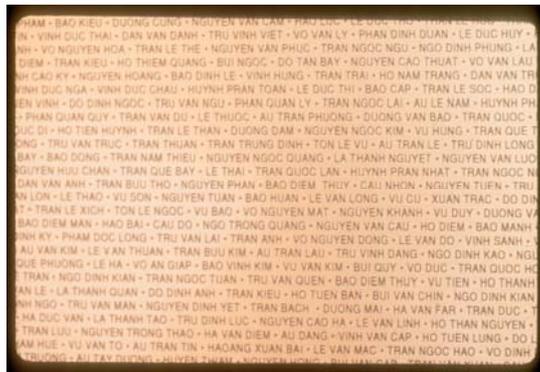
QUANTITATIVE FORM IN ARTISTS' ARGUMENTS

In addition to various written and graphical forms of quantitative information, the arts present different kinds of opportunities for people to understand and use quantities in arguments. As Toni Morrison states: “Data is not wisdom, is not knowledge.” (Quoted in Caiani, 1996, p. 3) Caiani goes on to add:

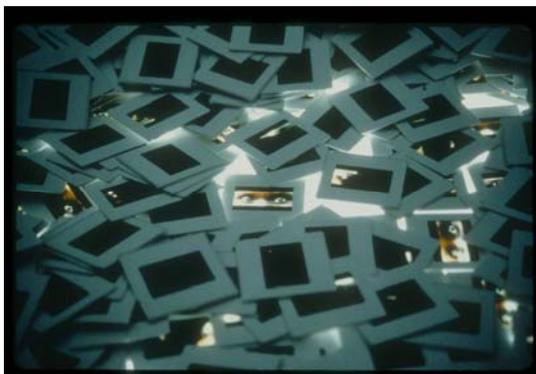
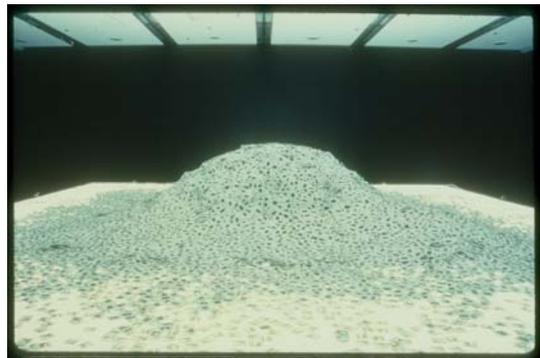
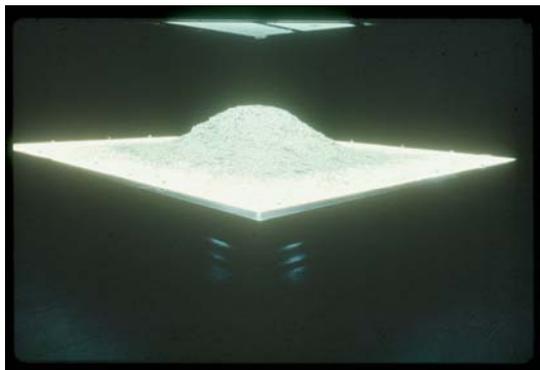
In contrast to stories told in a living language filled with images taken from the human world, facts, statistics, data and bits of information, valuable as they are, slide in and out of memory without fully engaging sustained, powerful connections to the whole being. Data are important, are necessary, but not all by themselves, not alone. Analysis and facts are not able to give a face, eyes, a body to the suffering, joy, love, anguish of the people ... Art, I am convinced (as indeed have been many scientists like Pascal and Einstein), is at least as necessary as the sciences in grasping reality if we are ever to effect the change we seek in our long struggle to be human. ... Our efforts to make a better world through a narrow, reductive, isolated, scientific method which relies on the accumulation of data and its business-like interpretation, will fail. (p. 3)

The following examples of art encode quantitative information in ways that make us understand—what does this amount mean? The numbers are the data of our world—our wars; the art allows us to understand the quantities in ways we could not understand from the numbers alone.

“The other Vietnam Memorial’ (by artist Chris Burden, USA) refers to the famous memorial in Washington, D.C. by artist Maya Lin which lists the names of 57,939 Americans killed during the Vietnam War. 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)



Another 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).



ADDITIONAL CONSIDERATIONS ABOUT QUANTITIES IN ARGUMENTS

In addition to quantitative form, there are other kinds of considerations about quantities that are important in understanding, evaluating and making powerful arguments that challenge the global imperialism that has trickled down into every

corner of our world. In addition to the more typical ways of classifying various misleading statistical accounts (like mistaking correlation for causation), I think two overarching questions are important to consider: What are the political, as opposed to scientific/mathematical, aspects involved in the data presented? Is the measure chosen the most accurate way of describing or analyzing the situation, or, in other words is the correct answer being given to the wrong question?

It is important to understand which aspect of quantitative evidence is mathematical fact and which is political, and therefore, subject to debate. Much data is presented as if they were neutral descriptions of reality, masking the political choices that produced the data. For example, once the government determines which categories of workers count as part of the labor force, and which categories of workers count as unemployed, rewriting that information in percent form is a mathematical algorithm for which there is only one answer and about which it does not make sense to argue. The politics about which we can, and I would argue, should, argue comes in decisions made by the government such as to count part-time workers who want full-time work, as fully employed, and to not count workers who have looked for over a year and not found a job, as unemployed.

It is also important to determine which quantitative measure gives the most accurate picture of a particular issue. For example, the ultra-conservative Heritage Foundation argues that our progressive federal income tax is terribly unfair because of facts such as in 1997 the top 1 percent income group paid 33.6 percent of all federal income taxes, while the share of all taxes paid by the bottom 60 percent was only 5.5 percent. But, a left (and even a liberal) perspective would argue that is the wrong measure by which to judge tax equity. It makes much more sense to look at what happens to the share of total pre-tax and total after-tax income. That picture reveals only a small progressivity: a slight upward shift for the bottom four quintiles, and a slight downward shift for the top income quintile. Ellen Frank (2002) then argues

If one believes that Ken Lay deserved no less than the \$100 million he collected from Enron last year, while the burger-flippers and office cleaners of America deserve no more than the \$6.50 an hour they collect, then a progressive tax would seem immoral. But if one believes that incomes are determined by race, gender, connections, power, luck and (occasionally) fraud, then redistribution through the tax system is a moral imperative. (p. 44)

Frank goes on to discuss the impact of other kinds of federal taxes, such as Social Security taxes (which are capped at \$90,000), excise taxes and so on which are regressive, as well as state and local regressive levies like sales taxes. She hypothesizes that adding all these taxes together would “almost certainly find that the U. S. tax system, as a whole, is not progressive at all” (p. 44).

CONCLUSION

In “Scenes from the Inferno,” Alexander Cockburn (1989) wrote about some of the realities behind the so-called worldwide triumph of capitalism. One of his illustrations is particularly relevant to understanding how the wrong quantitative measure has real consequences in people’s lives. He relates how in some neighborhoods of Santiago, Chile, “the diet of 77 to 80 percent of the people does not have sufficient calories and proteins, by internationally established standards, to sustain life.” Under Pinochet, the dictator of Chile during that country’s period of ‘triumphant capitalism,’ malnutrition was measured in relation to a person’s weight and height, in contrast to the usual comparison of weight and age. “So a stunted child is not counted as malnourished, and thus is not eligible for food supplements, because her weight falls within an acceptable range for her height” (p. 510). I argue that the overarching goal underlying a criticalmathematical literacy curriculum is to explore the connections between understanding the outrageousness of collecting such statistics, and struggling to change the outrageousness of such conditions.

This paper, however, focused on the importance of the form in which the measures are actually expressed. I argue for the importance of criticalmathematical literacy curricula also consisting of reflections on questions such as whether it is more powerful to state that “The wealthiest 1 percent of Americans control about 38 percent of America’s wealth” (Jackson, 1999) or that in the United States, “The richest 1 percent owns more than the poorest 92 percent combined” (Food First, 1998). Part of struggling to change our world in the direction of more justice is knowing how to clearly and powerfully communicate the outrageousness.

REFERENCES

- Baker, D. (2005). “Numbers before Politics.” In *These Times*, May, 9, p. 33.
- Caiani, J. (1996). “Art, Politics, and the Imagination.” *Resist Newsletter*, Vol. 5, No. 6, July/August, pp. 1-3; 11.
- Cockburn, A. (1989). “Scenes from the Inferno.” *The Nation*, April 17, pp. 510-511.
- The Democratic Staff of the Committee on Education and the Workforce. (2004). “Everyday Low Wages: The hidden Price we all Pay for Wal-Mart.” U.S. House of Representatives, Representative George Miller (D-C A), Senior Democrat. February 16. <http://edworkforce.house.gov/democrats/WALMARTREPORT.pdf>
- Denison, D.C. (2002). “Playing with Billions.” *The Boston Globe Magazine*, December 29, pp. 20-23; 29-31.
- Food First (1998). “Should American be Measured by its 3.5 million Millionaires . . . or by its 30 million Hungry?” advertisement, *The Nation*, December, 21, pp. 20-21.
- Frank, E. (2002). “Ask Dr. Dollar.” *Dollars and Sense*, September/October, p. 44.

- Frankenstein, M. (1983). Critical Mathematics Education: An Application of Paulo Freire's Epistemology. *Journal of Education*, 165(4), 315-340; reprinted in Ira Shor (Ed.), *Freire for the Classroom* (pp. 180-210). Portsmouth, NH: Boynton/Cook.
- Frankenstein, M. (1994). "Understanding the Politics of Mathematical Knowledge as an Integral Part of Becoming Critically Numerate." *Radical Statistics* 56 (Spring): 22-40.
- Frankenstein, M. (1998). Reading the World with Math: Goals for a Criticalmathematical Literacy Curriculum. In Enid Lee, Deborah Menkart, and Margo Okazawa-Rey (Eds.), *Beyond Heroes and Holidays: A Practical Guide to K-12 Anti-Racist, Multicultural Education and Staff Development*. Washington, DC: Network of Educators on the Americas.
- Gonzalez, J. (1995). *Roll Down Your Window: Stories from a Forgotten America*. London: Verso.
- Greenwald, R. (2005). *Wal-Mart: the High Cost of Low Price*. DVD.
www.walmartmovie.com
- Griffiths, D., Irvine J. & Miles I. (1979). Social statistics, towards a radical science. In J. Irvine, I. Miles & J. Evans (Eds.), *Demystifying social statistics*. London: Pluto.
- Herman, E.S. (1997). "Privileged Dependency and Waste: The military Budget and our Weapons Culture." *Z Magazine*, November, pp. 41-44.
- Holtzman, D. (1999). "Economy in numbers: Ecological Footprints." *Dollars and Sense*, July/August, p. 42.
- Jackson, D. (2001). "Who's Better Off this Labor Day? Numbers Tell." *Boston Globe*, August 31, p. A27.
- Johnston, D. C. (2003). *Perfectly Legal: The Covert Campaign to Rig our Tax System to Benefit the Super Rich—and Cheat Everybody Else*. New York: Penguin.
- Krugman, P. (2005). "Race and Social Security: Little Black Lies." *The New York Times*, January 25.
- The Nation. (1991). "What does he Mean?" February 18.
- Powell, Arthur B. (1995). Criticalmathematics: Observations on Its Origins and Pedagogical Purposes. In Y. M. Pothier (Ed.), *Proceeding of 1995 Annual Meeting of the Canadian Mathematics Education Study Group*, 103-116. Halifax, Nova Scotia: Mount Saint Vincent University Press.
- Rockwell, S. (1998). "Alfredo Jaar at Galerie LeLong in New York." In *dArt International*, /vol. 1, No. 3, Fall, pp. 3; 12-13.

- Sklar, H. (1999). "For CEO's, a Minimum Wage in the Millions: The Wage Gap between CEO's and Workers is Ten Times Wider than it was in 1980." *Z Magazine*, July/August, pp. 63-66.
- Spriggs, W. E. (2004). "African Americans and Social Security: Why the Privatization Advocates are Wrong." *Dollars and Sense*, November/December, pp. 17-19, 32-33.
- Wasserman, D. (1996). Op-Ed cartoon. *Boston Globe*.
- Wasserman, D. (1999). Op-Ed cartoon. *Boston Globe*, September 2.
- Wypijewski, J. (2002). "Light and Shadow in the City of Lights." *The Progressive*, February, pp. 26-29.
- Zinn, H. (1995, updated from 1980). *A People's History of the United States: 1492-Present*. New-York: Harper-Collins.

Note: A version of this paper, complete with extensive endnotes, appears on the conference website.