Do Mathematicians Have Responsibilities?

Michael Harris

I have been an admirer of Reuben Hersh ever since I received a copy of *The Mathematical Experience*, then brand new, as a birthday present. At that stage, of course, I was admiring the tandem Reuben formed then, and on other occasions, with his coauthor Philip J. Davis. It was only almost 20 years later, after I started reading *What is Mathematics, Really?*, that I could focus my admiration on Reuben—and not only on the mathematician, the author, and the thinker about mathematics but on the person Reuben Hersh—the unmistakable and unforgettable voice that accompanies the reader from the beginning to the end of the book. So unforgettable was the voice, in fact, that when Reuben wrote to me out of the blue three years ago to ask me what I thought about a certain French philosopher, I so clearly heard the voice of the narrator of *What is Mathematics, Really?* (and no doubt of many of the passages of his books with Davis) that I could honestly write back that I felt that I had known him for decades, though we have never met and until that time we had never exchanged a single word.

The voice in question is the voice of an author who is struggling to put words on an intense and intensely felt experience and who has intimate knowledge of how it feels to be a mathematician and also a knowledge no less intimate of the inadequacy of the language of our philosophical tradition to do justice to that experience, so that all attempts to do so inevitably end in failure; but this knowledge is compensated by the conviction that the stakes are so important that we can't choose not to try. What makes Reuben's authorial voice compelling is that it sounds just as we

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B. Sriraman (ed.), *Humanizing Mathematics and its Philosophy*,
DOI 10.1007/978-3-319-61231-7_11

expect the voice of a person in the middle of that struggle must sound.[1] It's the strength of this conviction that comes across in Reuben's writing, so that reading his books and essays is remembered (by me, at least) as a conversation, a very lively conversation, filled with the passionate sense that we are talking about something that *matters*. A conversation also filled with disagreements—because I don't always agree with everything I read in Reuben's books and essays. Beyond questions of detail, the difference might come down to my sense that Reuben is trying to *get to the bottom* of the mathematical experience, whereas I apprehend the experience as bottomless; or I might say that it's the effort to get to its bottom that is at the bottom of the experience. But the differences are of little moment; what stays with me after reading a few pages of Reuben's writing is the wholeness of the human being reflected in his words, a human being who cares so deeply about his mathematical calling that he is ready to add his own heroic failure to the long list of admirable failures to account for mathematics by the most eminent philosophers of the Western tradition; and without these inevitable failures, we would not begin to understand why it does matter to us.

It's not a coincidence that Reuben's philosophy of mathematics is human centered, that it takes as an essential and not an incidental feature of mathematics that it is an activity of human beings, and that his writing is an expression of an entire human being. Inspired by his example, I was looking forward in this essay to devising a philosophical failure of my own, which might nevertheless hint at something about mathematics that deserves further scrutiny. That was what I had in mind on October 24, 2016, when I agreed enthusiastically to contribute to this *Festschrift* and specifically to address what might be called the founding dogma of humanistic mathematics, namely, that anyone who claims that human mathematicians would be replaced by computers (as Paul Cohen reportedly claimed to Reuben 40 years ago) has failed to grasp what mathematics (really!) is and probably has a shaky understanding of human beings as well. But shortly after October 24, an Event took place that has been disturbing the sleep of everyone I know, as well as a great many people I don't know—every public lecture or round table I have attended in the intervening period has allusions to the Event, with the partial exception of mathematical lectures—and I can't help feeling that any expression of confidence in the future of human mathematics would be more convincing if I could find more solid reasons for continued confidence in the future of humans.

So I have (in the spirit of the times) made a deal with myself, and I hope Reuben will not object. I will set down my thoughts on the social responsibilities of mathematicians, which I feel compelled to discuss in view of the circumstances. In so doing, I will attempt to justify my belief—straining logic and credulity and readers' patience if necessary—that the way we approach questions of objectivity in

[1] As I wrote that sentence I remembered that I have still not met Reuben, nor have I ever spoken to him; but I checked one of the videos online in which he appears, and, sure enough, his literal voice is very much as I expected.

mathematics in the dominant strand of English-language philosophy, a perspective Reuben has questioned so vigorously, is an obstacle to taking our responsibilities seriously, as well as to understanding the point of the mathematical experience.

I understand why so many of my colleagues argue that mathematics and politics should not mix and why the mathematical profession should avoid taking political stands. The language mathematicians share ignores political differences, and our professional ethics compel us to recognize the contributions of colleagues with whom we may disagree profoundly on everything that is not specifically mathematical. This characteristic ethos of the profession, with which I think most of my colleagues agree, is often used to promote the position that the profession should maintain strict neutrality with regard to political questions and specifically that it is as individual citizens, and not as members of a professional community, that we should address the applications and implications of our work, as researchers, as teachers, and as participants in the institutions that make our work possible.

I think that position has never been tenable, either philosophically or morally, and developments during the past ten years have made this spectacularly clear. But before I remind the reader of some of these events, I want to discuss an older story, one in which the mathematical sciences play at most a supporting role, but that I think illustrates well how philosophical confusion about the nature of mathematics can interfere with informed judgment. Here is a sentence that, syntactically at least, looks like a legitimate question to which scientific investigation can be applied.

Does Mathematical Talent Have a Genetic Basis?

On the one hand, the answer is obviously yes: bonobos and dolphins are undoubtedly clever, but they are unable to use the binomial theorem. The question becomes problematic only when the attempt is made to *measure* genetic differences in mathematical talent. Then one is forced to recognize that it is not just one question innocently chosen from among all the questions that might be examined by available scientific means. It has to be seen against the background of persistent prejudices regarding the place of women and racially defined groups in mathematics. I sympathize as much as anyone with the hope that the study of the cognitive and neurological basis of mathematical activities can shed light on the meaning of mathematics—and in particular can reinforce our understanding of mathematics as a *human* practice—but given how little we know about the relation between mathematics and the brain, why is it *urgent* to establish differences between the mathematical behavior of male and female brains? The gap is so vast between whatever such studies measure and anything resembling an appreciation of the difficulties of coming to grips with the conceptual content of mathematics that what really needs to be explained is why any attention, whatsoever, is paid to these studies. Ingrained prejudice is the explanation that Occam's razor would select. But I've heard it argued often enough, by people whose public behavior gives no reason to suspect them of prejudice, that it would be unscientific to refuse to examine the possibility that the highlighted question has an answer that might be

politically awkward. It's the numerical form of the data, I contend, and the statistical expertise brought to bear on its analysis that provide the objectivity effect, the illusion that one's experiment is actually measuring something objective (and that also conveniently forestalls what ought to be one's first reaction: why has Science devoted such extensive resources to just this kind of question?). The superficially mathematical format of the output of the experiment is a poor substitute for thought. Maybe something is being measured, but we have only the faintest idea of what it might be.

This example, which is only mildly hypothetical, has the advantage of highlighting how an illusion of objectivity, produced by dressing up a question that is not necessarily meaningful as a quantitative measurement, is linked to the failure to reform the philosophy of mathematics to account for what mathematical talent is (really). And that, I submit, is why Reuben Hersh's project becomes profoundly ethical.

Here is another example that demonstrates why the development of humanistic mathematics is urgent in a way that studying hypothetical gender differences in mathematical behavior of human brains is most definitely not. The prediction by Paul Cohen that so irritated Reuben is constantly echoed in a journalistic narrative that is transparently driven by corporate priorities. An article by Elizabeth Kolbert, entitled *Our Automated Future*, in the Books section of a recent issue of *New Yorker* posed a rhetorical question:

> "What business will want to hire a messy, complex carbon-based life form when a software tweak can get the job done just as well?"[2]

The books Kolbert reviews highlight the looming threat of mass unemployment on a catastrophic scale—"nearly half the occupations in the U.S. are 'potentially automatable,'" she writes, and "this could play out within "a decade or two." This already ought to inspire mathematical scientists to start thinking about our social responsibilities, and I'll have more to say about that in a moment. Mathematical research itself, meanwhile, could be a collateral damage of the "automated future's" version of the bottom line, if the vision of Paul Cohen (and of increasing numbers of our colleagues) is realized. Provided, that is, that Cohen's implicit vision of what it means in mathematics to "get the job done" also comes to dominate and that mathematical research is no longer understood as synonymous with *human* mathematical research. Or as Kolbert wrote, in a somewhat different context, "if it's unrealistic to suppose that smart machines can be stopped, it's probably just as unrealistic to imagine that smart policies will follow. "

The implications of the arrival of "smart machines" were brought home to me a few months ago at the New York Psychoanalytic Institute, of all places, during a round table discussion entitled "Embodied AI." While the panel was billed as a report on AI's promise to "augment individual human senses and abilities, giving that technology platform the ability to see a patient's complete medical

[2]Elizabeth Kolbert, *New Yorker*, December 19 and 26, 2016 Issue.

condition, feel the flow of a supply chain, or drive a factory like a maestro before an orchestra," the discussion rapidly veered to ethical matters. We were naturally reminded that HAL 9000, in *2001: A Space Odyssey*, thought he was being a pretty "smart machine" when he computed that the best way to "save the mission" was to wipe out the crew. In connection with this kind of risk, among others no less alarming, it was announced that Facebook, IBM, Amazon, Google, and Microsoft had just formed the "Partnership on AI" for the purpose of "conducting research and promoting best practices." Mentioned in passing was the likelihood that rapid progress in "embodied" artificial intelligence would lead to the replacement of a large proportion of human workers by robots, as Kolbert predicted. Someone in the room was not convinced that the definition of "best practices" should necessarily be left to the tech giants that had come together in the Partnership on AI[3] and asked a question: had it occurred to none of the speakers that a process they saw as inevitable ought to be subject to democratic oversight? Why are decisions with such grave long-term implications being left to a handful of corporations with massive resources at their disposal? In response,[4] a historian recited the familiar story of Gandhi and his promotion of handloom weaving during the Indian independence movement; he called Gandhi's intentions "noble" and used the word "resistance" but only to conclude that it was futile.[5]

I draw three lessons from this brief exchange. The first is that the panelists had internalized a purely *instrumental* view of human activity, the presumption that humans work in order to "get the job done"; on instrumental grounds they are therefore expendable. The implications of this worldview are so repellant that it is to be hoped that more attention will be given to how it converges with the dominant ethos in Silicon Valley, where the sum total of human experience is treated as data to be mined for content. Kant's dictum from the *Groundwork of the Metaphysics of Morals* has been rescinded, and it's now OK to treat human beings as a means rather than an end. Applying this form of instrumental reason to mathematical research is the main mistake made by Paul Cohen in his comment to Reuben and by those of our contemporaries who agree with Cohen's prognosis; this is where the panel discussion becomes a challenge to humanistic mathematics.

The second lesson is that those who promote the instrumental view of human activity have little sympathy for democratic decision-making. In the context of

[3]Now joined, predictably, by Apple. In all fairness, I should add that on January 27 the Partnership on AI, which had reported no news during the previous three months, has added six independent members to its Board of Trustees, including a representative of the ACLU. I am cautiously optimistic. The outreach to civil society does not invalidate the impressions I took home from last October's panel.

[4]The word "Luddite" had been pronounced earlier, and hung over the discussion, as if to reinforce the sense that the social transformations the panelists were discussing were foreordained; the question I just quoted—I happen to be the one who asked it—was the only one to challenge this claim of inevitability; and many of the original Luddites were also handloom weavers.

[5]He seemed to have forgotten that Gandhi's movement was primarily a reaction to colonialism, a strange oversight for a historian.

the meeting on "Embodied AI," it would probably be more accurate to say that sympathy is beside the point; the panelists all appeared to be convinced that technological determinism trumps democracy. When resistance is futile and the new technology is on its way whether we like it or not, the best we can do—our only option, really—is to leave management of the impending social dislocations in the hands of those best equipped to steer the transformation consistently with our principles—the latter being identified, of course, by the billion-dollar corporations that stand to benefit the most.

The third lesson, most important for our purposes, is that the primary qualification for membership in the steering committee of our inescapable technological future is a command of relevant quantitative sciences. Progress is a wave and you either ride it or go under; and you learn to ride the wave by mastering complex mathematical theories. Ethical principles not backed up by calculations stand no chance against the people with the clipboards. The experts may appear arrogant when they dismiss your concerns; but the fact is that they know more than you, so why should your opinion count as much as theirs?[6]

Once mathematics, narrowly conceived as the gathering and analysis of quantitative data, is accorded the role of the sole standard of *objectivity*, there indeed seems to be no alternative—in the spirit of Margaret Thatcher's *There Is No Alternative*—to surrendering control not only of democratic decision-making but of *meaning* itself, to mathematically trained experts. This is not a novel observation.[7] Here, for example, are Horkheimer and Adorno[8] on what happens when one reduces "thought to a mathematical apparatus":

> *What is abandoned is the whole claim and approach of knowledge: to comprehend the given as such; not merely to determine the abstract spatio-temporal relations of the facts which allow them just to be grasped, but on the contrary to conceive them . . . as mediated conceptual moments which come to fulfillment only in the development of their social, historical, and human significance . . . .*

More recently, Achille Mbembe[9] pictured the "21st century political landscape" as a Big Data apocalypse:

> *In this new landscape, knowledge will be defined as knowledge for the market. The market itself will be re-imagined as the primary mechanism for the validation of truth.*
>
> *As markets themselves are increasingly turning into algorithmic structures and technologies, the only useful knowledge will be algorithmic.*
>
> *Instead of people with body, history and flesh, statistical inferences will be all that count. . . . The new human being will be constituted through and within digital technologies and computational media.*

[6]This is not to suggest that expertise should give way to the populism of a strongman, but rather that it's incumbent on experts to be less arrogant.

[7]For Jane Austen, it was the *mathematician* who had the "coldest heart and the steadiest brain." *Emma*, Volume III, Chapter 3.

[8]*Dialectic of Enlightenment*, New York: Continuum (1994) pp. 26–7.

[9]"The age of humanism is ending," *The Mail and Guardian*, December 22, 2016.

If I have devoted so much space to the implications of "Embodied AI" it's because I happened to be on hand at a meeting where the three lessons just outlined were displayed with exemplary clarity. And one has to suppose that a volume devoted to mathematical humanism would value the inclusion of a human perspective on post-humanism, even if it is only my own. But the same three lessons can be drawn in any of the increasingly frequent situations in which mathematics-based technology has come into conflict with democratic principles. While pure mathematicians in particular may have wondered whether much of their work would ever be socially useful, it was generally believed that at least it caused no harm.[10] Events of recent years have called that belief into question. The sophisticated and often opaque derivatives developed by financial mathematics magnified the effects of a downturn in sectors of the US housing market into a global financial crisis whose consequences are still with us. Edward Snowden's revelations in 2013 served as a reminder that contemporary cryptographic techniques based on number theory can also be used to facilitate general surveillance by governments. The rapid growth of Big Data has made it possible for commercial as well as public actors to track individual behavior with increasing precision, with grave implications for privacy.

In each of these applications of mathematics, one finds the same three features that were visible in that brief panel discussion on "Embodied AI": an approach to human activity that is purely instrumental (serving the interests of the market or of government surveillance; of course there are also military applications, but they are not especially new), a disdain for democratic decision-making, and the empowerment of experts on the basis of their mathematical training. And in each case, a few mathematical scientists have pointed out that the power of mathematical technology imposes social responsibility on those who develop it, beyond putting trust in experts. Responses have been as varied as the *Code of Ethical Conduct for Virtual Reality Research*, formulated by Michael Madary and Thomas K. Metzinger[11]; the *Hippocratic Oath* for financial modelers, proposed by Emanuel Derman and Paul Wilmott[12]; Cathy O'Neil's suggestion for an analogous *Hippocratic Oath*[13] for data scientists and developers of algorithms; the debate sponsored by the *Notices of the American Mathematical Society* on the role of the NSA, in the wake of the Snowden revelations[14]; and the reactions of a number of

[10] Nearly 30 years ago, in an article entitled "A Hippocratic Oath for Mathematicians?" (in Christine Keitel, chief editor, *Mathematics, Education, and Society*, Science and Technology Education, Document series No. 35, UNESCO (1989)), Chandler Davis was already suggesting that the harmlessness of the work of pure mathematicians deserved closer examination. Davis's article mainly referred to military applications; those considered here mostly concern the civilian sector, though no one can ignore the military implications of "Embodied AI," for instance.

[11] *Frontiers in Robotics and AI*, 19 February 2016, volume 3, article 3, www.frontiersin.org.

[12] in the *Financial Modelers' Manifesto*, see https://en.wikipedia.org/wiki/Financial_Modelers'_Manifesto and the references given there.

[13] *Weapons of Math Destruction*.

[14] See http://www.ams.org/notices/201504/rnoti-p400.pdf and the references indicated there.

French mathematicians to public blaming of mathematics for the 2008 financial crisis. The spirit of these oaths and codes is concisely summarized by Amaury Lambert and Laurent Mazliak.

> *As long as no one calls into question the ultimate goal of a technique, it can persist on its own, and it remains impossible to dissociate its harmful effects from its positive effects. Moreover, in order to guarantee the correct usage of financial techniques, it is not only necessary to define what that means; we must also all be prepared to refuse to cooperate if that usage appears to us to have been hijacked.*

Their specific target is financial mathematics, but their words apply to all the technologies mentioned above and to many others not yet conceived. Lambert and Mazliak add:

> *Rather than taking the time to question the aims of participation in the game of financial mathematics, efforts have been made to throw all our weight behind it, and we shielded ourselves from the consequences behind a supposed neutrality*.[15]

As I wrote, I don't believe this neutrality is tenable.

Reuben Hersh has done as much as any living mathematician to remind us how exciting it is to pay attention to the philosophical challenges inherent in our profession. I want to close by pointing out two substantial challenges that are authentically *philosophical* and that mathematicians will have to overcome in order to formulate a coherent commitment to socially responsible behavior. The first is an uncritical acceptance of conventional standards of "usefulness" as they apply to mathematics. My book *Mathematics without Apologies* devoted much of chapter 10, and nearly all of chapter 4, to analyzing the risks and contradictions of adopting a purely instrumental understanding of what it means for mathematics to be "useful," especially when the goals for which mathematics is meant to serve as an instrument are absurd or socially destructive. The most hostile reviews of my book saw these passages as proof of my irresponsible elitism, or my elitist irresponsibility, warning of dire consequences if government funding agencies were to realize that pure mathematical research is largely not aimed at generating what decision-makers find useful, whether it be new life-saving therapies or new techniques of mass surveillance. No consensus on norms of social responsibility is possible if the word "useful" is deemed to be neutral and off-limits for philosophically analysis.

The second challenge is more difficult still, because it goes to the heart of the philosophical disorientation that surrounds mathematics and that Reuben has explored in so many of his writings. The insistence on political neutrality is sustained in the minds of many mathematicians by the four Myths Reuben identifies in *What is Mathematics, Really?*—and especially by Myths 3 and 4—certainty and objectivity. While it can't be denied that the promises of mathematical certainty and

[15] Amaury Lambert, Laurent Mazliak, E la nave va?, *Gazette des mathématiciens,* **120**, avril 2009, pp. 103–5. My loose translation.

objectivity are a source of comfort—especially in an era of "alternative facts"[16]—Reuben argues that mathematicians are well aware that they are Myths, though we may wish it were not so:

> *Mathematicians want to believe in unity, universality, certainty, and objectivity, as Americans want to believe in the Constitution and free enterprise, or other nations in their Gracious Queen or their Glorious Revolution. But while they believe, they know better.*[17]

Nevertheless, being entrusted with power by virtue of our role in the transmission of mathematical knowledge imposes the responsibility to insist on the limitations of that knowledge. The ideology of mathematical certainty and objectivity is our most potent weapon; we should not allow it to be used to undermine democracy. With regard to mathematical modeling, we should constantly remind anyone who is willing to listen that a model is not objective or scientific just because it is mathematical. As Cathy O'Neil writes in regard to the Big Data algorithms she calls "Weapons of Math Destruction":

> *Though economists may attempt to calculate costs for smog or agricultural runoff, or the extinction of the spotted owl, numbers can never express their value. And the same is often true of fairness and the common good in mathematical models. They're concepts that reside only in the human mind, and they resist quantification.*[18]

I appreciate Thomas Piketty's bluntness in emphasizing how an unquestioning belief in the objectivity of mathematical formalism has damaged critical thinking in economics:

> *To put it bluntly, the discipline of economics has yet to get over its childish passion for mathematics and for purely theoretical and often highly ideological speculation, at the expense of historical research and collaboration with the other social sciences. . . . This obsession with mathematics is an easy way of acquiring the appearance of scientificity without having to answer the far more complex questions posed by the world we live in.*[19]

Reuben Hersh has tirelessly challenged us to look at what lies behind the appearances of scientificity in mathematics. For this we should all be grateful to him.

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[16] Nevertheless, see this from Fox News, in 2011: "the talk of the new year is this repealing Obama-care . . . . The debate should be about the liberals . . . trying to repeal the laws of math and physics. "http://www.morrisanderson.com/resource-center/entry/Boehner-Offers-Evidence-Obama-care-is-Job-Killer-Spending-Trillion-on-Plan-/.

[17] Hersh, Reuben. What is Mathematics, Really?. Cary, US: Oxford University Press (US), 2001. ProQuest ebrary. Web. 4 February 2017, p. 39.

[18] *Weapons of Math Destruction*, New York: Crown (2016) p. 207.

[19] *Capital in the Twenty-First Century*, Cambridge, MA: Belknap Press (2014) p. 32. Also, on p. 574: "For far too long economists have sought to define themselves in terms of their supposedly scientific methods. In fact, those methods rely on an immoderate use of mathematical models, which are frequently no more than an excuse for occupying the terrain and masking the vacuity of their content."