

# Moment of Proof

*Jonathan David Farley*

I wondered if I was in the right place. The sun was smiling, the skies a beautiful blue. L.A. The streets were long, wide, and almost deserted. The large building in front of me looked fairly uninviting. *Move along*, it said, *nothing to see here*.

It was a short walk down an incline to a guard's glass booth. "I'm going to the set of the television show *NUMB3RS*," I said tentatively. I don't think the guard called anyone or even checked my ID. He just gave me a badge, and directions. Soon enough I was with my contact, with whom I had only previously communicated via email. We were in an elevator going up. One flight, two flights—the doors opened. Suddenly I was inside FBI headquarters....

In recent years, math has broken out of the classroom and onto the stage and silver screen. What's the image of mathematicians in pop culture? Why are we seeing more and more of them in the movies? And can these movies help mathematics?

## Fermat's Last Theatre

It certainly seems hard to deny that the number of movies and plays featuring math and mathematicians is rising exponentially. The list includes *21 Grams* (Sean Penn plays a mathematician, at one point uttering the grammatical equivalent of nails-on-the-chalkboard, "mathematics are"), *Mean Girls* (teen queen Lindsay Lohan plays a "mathlete"—solving a calculus problem is a miniature climax in the story), *Die Hard 3* (Bruce Willis and Sam Jackson have to solve a math problem in order to stop a mad bomber), *Contact* (the movie starring

Jodie Foster did not have math, but the novel by Carl Sagan had a chapter on transcendental numbers), *Arcadia* (a play that begins with a conversation about Fermat's Last Theorem), and, of course, *Proof*.

Often in film mathematicians are absent-minded eccentrics who can't balance a checkbook, extras from *Revenge of the Nerds*, or erratic wunderkinds on the verge of some great discovery—and the verge of a nervous breakdown.

There is of course Russell Crowe in *A Beautiful Mind*, the story of the mathematical genius who talked to space aliens and wound up winning the Nobel Prize. Matt Damon in *Good Will Hunting* played a troubled kid from the streets who astounds MIT professors with his mathematical prowess. In the time travel story *Sphere*, Samuel L. Jackson is a mathematician who obtained both his Ph.D.'s before age twenty. The hit play *Proof* is about a woman who sees dead people—but just may have solved the most important mathematics problem in the world. Then there's Tom Stoppard's *Arcadia*, considered by some the best play of the twentieth century, about a precocious teenager who discovers fractal geometry about 160 years before it was actually invented. Finally there's *Pi*, about a man on the brink of madness who thinks the secret of God can be found in math's most famous number.

Sometimes in film mathematicians are unrealistically suave. In previously unpublished interviews I conducted for *Time* magazine, I asked several mathematicians and filmmakers for their thoughts. "Hollywood has a mythical idea of a mathematician," said Harvard professor Dick Gross, the technical advisor for *It's My Turn* (starring Jill

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Clayburgh and Michael Douglas). “Clayburgh’s character was a glamorous female mathematician,” he continued. “When I had her get together with several actual women mathematicians, [Clayburgh] said she found them too depressed, not what she had in mind for the character at all.” In *Jurassic Park*, Jeff Goldblum tries too hard to be hip in his shades and black leather jacket. In *Sneakers*, the mathematician wears all white.

But there are exceptions: sometimes in film mathematicians are almost human. Jeff Bridges plays a mathematics professor who marries Barbra Streisand in *The Mirror Has Two Faces*, and Edward James Olmos is a teacher who inspires kids with calculus in *Stand and Deliver*. In the view of former Caltech number theorist Edray Goins, “One of the first mathematicians ever to be featured in a positive light was ‘Dwayne Wayne’ of [the sitcom] *A Different World*.” In it, actor Kadeem Hardison plays a math major at a black college.

In a society so innumerate and math phobic, why are we seeing so much mathematics on film? “Math is a wonderful storytelling tool, filled with metaphors for the human condition,” says Sofia Quintero, creator of the hip-hop drama *Picture Me Rollin’*. “It’s a language that is both mystical and universal.”

Adds British Academy Award-winning filmmaker John Lynch, “Here’s a world most people think of as dull, as incomprehensible, and they can’t understand why anybody would do it. But within it are the most passionate drives and emotions that are fundamental to the human spirit.” Indeed, *Enigma*, the World War II spy thriller starring Kate Winslet, is as much a love story as it is a story about mathematical codes. (It draws of course from the life of mathematician Alan Turing, whose true story is told in the film *Breaking the Code*, based on the play by Hugh Whitmore.) Lynch co-directed *Fermat’s Last Theorem*, a documentary about the only theorem ever mentioned in a *Star Trek* episode.

“Math in Hollywood films is great,” adds Lynch’s co-director, Simon Singh, “but the real breakthrough would be prime-time TV.”

### Running the *NUMB3RS*

“Let me toss this out to you, see what you think.” It was my contact, Andy. “We’re developing a story around what our writer is calling ‘mosaic theory’—basically, is it possible to have only five pieces in a 1,000-piece puzzle, yet know what that entire puzzle is?... Is the puzzle metaphor a good one for mosaic theory? Is it realistic from an applied math point of view?”

I mentioned “secret sharing” schemes to Andy (whereby a secret is divided up into pieces so that it is impossible for it to be reconstructed from any proper subset of the pieces). When I visited the set

I discussed an anecdote about Norbert Wiener with the head writer; and I told Andy that the story about Schrödinger’s cat in one of the scripts (in which a cat is poisoned) might offend cat lovers. (When I met him, the creator of the show himself brought up the fact that this story might cause offense, although he didn’t know it was I who had emailed Andy about this days before.) I told Andy and one of the writers about “reflexive theory,” a branch of mathematical psychology used by the Soviet defense establishment; ten months later, Andy and another writer held a conference call with Vladimir Lefebvre, the Russian who created this theory. Tony Harkin, an applied mathematics fellow at Harvard<sup>1</sup> and consultant with my company Hollywoodmath.com, told Andy about how mathematics is being used to try to predict the paths of hurricanes. (The very next script we were sent was entitled, “Whorlwind” (sic).) Tony also suggested that the mathematics professor in the show, Charlie, might want to think twice about dating his graduate student.

Since the hit television crime drama *NUMB3RS* premiered in early 2005, mathematicians have been asking, “Can movies and television help mathematics?” I’ll be a bit perverse, and ask the converse: “Can mathematics help the movies?” It can, and in two ways: by improving plots and by improving profits.

“Guys—this is really wonderful stuff,” Andy told us later. “Unwittingly, you’ve sparked a creative argument over here: Nick Falacci, one of the creators, really liked the Secret Sharer stuff. Cheryl, his wife and co-creator, really wants to embrace the mathematics of a hurricane for better thematic resonance. My guess is we’ll use both, just save one for a coming episode.”

Mathematicians can help movies by providing writers with interesting ideas around which they can weave their stories. (Right now Gary Lorden of Caltech is the consultant for *NUMB3RS*.) The whole mathematical community—if not the whole country—may benefit if *NUMB3RS* succeeds.

For this reason Robert Barker of the U.S. Air Force has crafted a program whereby mathematicians and scientists can learn the art of screenwriting. The hope is that more positive images of scientists on-screen today will result in more American scientists in the laboratory tomorrow.

It may actually be a matter of national security—at least, it looks like the government thinks so. When I visited the *NUMB3RS* office and set, one of the people I bumped into was George S., a special agent for the FBI.

We could even create our own opportunities. A documentary based on Karl Sabbagh’s readable *Dr. Riemann’s Zeros* might have popular appeal.

<sup>1</sup> Now at the Rochester Institute of Technology.

The AMS could work on the documentary *Incompleteness: The Life of Kurt Gödel* with Philipp Steger of the Austrian embassy's Office of Science and Technology. (The Austrian logician would have been 100 in 2006 had he continued taking his vitamin C supplements.) The Sloan Foundation and EUROPAWS (a European society for the public awareness of science) could help fund these projects.

But there's another, perhaps more significant, way mathematics can help the movies.

### **Proof of Principle**

The movie *Proof*, starring Gwyneth Paltrow and Anthony Hopkins, cost an estimated US\$20 million. In its first three weeks, it earned only US\$2.5 million—not exactly a large cardinal. This could have adverse consequences on whether we see more math in theatres. What might the mathematics community have done?

Firstly, *Proof's* base audience could have been mobilized. Over 30,000 people belong to the AMS and related organizations. (This figure does not even include math teachers at the high school level or student mathematics organizations.) College mathematics classes typically have 20–30 students each. Add to this the approximately 15 million high school students, and, even if only a fraction of these individuals were encouraged (or required by their teachers) to watch *Proof*, perhaps an additional US\$10 million or more could have been netted for the film. University mathematics departments and math organizations (at little or no expense to the film's distributor, Miramax) could have promoted the film and encouraged professors and student organizations to watch *Proof*. The AMS and other groups could also have asked their members to do so.

In January 2005 we told Jill DeWinter of *NUMB3RS* that a “math literacy” campaign based around *NUMB3RS* would be embraced by schools and math teachers across the country, thus magnifying their audience enormously without expensive advertising. We later explicitly suggested that they work with the National Council of Teachers of Mathematics (NCTM) to prepare lesson plans, sample assignments, background notes and references for topics that arise in the show, including explanations of formulas and other supplementary materials. On September 19, 2005, *NUMB3RS* launched such an educational initiative in cooperation with NCTM and Texas Instruments.

Harvard president Larry Summers' inept remarks about women's “innate ability” (or inability) to do mathematics garnered a huge amount of publicity over several weeks. This kind of controversy could have been turned to *Proof's* advantage, given the subject matter of the film. Women's organizations, both for adults and for college students, could have

been tapped into in the same fashion as mathematics organizations to encourage women and girls to see the film. Such organizations might have included the National Organization of Women and the Association for Women in Mathematics. Moreover, well-placed newspaper editorials could have revived the Summers controversy to the benefit of *Proof*. As the National Science Foundation (NSF) has special initiatives for increasing the numbers of girls who go into math-related careers, the NSF could have been encouraged to support field trips for schools to see the movie. Or, special screenings could have been set up in schools for a fixed sum.

### **The Primer Number Theorem**

Shane Carruth studied applied mathematics as an undergraduate. In 2004 his film *Primer* won the Dramatic Grand Jury Prize at the Sundance Film Festival. At the request of *Primer's* public relations firm, Tony Harkin (mentioned above) attended the Boston premiere in order to lead an audience discussion about the science in the film. The theatre was sold out.

This is an excellent way to create buzz for a film. There could have been similar audience discussions for *Proof*. These special screenings would themselves have generated additional publicity for *Proof*.

### **Is Math the New Black?**

What is the future of cinemath?

“The truth is that math is a difficult and lonely business, conducted largely within the confines of one's own mind,” pines Harvard's Dick Gross. “This has little appeal to Hollywood.”

That is, it *used* to have little appeal. In the summer of 2005 a producer who was adapting *The Oxford Murders* for the big screen contacted Hollywood Math and Science Film Consulting. Lattice theorist Guillermo Martinez penned *The Oxford Murders*, a detective novel set in the quaint English city where the spires dream and the dons are only *slightly* mad.

Already under way is the shooting of *The Da Vinci Code*, based on the book by Dan Brown. The movie stars Tom Hanks and  $(1+\sqrt{5})/2$ , and is sure to be a blockbuster hit. (Incidentally, Dan Brown's father is a math teacher and part of the reason why Fibonacci numbers appear so prominently in the book.)

And what's next for TV? “Maybe [TV sitcom psychiatrist] Frasier could switch jobs,” jokes Simon Singh, “and turn to proving the Riemann hypothesis...”

I guess you could call it the revenge of the geeks. Or numerical chic. But for now, in Hollywood, it's hip to be square—or some other geometric object.