

# Seven

## Arthur Benjamin

Donald J. Albers

Arthur Benjamin is a Professor of Mathematics at Harvey Mudd College in Claremont, California. He is a gifted teacher, an accomplished magician, and a dazzlingly good mental calculator. Now forty-eight, his career has been marked with a string of successes. But as a child growing up in Cleveland, Ohio, all bets were off about his future. Little Art Benjamin was so rambunctious in his first nursery school that he was thrown out! Ditto for his second nursery school, and the third. Today his problem would be called ADHD. He overcame the problem, eventually earning a PhD in mathematical sciences from The Johns Hopkins University.

Benjamin's passion for both magic and mathematics is so strong that he refers to himself as a "mathemagician." As a teacher, he has a knack for involving students with his subject, and he has written many research papers in collaboration with them. During his spare time, he performs on numerous stages as Art Benjamin—Mathemagician. He has appeared on television shows in the United States, England, Canada, and Japan, including the *Today Show*, *Evening Magazine*, *Square One*, and on CNN. He has been profiled in the *New York*

*Times*, the *Los Angeles Times*, *USA Today*, *Scientific American*, *Discover*, *Esquire*, *People*, and several other publications. In 2005 *Reader's Digest* called him "America's Best Math Whiz."

Benjamin has a strong interest in the theater, which is not surprising in view of the fact that his brother is an actor and director, his sister has a trained voice, and his father was an amateur actor and director as well.

His performing abilities and awareness of audience involvement serve him well in the classroom. It is common for him to analyze one of his class presentations to see how he can increase student participation. He has won significant teaching awards, including the Haimo Award for Distinguished College or University Teaching from the Mathematical Association of America (MAA), in 2000. After receiving his doctorate, he sought a school that would value his teaching as well as his research. He says that he found it in Harvey Mudd College.

Benjamin has written more than seventy research papers, most in combinatorics, game theory, or number theory, and two books: *Secrets of Mental Math*, with Michael Shermer (Three Rivers Press, 2006), and *Proofs That*

*Really Count: The Art of Combinatorial Proof*, with Jennifer Quinn (MAA, 2003), which won the Beckenbach Book Prize from the MAA. In 2009 he co-authored the MAA book *Biscuits of Number Theory* with Ezra Brown.

On the occasion of the 1998 Mathfest of the MAA in Toronto, Arthur Benjamin, together with Brent Morris, gave a special short course on magic in mathematics and, following that, at the opening banquet, he performed feats of mental calculation, to sustained and enthusiastic applause. This interview took place the following day, July 17, 1998.

## Childhood

**MP:** *You were born on March 19, 1961, in Mayfield Heights, a suburb of Cleveland, Ohio. You have a brother and a sister. What did your parents do?*

**Benjamin:** My father, Larry, was an accountant, and my mother, Lenore, was a special education teacher. My hyperactivity as a child drove her to get a master's degree in special ed.

**MP:** *Really?*

**Benjamin:** Yes, so she could understand me.

**MP:** *Let's start out, then, with Arthur the child.*

**Benjamin:** As a child I was hyperactive, and I think in today's language, they would say such a person has ADHD, attention deficit hyperactivity disorder. I love attention, and I was a tough kid to handle. I was kicked out of several nursery schools.

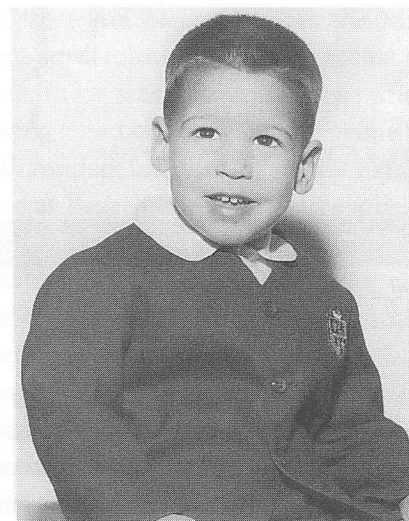


Figure 7.1 Rambunctious Art was kicked out of his first nursery school.

**MP:** *You were literally kicked out?*

**Benjamin:** Yes, just because it would be nap time, and all the kids would dutifully lie on their blankets, and I would be running around the room. I think looking back, a lot of the problem may have stemmed from the fact that I was bored with many things.

I understood things the first time they were explained, and by the time something was taught or done the fourth or fifth time, I'd rather get silly than pay attention. There was a lot of that, but there was also something medical about it. Back then, the treatment was to put you on Valium, which I took for ten years, until I was in eighth grade.

**MP:** *But it did calm you down.*

**Benjamin:** Yes, I think so. My parents thought there was a big difference, but the dosage was being reduced gradually. I

don't know to what extent the effects of the hyperactivity are still there. My wife says I'm certainly easily distracted and to some extent have a short attention span. People find it interesting when they see one of my shows and are surprised to know that I am very absent-minded. I was late for this interview, partly because I got lost. What I'm pretty good at is concentrating in bursts, which makes games like chess and backgammon good games for me and allows me to mentally multiply five-digit numbers. That kind of thing I can do, but sustained attention is another matter. For instance, if that television were on, even with the sound off, I'd be constantly looking over there.

**MP:** *You must be a serious channel surfer then.*

**Benjamin:** Well, no. It irritates me when people channel surf. My preference is to keep the TV off, but I tend to get sucked in. As a child, I wanted a lot of attention, and I would do lots of things to get it.

**MP:** *What, for example?*

**Benjamin:** Finding magic as a hobby provided something to show off. I would sing. I tried dancing. I became very good at different games. I learned to calculate quickly—things that would impress people. I used to memorize things. When I was five years old, I memorized the states in alphabetical order and their capitals. I learned the presidents in order. Later in life, I learned the Tom Lehrer songs and memorized the elements.

**MP:** *Clearly your parents were giving you lots of attention. After all you were their first-born. The first child usually gets more attention.*

**Benjamin:** Actually, in my first four or five years of life, I spent a lot of time in children's hospitals, to diagnose and treat my hyperactivity.

**MP:** *For what length of time? Days at a time? Weeks?*

**Benjamin:** Weeks.

**MP:** *So you were seriously hyperactive.*

**Benjamin:** Yes. I can remember being in one hospital that was especially traumatic. They put a net over my bed because I would crawl out at night and walk down the halls. I hated that.

**MP:** *You felt as if you were trapped.*

**Benjamin:** Who would want to sleep in a cage, which essentially it was. But for all my hyperactivity, there was no maliciousness.

**MP:** *You weren't destructive.*

**Benjamin:** No, I was a nice gentle kid, probably just overly curious.

**MP:** *Did you have the other usual interests in terms of playing in sports?*

**Benjamin:** Oh, yes. I liked sports. I wasn't very good because the medication did slow me down. I do think that it made me less coordinated. When I got off the medication, I went out for the track team. My parents



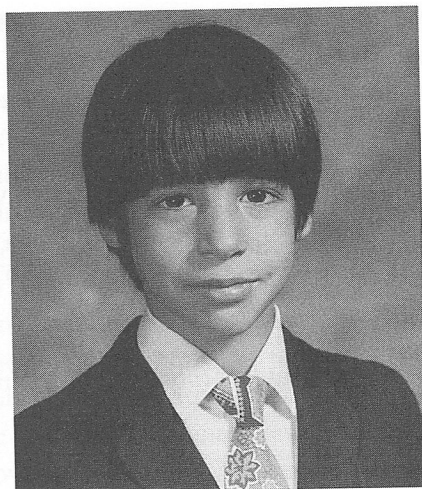


Figure 7.2 Mr. Benjamin, dressed for success.

exposed me to a lot of different activities and let me go in the directions I had aptitude for and enjoyed the most. There was no push to make me a mathematician or my brother Stephen an actor or whatever.

**MP:** *Is he an actor?*

**Benjamin:** He was for a time. Now he's a teacher. But what the three of us have in common is a profound love for the theater and being on stage generally. In fact, last night my wife Deena and I were at the Shaw Festival. We went down to Niagara on the Lake and saw *Major Barbara*. It was wonderful. From the time we were about eight years old or more, my siblings and I were on stage, performing in the community theater.

**MP:** *Did your mother and father also perform?*

## The Great Benjamini

**Benjamin:** My father was very active in community theater. He was an accountant by day and an actor and director by night. I think he wished that he had taken a shot at some form of career in theater, either as an actor or as a theatrical manager. I think he passed that on to us. I think that's why my brother tried for many years to make it in the entertainment industry and gave it a very good shot. He's very, very talented, but he came back home to Cleveland where he's still one of the stars of the community theater scene as an actor and director. He followed somewhat in Mom's footsteps and got his master's in special education.

My sister Mara does public relations advertising, and she also is still very active in theater in Columbus, Ohio. She has a trained voice. My mother never did anything on the stage, but she was very supportive of all of us in that regard. From a very early age we had not only no fear but an enjoyment of being in front of groups of people, and that has helped me immensely in my teaching.

I did my magic as a hobby in high school. I did magic shows throughout the East Side of Cleveland. My stage name was The Great Benjamini.

**MP:** *The Great Benjamini! Was this your father's suggestion?*

**Benjamin:** I don't know who suggested the name. He printed a business card for me once. I think we had used it as sort of a joke. I actually did shows, birthday parties, etc. I didn't have much in the way of expensive





Figure 7.3 As a high school student, “The Great Benjamini” performed magic.

equipment. I just did what I could to make the kids laugh—fall on my face, and slapstick. That’s what the kids like, and I just did things that involved a lot of audience participation. I wasn’t just up there doing a trick. The real trick was getting the audience involved.

**MP:** *You’re still doing that.*

**Benjamin:** Yes, that’s what I’m still doing as a teacher.

**MP:** *And that really works.*

**Benjamin:** Yes, and as a performer, too. You don’t want people to hear just monologues. Those are rarely great. Dialogues,

conversations, active involvement, hands-on—at least minds-on—involvement, and whether I’m teaching or performing, I like to do that. So I think I learned a lot about teaching by entertaining six-year-olds.

**MP:** *From kids?*

**Benjamin:** Yes, because if you don’t involve them, they’ll tune out. So when I started getting some teaching experience, while I was an undergraduate at Carnegie Mellon, I tried to involve the students.

**MP:** *As an undergraduate?*

**Benjamin:** Yeah. I was a teaching assistant (TA) for an economics class, for a professor who felt that the undergraduate students from his class could do a better job as TA than graduate students who hadn’t had his class. I also did some TA work for the statistics department, which was my area of concentration.

**MP:** *Was that your undergraduate major?*

**Benjamin:** Yes, I got a BS in applied math, concentrating on statistics at Carnegie Mellon. I did not have that much pure mathematics exposure. I had to learn more pure mathematics when I started graduate school in operations research at Cornell. I consider myself on the border between pure and applied math. Discrete mathematics is my love; both applications and theory are very attractive to me. The types of courses I teach at Harvey Mudd are calculus, discrete math, linear algebra, abstract algebra, number theory, operations research, and game

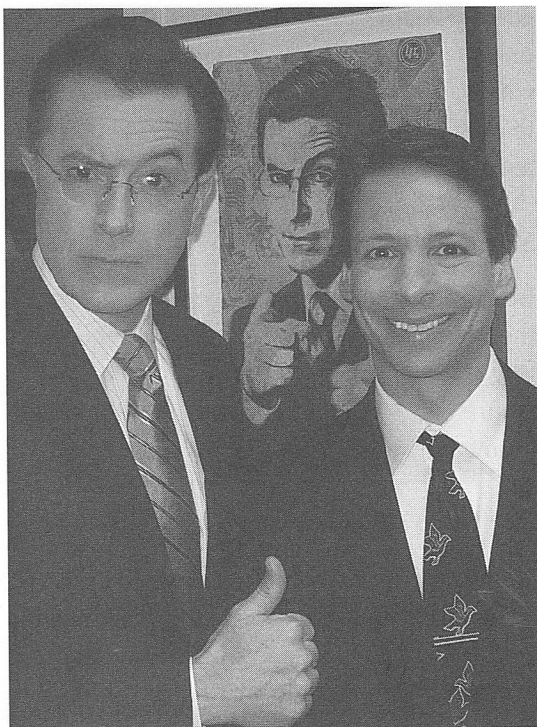


Figure 7.4 Benjamin appeared on the Colbert Report in January 2010.

theory. It's a broad spectrum, not overly pure and not classically applied.

**MP:** *I want to get back again to your early involvement with magic. You said that kids appreciated seeing you do rather standard tricks. And you became very sensitive to what works with kids and what doesn't.*

**Benjamin:** When I started doing shows, I didn't have much in the way of fancy equipment so I was really entertaining them with myself, my own personality, just monkey business, having fun, making intentional mistakes. Kids love watching that sort of thing.

**MP:** *The other night after your performance at the opening banquet several people came up to talk with you, but those who seemed to hang around the longest were kids. They seemed to be intensely interested in what you were doing. Let's trace the origins of your interest in magic.*

## Early Interest in Magic

**Benjamin:** As a kid, I think I did lots of things just to show off. I think by about seventh or eighth grade, I was still doing magic as one of my hobbies, and nobody else in my school was. So that did get me a lot of attention.

That gave me an incentive. I realized that I was somewhat special in that regard. I really worked hard to do more of it. The exact same things happened with my mental calculations training. I realized that I could do this, and we weren't going to learn this in school. I guess I just had a personality that worked well with magic, whether it was for six-year-olds or my peers. I would learn various card tricks and coin tricks, and people were impressed. That was a good thing for a couple of years. In fact, it really helped socialize me. I was a studious little kid.

Doing magic tricks became such a social boom for me that it eventually became a crutch, to the extent that I wouldn't go anywhere without a deck of cards in my pocket. I wouldn't go to the corner drugstore without something in my pocket, just in case the pharmacist wanted to see a trick.

MP: Wow!

**Benjamin:** I think it started as something like, "Hey, this guy is interesting." Then it became "Make him stop!" but I was somewhat oblivious to that. I'd think, "Hmm, I'm not impressing people the way I used to. Maybe I'll have to learn more or get better at this or that." As a consequence, I learned a lot of interesting skills and impressive talents, but all the while, maybe I was hurting myself socially. It was sort of "enough already, enough." I don't try so hard to impress anymore.

And that's why it was good when I went to college, Carnegie Mellon, where nobody knew me. I got off to a fresh start. I didn't want people to know me for my magic.

MP: *You concealed your magic?*

**Benjamin:** Pretty much.

MP: *Can you recall why you made that decision before going to Carnegie Mellon?*

**Benjamin:** I wanted to make friends, and I wanted a fresh start. But in the spring of my first year of college, there was a magicians' convention in town. That wasn't unusual, but the headliner was Harry Lorayne, whom I really wanted to meet. Lorayne was an outstanding magician and had written some of the best books on card magic ever. I dutifully studied from them in high school. He was also famous as a memory expert. He had written a couple of books on how to improve your memory, including one called *The Memory Book*, that he co-wrote with Jerry Lucas, which was a best seller.

My mother in her special education studies showed me the book, and I absorbed everything in it. I still incorporate some of these techniques when I'm doing large mental calculations. You have heard me turning numbers into words; that's using a mnemonic code system that I learned from his book. It's called the major system, and it has been in use in the English language since at least the 1870s.

As a high school student, I taught a one-week course on how to improve your memory using the techniques that I learned from Lorayne's book. Apparently teaching was something I always enjoyed doing.

MP: *Teaching for me is performing to some extent.*

**Benjamin:** Yes. By then, of course, I had been in front of an audience for a long time. When I really started teaching, I had the same expectations that a performer would have. You want to keep your audience alive. You even want to keep them laughing to some extent, if you want them engaged in what you're doing.

You don't want them falling asleep on you (unless you are a hypnotist). So I worked hard at the teaching to maintain the same kind of enthusiasm.

MP: *It's very important to you?*

**Benjamin:** Absolutely! If I come out of a lecture, I can tell when it fell flat. I will go back and analyze the lecture and think of what would be a better way to do it, because if they don't take things away from your lecture, you can be replaced by a well-written



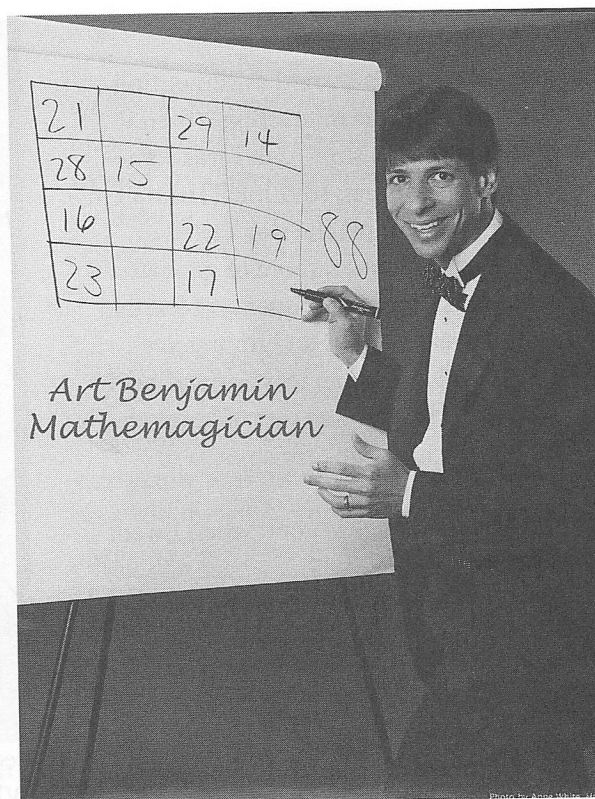
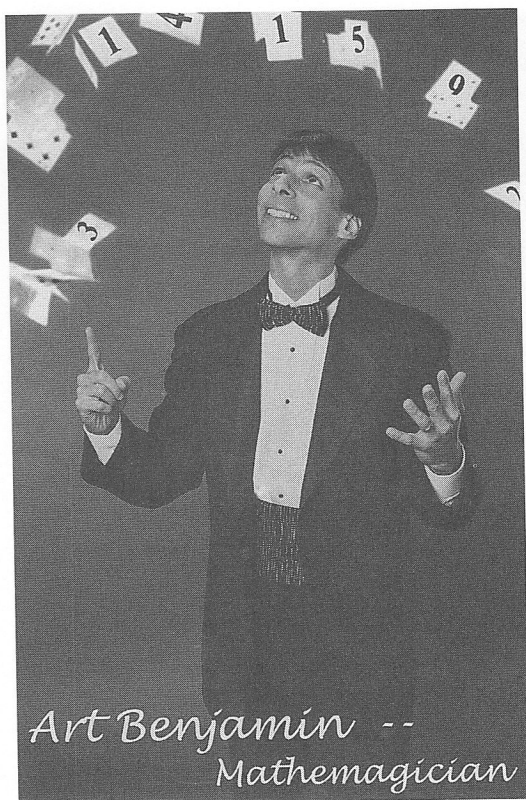


Figure 7.5 Mathemagician Benjamin continues to perform amazing feats of mental calculation on television and in many other settings.

set of notes. What's the point of being up there if students are not going to get something out of classes? Incidentally, students are rational people. Generally, they know they don't have to come to class. If you're not going to give them good use of their time, then they won't show up.

By the way, just on my way over here, I finished reading the MAA book, *Lion Hunting and Other Mathematical Pursuits* by Ralph Boas, and his chapter on teaching resonated with me fully. Boas was a guy who understood teaching!

**MP:** *Let's get back to the magic convention. You got a lot of attention there.*

**Benjamin:** Yes. I demonstrated some of my mental calculations for some of the magicians at this convention, and the reaction was bigger than I expected. In particular, there were some guys who were opening up a magic nightclub in downtown Pittsburgh called the Dove and Rabbit, which has long since closed. They asked if I would be willing to perform. And I thought, why not? It was separate from my college life. So nobody knew that I would take buses to downtown to perform.

MP: *You were really keeping this under wraps then?*

Benjamin: Yes. It was in the spring of my freshman year when I performed there every two or three weeks and would do two or three shows a night. While there, I really developed my stage routine. It's the same show that I perform for general audiences now at the Magic Castle in Los Angeles. I met other magicians who also were performing there. They got me involved in the Pittsburgh magic community, and they were an extremely supportive group of magicians, including another famous magician named Paul Gertner. He took me under his wing. He said, "You've got something special here. You've got something that other magicians work all their lives trying to get." Then I attended other national magic conventions in Evansville, Indiana, and Colon, Michigan. Pittsburgh was hosting the International Brotherhood of Magicians meeting the following year, and I was one of the opening-night performers. That got me a lot of exposure in the magic community.

## Magic or Mathematics?

MP: *How big is the magic community?*

Benjamin: The national meeting of the IBM (International Brotherhood of Magicians) had a thousand or so magicians in attendance.

MP: *That's a lot!*

Benjamin: My act got written up in some magic magazines. I was in college, and I was

even giving thought to becoming a professional magician.

MP: *And giving up mathematics?*

Benjamin: I hadn't thought seriously of dropping out of college, but I did think about magic as a career when I graduated. Anyway, the Dove and Rabbit gave me a chance to repeat the same kind of show and refine it. That was good. The Pittsburgh magicians, notably Paul Gertner, were very supportive. I did not get that kind of support in Cleveland. I performed at the Pittsburgh magicians meeting the following year. I was introduced by a guy named James Randi. And that was a turning point for me. He's an amazing magician and known as a challenger of paranormal claims—he has been called Psychic Enemy No. 1. He won the McArthur Award in 1986.

He made a rare appearance at this Pittsburgh meeting and somebody said, "Hey, Randi, have you ever seen Benjamin? You've got to see him." So, I go and show him my stuff, and his first instinct, of course, was to ask, "How is he doing this?" There are a number of ways that this could possibly be duplicated. I could be using a fake calculator, which has certain answers preprogrammed. I could have an assistant somewhere, who is communicating the answer to me. The first thing he did was to give me a few problems that combine magic and logical thinking. I was able to answer them, which impressed him. Then I started explaining my methods to him, and he concluded that I was for real. And he got very excited because his reputation had been one of a somewhat negative person. People thought of him as someone

who went around saying, “you can’t, you can’t, you can’t,” and here’s somebody who can. This is the sort of phenomenon that we should be focusing our attention on, not people who claim to do things that break all the rules of math and science. These are the positive things that we should be giving our attention to, not astrology and psychics and all that stuff.

So he took me on the road. He said, “I’ve got people I want you to meet. I want to introduce you to Scot Morris of *Omni* magazine. I’m friends with Leon Jaroff who is the founding managing editor of *Discover* magazine.” The *Discover* article about me was a direct result of Randi bringing me up to Jaroff’s office. That’s Randi. He got me a show at a public library just so that there could be a photographer there to take pictures, and the funny thing is that this picture has made its way into a mainstream textbook on cognitive psychology. So that got me a certain amount of attention. I was mentioned in *Omni* magazine as well, and that was where the early exposure came from. Randi and I have remained close friends. He has been very supportive. He took me with him to Japan in 1989, where we did a television special together.

Between Randi and the magicians in Pittsburgh, I gained new confidence in my magic, but the third part of the equation came in my freshman year of college. I was taking a course in cognitive psychology, which I was always interested in. The whole business about how we think and memorize is fascinating. I was very excited to be taking that course. The professor, Marcel Just, was lecturing on human calculators one day

and what common properties they had and what these individuals could do. He himself had learned a few tricks that are designed to look as if you have mental talent. He said, “Now, I know we have a lot of science and math students and engineering students in this classroom. Does anybody here know any tricks?”

## Mental Calculation

**MP:** *You just happened to have a few tricks to demonstrate.*

**Benjamin:** I really shouldn’t have done it. There I was trying to keep things under wraps, but, when somebody said that, I had to say yes. So I got up and took over the class for the next ten minutes doing my magic act from the Dove and Rabbit. That made a big impression on the class, and on the professor. Afterwards, the professor told me that as part of most undergraduate psychology classes, students are required to participate in a handful of experiments for their professors and graduate students, who are doing research.

I asked him whether there were any professors who would like to talk to me about my mental calculating instead of just doing some random kinds of experiments. He said, “I think I know someone who would be interested.” So he introduced me to Dr. William G. Chase, who was an expert in skilled memory and was working with a student who had expanded his memory considerably. The student had expanded his recall of digits from groups of eight digits up to





Figure 7.6 Benjamin outperforms many calculators—even very big calculators.

seventy digits. Dr. Chase was interested in my use of mnemonics and other techniques. I did a few sessions with him. I became something of a research assistant and research subject for the next few years. In the process I acquired a better understanding about what I was doing and my capabilities and my limitations.

When I started college, I did not think that multiplying distinct three-digit numbers was something I could ever do in my head. I could square them, but multiplying different ones seemed beyond me. By the time I graduated from college, I was multiplying different six-digit numbers together without having to see the problem.

The problem would have to be called out to me slowly so that I could create mnemonics to remember the twelve digits of the problem, and somewhat laboriously I would be able to get the answer correct over half of the time. Nowadays in my finale, I will either square or multiply two five-digit numbers.

**MP:** *But you can do six?*

**Benjamin:** I can, but I've never publicly performed them because the error probability is too high. Because the college was interested in what I was doing, that got me onto the *Today Show*.

## Arthur the Lyricist

**MP:** *That's pretty heady.*

**Benjamin:** Yes, it was. But by this time I think I had established enough friends and

other activities that people didn't just think of me as Arthur the Magician. But the thing that I spent most of my time on during my freshman year was writing the lyrics for the big spring musical. Carnegie Mellon had an organization called Scotch and Soda, which had a long tradition of producing an original musical each year. Usually that musical was written or proposed the year before, so that people had a chance to do the writing at least a year in advance. Apparently, that year they didn't have any submissions that were ready to go. So they had the authors present submissions, and one of the authors, Scott McGregor, was still looking for a lyricist and a composer.

I always wanted to write lyrics. If you had asked me in high school, what I wanted to be when I grew up, I might have said a Broadway lyricist. At Carnegie Mellon, I wrote a musical called *Kijé*, based on an old Russian folk tale, that prompted the popular Lieutenant Kijé Suite by Prokofiev. A graduate student had written a "book" for it. A talented freshman named Arthur Darrell Turner wrote the music. It wasn't until a few months later that it was actually selected, but we started writing right away. I was having a lot of fun. Turner could write music, and I could write lyrics. We fought like crazy, but it was a dream come true. The musical was performed on two weekends, with six performances. It was the biggest money-maker that Scotch and Soda ever had. It was a big hit. I had delusions of Broadway.

**MP:** *How did you find time for classes?*

**Benjamin:** I did okay. I got As in my math and Bs in my other courses.

MP: *But you were taking the show seriously.*

Benjamin: All my spare time was going into that musical, and I was performing at this nightclub. And I had classes.

MP: *So your life was pretty full?*

Benjamin: I've always been involved in lots of things. Even now, I still have my hand in a lot of different activities.

MP: *Such as poetry?*

Benjamin: I always enjoyed the art of parody, and in the ninth grade I had to write something in Edgar Allen Poe style. The typical thing would be to take a nursery rhyme and write it as if Edgar Allen Poe had done it, but I had decided that since I had always enjoyed "The Raven," I would do something different. So I wrote "The Raisin" (see p. 120).

MP: *Very good.*

Benjamin: That was one of the best things I've written in my life. I think that's how I got the job writing lyrics for the *Kijé*.

## The Whole Problem Is Memory

MP: *On the general subject of memory, during your years at Carnegie Mellon, your memory was enhanced.*

Benjamin: Right. I participated in experiments for Professor Chase—I would do calculations, and I would think out loud how it worked. In some experiments he just timed

me doing problems. In others he said, "Okay, think out loud as you're doing this" while somebody was transcribing the protocol. Then he gave me a problem that was sufficiently large that I had to slow down.

Some of the processes had gotten so quick by that time, for example, that it was difficult to explain that 56 times 7 is 392. Was it memorized? Was it something I was actually doing? The processes were so fast that they were hard to articulate. But when I was doing very large problems, everything was slowed down, including the simple steps. So that 7 times 50 is 350, plus 42, is 392. So now I know quite clearly what I'm doing. Also, the use of mnemonics, being able to take three-digit numbers and replace them with a single word, expanded my calculating potential because multiplying five-digit numbers and six-digit numbers is not a hard thing to do on paper. It's tedious, but everyone can do it. The whole problem is memory. Most of us can hold only eight plus or minus two digits in our working memory. My working memory was pretty average, and yet, I was able to square four-digit numbers. How was I doing that with only a normal-sized working memory? Chase outlined what I was doing and saw that I never held on to numbers for long. Most numbers get utilized as soon as I computed them.

MP: *In the process of doing this rapid mental arithmetic, properties of numbers were becoming very interesting to you as well.*

Benjamin: Right. I've always been fascinated by numbers. As a kid, I enjoyed casting out nines, and I would check my answers by doing it mod 9 and seeing if it matched up.



## *The Raisin* by Arthur Benjamin

*Once upon a day quite cheery,  
far from lusterless Lake Erie,  
on a beach somewhere southwest of the  
City of Singapore,  
'twas a grape that had a notion:  
If he'd rest close to the ocean,  
he would tan without his lotion,  
just by resting near the shore,  
and he'd meet up with adventures that  
he'd never dreamt before,  
all of this and much, much more.*

*All of this had happened one day.  
It was on a sunny Monday  
as he soaked up every sunray going into  
every pore.  
Not a gust of wind was breezing,  
and the warmth was, oh, so easing  
and so beautifully pleasing.  
He was filled with joy galore.  
"Oh, how I wish," he said, "that I could  
stay here on the shore,  
remaining here forever more";*

*Well, that grape who had that notion,  
slowly motioned to the ocean.  
He then discovered something that filled  
him with much gore,  
for he saw by his reflection  
nature made a small correction.  
He was further from perfection,  
meaning worse off than before.  
He had changed into a raisin while he  
rested on the shore,  
and that he'd be, forever more.*

*Well, one day a man in yellow  
gazed on at that little fellow  
and looked at him and other raisins  
resting on the shore,  
for you see his occupation  
was to go to this location,  
meaning that it was his station,  
to pick raisins off the shore.  
So he knelt down towards that raisin on  
the beach near Singapore,  
picked him up with many more.*

*All of them were squished together  
in a packet made of leather  
in a factory southwest of the city,  
Singapore,  
and that raisin was a snooper  
and he saw a spacious super  
massive mammoth monstrous scooper,  
scooping raisins by the score,  
packaged them in Raisin Bran and sold  
them to the store,  
scooped him up with many more.*

*And that raisin now is well aware  
he's in a bowl in Delaware  
ready to be eaten by a child not yet four,  
and the milk was slowly dropping  
and the raisin heard it plopping,  
then the raisin heard it stopping  
for the milk had ceased to pour.  
"Au revoir, sweet life," he cried, "life  
which I truly do adore!"  
Quoth the raisin Nevermore.*

**Benjamin:** Give me a four-digit number to square, and I'll outline my method.

**MP:** 6,743.

**Benjamin:** Okay. 6-7-4-3. The first thing I do is to multiply 7,000 and 6,486. Where do these numbers come from? I doubled 6,743 to get 13,486, which separates into 7,000 and 6,486. I do 7,000 times 6,486 in two chunks: 7 times 6,400 is 44,800, plus  $(7 \times 86 =) 602$  is 45,402. So that's 45,402,000. At this point I will say "45 million" to get it out of my memory and into the audience's memory.

**MP:** *I observed that the other night. Go ahead.*

**Benjamin:** Now I need to store the number 402. Using the phonetic code—4 has the R sound, 0 has the S or Z sound, and 2 has the N sound, so by inserting vowel sounds, 402 becomes the word "raisin." It could be "reason", or "rosin," but "raisin" is perfect. So I say "raisin" to myself once or twice, and now I square 257 (the distance between 6,743 and 7,000) by the same method. I do 300 times 214, which is 64,200, plus the square of 43, which I have memorized (1,849), to get 66,049.

I'll maybe turn 049 into "syrup" (since 0 = S, 4 = R, 9 = P or B) for future reference. I'll say "syrup" a few times then take 66,049, add that to "raisin" (which I translate back to 402,000), and I get 468,049.

What I'm doing algebraically is  $A^2 = (A + d)(A - d) + d^2$ . I figured this out experimentally in eighth grade.

**MP:** *In one of the articles that you provided, you talk about, as a young kid, having a Velcro board with the numbers one to ten on it.*

**Benjamin:** I would think about it . . . multiply those numbers, and I would get ten in so many different ways, I could build up some of the mental muscles. I got to be good at multiplying by one-digit numbers. I was intrigued by my own home address which was 1260 Belrose Road, and 1-2-6-0 is a highly composite number. As a matter of fact, it's half of 2,520 which is the least common multiple of the numbers one through ten. I've always liked playing with numbers.

**MP:** *But not enough to drive you in the direction of number theory?*

**Benjamin:** If I had been exposed to it earlier, I'm sure I would have loved it. If I had seen a book like *Power Play*, by Ed Barbeau, I would have eaten that stuff up, and it would have sent me more in that direction. Other than

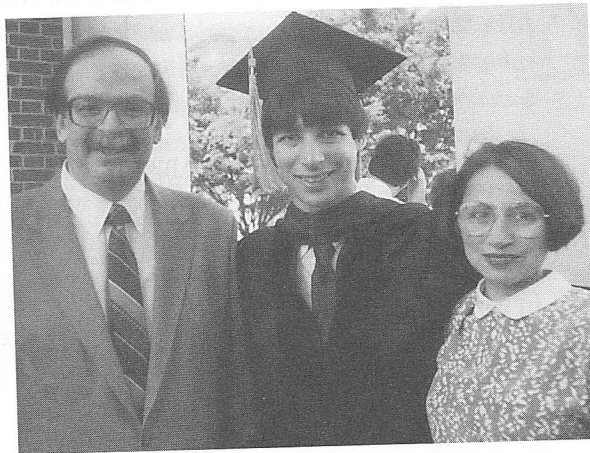


Figure 7.7 The newly minted Dr. Benjamin with his parents, Larry and Lenore Benjamin, on the occasion of his graduation from The Johns Hopkins University in 1989.

the fact that I liked numbers, I just didn't have much exposure to pure mathematics.

## Mathematics and Games at Carnegie Mellon

*MP: But you were likely to get lots of exposure to pure mathematics at Carnegie Mellon.*

**Benjamin:** Yes, I went to Carnegie Mellon to study mathematics, but another side of me, a very big side of me, was interested in games, backgammon and chess in particular. I was captain of my chess team and played seriously. I studied chess from the seventh grade through twelfth grade. I gave that up when I entered college as well, because I realized that if I were going to go to the next level, that would require a bigger investment of time than I was willing to make. So I put chess off on the side; I could get better at backgammon much more quickly.

*MP: So you got to be very good at backgammon. Do you still participate in backgammon tournaments?*

**Benjamin:** In fact, I won the American Backgammon Tour in 1997, and, for a while, I had accumulated more points than anyone in the competition's history. So my interest in games has always been there, and that got me interested in probability, operations research, and game theory. I still do a lot of work in that area.

*MP: Let's skip for a minute to your scientific publications. I think some patterns are well established already. Your mode of operation*

*with students and teaching is likely pretty well-formed. I am impressed very much that many of these papers were written with students. You might explain that. How does that happen?*

**Benjamin:** Every year, I take one or two senior math majors who want to do a senior thesis with me, and I either give them a problem or a problem area, and we work on them. Often the topic is something that is interesting enough that we send it off for publication.

*MP: That's not easy to accomplish.*

**Benjamin:** I won't take all the credit. Students at Harvey Mudd College are very good. The problems are my own, and I would work with them, but the students deserve most of the credit. I just try to identify the things that I liked as an undergraduate and what would appeal to me and what still appeals to me. I get a lot of inspiration from the MAA journals. I think they are a good source of problems and ideas.

## "I Want to Bring Math to the Masses"

*MP: While at Carnegie Mellon, you must have been wondering about what you were going to do with your life.*

**Benjamin:** Yes.

*MP: The decision was made at some point.*

**Benjamin:** The people I looked to for inspiration were guys like Martin Gardner and Carl Sagan. I wanted to be someone who



would bring math to the masses, and I could use my entertaining talents to get more people excited about math.

On top of that, I had some teaching experience as an undergraduate. I thought teaching was fun, and it was just like performing except it was better because your repertoire changed every lecture. I even sensed then that if I were a full-time performer, it would get a little bit repetitive after a while.

*MP: Doing the same show again and again.*

**Benjamin:** I love applause, no question about that, but eventually you start saying, “Yes, I can do this, but what else?” I wanted something more substantial, something more intellectually satisfying. I also felt that if I were going to have any credentials for popularizing mathematics, having a PhD would be essential.

*MP: It doesn't hurt to have the doctorate.*

**Benjamin:** It seemed like the right path, but if you had spoken to me at the beginning of my senior year of college, I thought I was going to be working at Bell Laboratories in Holmdel, New Jersey, as an operations researcher, and they would pay me to earn a master's degree in operations research. The Bell people interviewed me and wanted me, but that year they had a divestiture, and they weren't hiring undergraduates. So I also interviewed at the National Security Agency (NSA).

*MP: Brent Morris told me about that.*

**Benjamin:** I met Brent at NSA. Everyone I met while interviewing there said, “You've

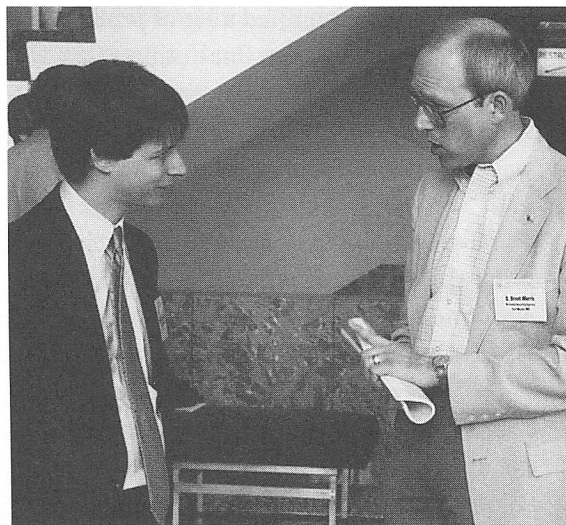


Figure 7.8 Benjamin with Brent Morris, another mathematician who practices magic, at the seventy-fifth anniversary celebration of the MAA in Columbus, Ohio, 1990.

got to meet Brent Morris.” On my last day of interviewing, I met Brent, and we had a wonderful hour jam session where he showed me his faro shuffle stuff, and I showed him my mental calculation stuff. We have stayed in touch over the years. By the time I heard from NSA, I had graduated from Carnegie Mellon a semester early and had entered the doctoral program at the department of operations research at Cornell. As it turned out, I worked at NSA for a little bit near the end of grad school.

At Cornell I really got a taste of teaching. I was a TA for a stochastic processes class, and that was a job I loved. Unfortunately, because I had graduated a little early, I started in the spring. I was out of sync with the other grad students. I also became painfully aware of the lack of pure mathematics

in my background. I had a lot of probability and statistics classes but nothing that required any deep mathematics. So I took some of those courses at Cornell and did well in them, but it was just so much work. I felt as if I was a step behind everyone else who had more pure math in their background. I took my first theoretical analysis class and linear algebra class at Cornell, which I enjoyed, but I decided to start over again. I spent two semesters at Cornell, then a semester back home in Cleveland that spring. While there, I worked as a grader at John Carroll University and came to appreciate what it would be like to teach at a good four-year college. The following fall, I started fresh at Johns Hopkins in the department of mathematical sciences. After that, it was smooth sailing.

*MP: How did you end up choosing Johns Hopkins?*

**Benjamin:** I was so unsure of what area I wanted, I considered some areas of operations research, discrete mathematics, maybe integer programming, that kind of thing. I was starting to feel that it was discrete math that I really liked, but I didn't think I wanted to delve into a pure mathematics program and have to take graduate courses in topology, complex analysis, and geometry. I wasn't really trained for that. I picked up a lot of that stuff along the way on my own.

Hopkins was one of the few applied math departments that was not oriented along classical applied math lines. It did almost all the applied mathematical areas except

for differential equations and mathematical physics. It was basically operations research, statistics, and combinatorics. It's a smallish department, but it was perfect for me. I got attention from very dedicated caring faculty. They cared about teaching, too, much more so than most universities. Alan Goldman was my advisor from day one. We had a great relationship. Ed Scheinerman was a fresh PhD and had just started on the faculty at Hopkins the year I started as a graduate student. We formed a friendship that has remained strong to this day.

*MP: You're not that far apart in age.*

**Benjamin:** No, about five years or so. I felt my teaching talent was very much enhanced by watching Scheinerman, one of the best teachers around. The department chair, John Wierman, took good care of me. My first semester there, I did well. They nominated me for an NSF Graduate Fellowship, and I got it. When I interviewed at Johns Hopkins, I was sent around to meet various professors, including Alan Goldman, who is extraordinarily well read and interested in everything. There are tons of library books on his bookshelf. If he ever returns them to the library, they will need to build an extra bookshelf or perhaps a room. When I first met Goldman, he said, "Oh, Art, I understand you're interested in mental mathematics. Are you familiar with this book?" And he pulls out a book called *The Great Mental Calculators* by Steven B. Smith. I said, "Well, yes, I'm Chapter 39." He didn't flinch. He said, "Aha, then you're obviously familiar with it," and he put it away.

MP: *Great story.*

**Benjamin:** Goldman would try to understand each student and find a problem that fit. He really looked for problems, but in many different areas, and I think I've absorbed a little bit of that mindset myself in how I treat students.

My research interests are not as well defined as those of many others. My publications are all over the place. I find interesting problems, and I just like to work on them. Lately I've had a lot of fun working with Jennifer Quinn, finding combinatorial proofs of Fibonacci number identities.

The problem in my thesis concerned games or maneuvering problems where you want to get objects from one place to another. I proved that if your rules for movement satisfy some simple conditions, then your optimal strategy would be to spend most of your time repeating a few basic patterns of movement. My thesis was called Turnpike Structures for Optimal Maneuvers. It was published in *Operations Research* and was awarded the Nicholson Prize for Best Student Paper from the Operations Research Society of America, which just flabbergasted me.

### "A School That Valued Teaching—That's Where I Wanted to Be"

**Benjamin:** Interestingly enough, when I went on the job market, there was more interest from the big research schools for me than where I really wanted to be—at a school

that valued teaching. I got one offer from a big university. The faculty consisted of quantitative modelers, and my thesis was very interesting to them. While I was interviewing at the school I met a young professor, and I noticed on his bookshelf a trophy that the university gave for outstanding teaching. I said, "Hey, that's really great." And he said, "Yeah, that and 50 cents will get you a cup of coffee around here." I said "Would you trade that in for a publication?" He said, "In a heartbeat."

He said in terms of what it was worth as a faculty member there, it would be substantially more beneficial to have one more publication than that teaching award. I just didn't feel that I could be happy in a place where one of my strong suits was not valued. The dean told me, "To make it here, you're going to have to spend a couple of days a week with your door closed where you're in your office reading and writing and grant-getting." To me that sounded like work.

MP: *A job.*

**Benjamin:** It sounded like a job. That's not what I got a PhD for. Whereas Harvey Mudd sounded like a lot of fun. To be sure, I put a ton of hours into Harvey Mudd. But they are fun hours. And my door is open, and students come by. I can be talking to students several hours a day. My chairman and dean can walk by my office, and they will think that I'm doing a great job. They can look at all the interaction I'm having. At many other places, that would not be considered a very smart use of my time.



**MP:** *So you found a place where you wanted to be.*

**Benjamin:** Absolutely. I'm very happy there. The department is rebuilding. HMC is a relatively new college. The school was established in the late 1950s, and almost all the faculty were hired in the 1960s, so we have seen a recent wave of retirements. At one point there was a twenty-five-year age gap between me and the next oldest faculty member. When I went up for tenure, I was the first person to do so in twenty years in my department.

**MP:** *Wow!*

**Benjamin:** So now it's a brand new department.

**MP:** *A young department.*

**Benjamin:** Three years ago, the median age in my department was 63. Now it's 36.

I am at the median, and I may be above it. And in a few years, I may be the only person here who was hired when I started in 1989. It's exciting, and with my amazing department chair, Michael Moody, we're hiring great new faculty. Our students are very satisfied. About 40 percent of our students go on to get PhDs. In the last ten years, we've managed to get a third-place team finish on the Putnam. Last year we were ninth. Last year, we had five student publications in refereed journals.

## Marriage, Children, and the Future

**MP:** *That's great. Now there's another dimension or two of your life here—your wife, Deena.*

**Benjamin:** We met at Johns Hopkins when I was a graduate student. She was an undergraduate. We got to be very close friends our last year at school. Then we went our separate ways. Immediately thereafter, I went off to Harvey Mudd, and she went off to the University of North Carolina in their operations research program. She was there for two years and got her master's. When she was looking for a job, I suggested that she consider California. A year later, we were engaged, and the following year we were married. She started working at the RAND Corporation and was there for five years. She now does computer contract work, technical writing, and soon motherhood.

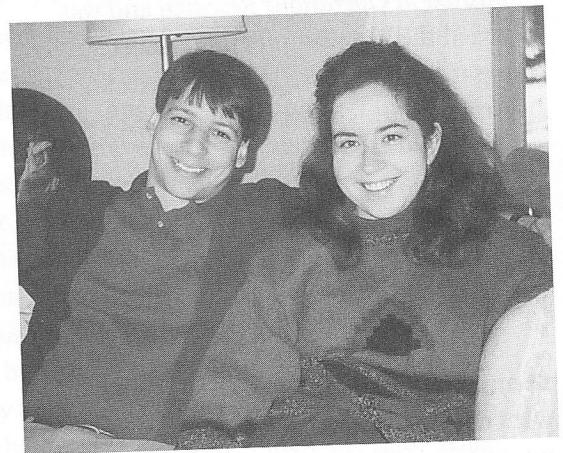


Figure 7.9 Art and Deena Benjamin relaxing at home.

MP: *What do you hope for your child? The gene pool is sort of stacked for this kid.*

Benjamin: Well, our plan is to do what my parents did, which is to expose the child to everything and let him or her find his or her way and find things that are enjoyable. The thing that bonds my brother, my sister, and me together, as I said before, is our love for theater and performance. That has helped all of us in our lives, but no person should go on the stage if he doesn't want to go. I'll certainly present mathematics in the best light, but I'm not going to force it down their throats. I'm not going to try to turn our children into professional mathematicians.

MP: *For many faculty, the classroom is their stage. It sounds to me as if it is an important stage for you, too.*

Benjamin: Oh, yes. I think every lecture should have a little bit of relevance or elegance because that's what students respond to.

MP: *But you have every intention of continuing your magic and your mentalist activities?*

Benjamin: It's a part of me. Although I fully expect that with the arrival of a child my life will be altered significantly.

MP: *At least for a few years.*

Benjamin: Yes, I'm going to spend a lot of time with the baby. Another long-term goal is seeing Harvey Mudd College and the mathematics department there blossoming and reaching its full potential. I think the Harvey Mudd department has a good

balanced view of teaching and research, and the students really benefit from that.

MP: *Would you ever want to be chair?*

Benjamin: No, no. I do not want to be a chair, partly because I know myself well enough to feel that that would not be my strongest suit. There are aspects of being a chair that play into my weaknesses. I've had experiences in other organizations, and I know what I'm good at. I'm a good person to work with a chair and be put in charge of certain types of initiatives. And I'm very content with what I'm doing.

MP: *What other goals do you have?*

Benjamin: I have a goal of bringing mathematics to the masses. A few years ago I did develop educational material on doing mental math. I created a book and videotape and audiotapes, which were mass-marketed for a time with an infomercial. That was sort of a risky thing to do, especially around the time I was going up for tenure. That has worked out fine. It was based on the book, and it's been great. Lots of people have learned how to do math in their head through these programs. That was partly a dream come true.

I haven't reached Carl Sagan or Martin Gardner proportions yet, but it did bring mathematics to a lot of people!

Postscript: Professor Benjamin, a decade after the original interview, has added to his list of accomplishments the co-editorship of the student journal, *Math Horizons*, has two daughters, Laurel and Ariel, and, yes,

has even had a term as department chair at Harvey Mudd College. He has created two DVD courses for the Teaching Company on the Joy of Mathematics and Discrete

Mathematics. In 2006 the American Mathematical Society gave its first award for an Outstanding Mathematics Department to Harvey Mudd College.

