



## Arthur Benjamin Interview



Arthur Benjamin is Smallwood Family Professor of Mathematics at Harvey Mudd College. He co-authored the award-winning book *Proofs That Really Count*, and most recently he was awarded the Joint Policy Board for Mathematics Communications Award in 2016. He is also known for his “Mathemagics” shows, where he demonstrates and explains how to do rapid mental calculations. He has given three TED talks, which have been viewed over 12 million times.

**Diaz-Lopez:** *When did you know you wanted to be a mathematician?*

**Benjamin:** That came pretty late for me. When I started college I remember thinking I would not be a professor because it would take about ten years of school and, when you are eighteen, that seems like a large fraction of your life. But when you are graduating you think, “Oh, in another three to five years I could have the credentials to be a college professor. Let’s do it.” Then I got my first taste of being a TA in graduate school, and I loved it. I loved being in front of a classroom, and I thought if I get paid to teach and explain math to other people, how great would that be?

**Diaz-Lopez:** *Who encouraged or inspired you (mathematically or otherwise)?*

**Benjamin:** My favorite professor in graduate school was Ed Scheinerman in the Department of Applied Mathematics and Statistics at Johns Hopkins University. Ed is a fantastic teacher and a wonderful human being. He has been a role model for me professionally.

**Diaz-Lopez:** *How would you describe your research to a graduate student?*

**Benjamin:** Most of the work I’ve done in the last twenty years has been in the area of finding combinatorial proofs for interesting mathematical identities. A lot of them have to do with Fibonacci numbers and their generalizations, continued fractions, and determinants. My PhD is not in pure mathematics, so the work that I do has to be simple. I’m at an institution where I work with talented undergraduates, so it’s a nice fit.

**Diaz-Lopez:** *What theorem are you most proud of and what was the most important idea that led to this breakthrough?*

**Benjamin:** “A Combinatorial Proof of Vandermonde’s Determinant,” with Greg Dresden, published in the *American Mathematical Monthly* in 2007. The proof consisted of a card-counting argument. It involved sorting cards on a table and counting the arrangements in various ways.

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*If you get discouraged on a problem, let it sit, put it aside, and work on something else*  
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**Diaz-Lopez:** What advice do you have for graduate students?

**Benjamin:** Don't be afraid to change directions. I switched graduate schools after my first year. I started at Cornell's Operations Research Department. It's a great department, but I didn't have a strong enough pure math background coming in, since I had concentrated in statistics as an undergraduate (at Carnegie Mellon). I didn't know if I could manage the next four years with the background I had. So I took a step back, went home, then to Johns Hopkins, and started again. It was smoother sailing after that. My experience having seen both graduate programs has been very valuable for me in terms of the contacts I made and the different approaches that I experienced. It's good for students to know that there are going to be highs and lows during their graduate school career.

**Diaz-Lopez:** All mathematicians feel discouraged occasionally. How do you deal with discouragement?

**Benjamin:** I recommend having lots of different problems to work on. If you get discouraged on a problem, let it sit, put it aside, and work on something else. More broadly, I think it's good to have lots of passions in your life, so when math is not treating you well, then pay attention to other things that you love to do.

**Diaz-Lopez:** You have won several honors and awards. Which one has been the most meaningful and why?

**Benjamin:** The Joint Policy Board for Mathematics (JPBM) Communications Award. I am honored and humbled to be the newest recipient of this award. It has been awarded to Martin Gardner, Ivars Peterson, Keith Devlin, Nate Silver, Steve Strogatz, and others who have brought mathematics to the masses. It has always been my goal to get people excited about mathematics.

**Diaz-Lopez:** Apart from your mathematics, you are very well known for your "Mathemagical" presentations. How did you get involved in this?

**Benjamin:** As a kid I loved doing magic, and I grew up in a very theatrical family. My father was an accountant by day and an actor/director by night. My brother and sister and I were all put on the stage at an early age. I've always thought of myself as an entertainer. Even in the classroom and in my writing, I want people to enjoy what I am doing. I was fascinated with magic and did shows for children throughout the east side of Cleveland, Ohio, as "The Great Benjamini." It was the traditional rabbit-out-of-the-hat, make-the-kids-laugh type of magic. As I started doing shows for older audiences I moved into the area of magic known as mentalism, which is magic of the mind. My dad then suggested that I include some of my mental math feats, which had always been a hobby of mine. I was fascinated with numbers and finding new ways for multiplying numbers, squaring, and so on. Much to my surprise, the mental math part of my show got the best reaction. Over the course of a couple of years that became the main focus of my show. I stopped doing the "fake mind-reading stuff" because I didn't want to promote pseudoscience. By focusing on mental math, I could teach my calculating techniques to the audience, which they enjoyed a lot.

**Diaz-Lopez:** What's the square of 283?



Arthur Benjamin in a mental math performance at the Curiosity Retreat 2015 in Gateway, Colorado.

**Benjamin:** [In a fraction of a second] That would be 80,089.

**Diaz-Lopez:** While magicians usually do not reveal their secrets, can you explain to us how you did that so quickly?

**Benjamin:** Absolutely. Let's begin with a two-digit square and then go up to three digits. Let's start with the square of 17. You may already know that the answer is 289, but here is how you would square it using my method. I multiply 20 by 14 to get 280, then add the square of 3 to get 289. Algebraically, this is  $A^2 = (A + d)(A - d) + d^2$ , where  $A = 17$  and  $d = 3$ . Once you get comfortable squaring two-digit numbers, you can attempt squaring three-digit numbers. For the square of 283 I go up 17 to 300, down 17 to 266, and multiply 300 by 266 to get 79,800. Next I add the square of 17 to get  $79,800 + 289 = 80,089$ .

**Diaz-Lopez:** You have given almost 300 research presentations, published almost 100 papers, refereed for numerous journals, and published many books. Given your many commitments, what techniques do you use to manage your time?

**Benjamin:** I would be remiss if I didn't mention my fantastic wife, Deena, who has been incredibly supportive throughout my career. I am also very fortunate to be in a department that values my nontraditional activities, as I give talks to colleges, universities, and student groups around the world. They view that as a good thing, even though it cuts into my traditional research productivity.

Early in my career I spent a lot of time preparing my classes, so my research mainly got done during summers and holidays. Eventually, I was able to do research during the school year. Still, I was most productive during the summer. After tenure, my research turned the corner when I began a fruitful collaboration with Jennifer Quinn.

**Diaz-Lopez:** Any final comment or advice?

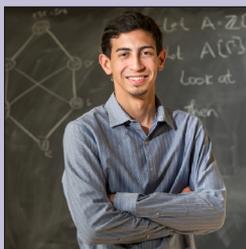
**Benjamin:** Professors in graduate school are likely to encourage you to pursue an intense research career. They want their students to become faculty members at PhD-granting institutions, even though the reality is that the vast majority of graduate students won't end up there. Don't be afraid to strongly pursue other academic options. I think teaching at a four-year college is a wonderful place

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to be. I feel that it's easier to enjoy your research at a teaching-oriented institution than to enjoy your teaching at a research-oriented institution. Harvey Mudd College was a great fit for me, and I am very happy that I made that choice for my career.

**Editor's Note:** Benjamin's latest book, *The Magic of Math*, is featured in the "BookShelf" in this issue of the *Notices* (See p. 50).

**Photo Credit:** Photo of performance is courtesy of Harvey Mudd College.



**Alexander Diaz-Lopez**, having earned his PhD at the University of Notre Dame, is now visiting assistant professor at Swarthmore College. Diaz-Lopez was the first graduate student member of the *Notices* Editorial Board.



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