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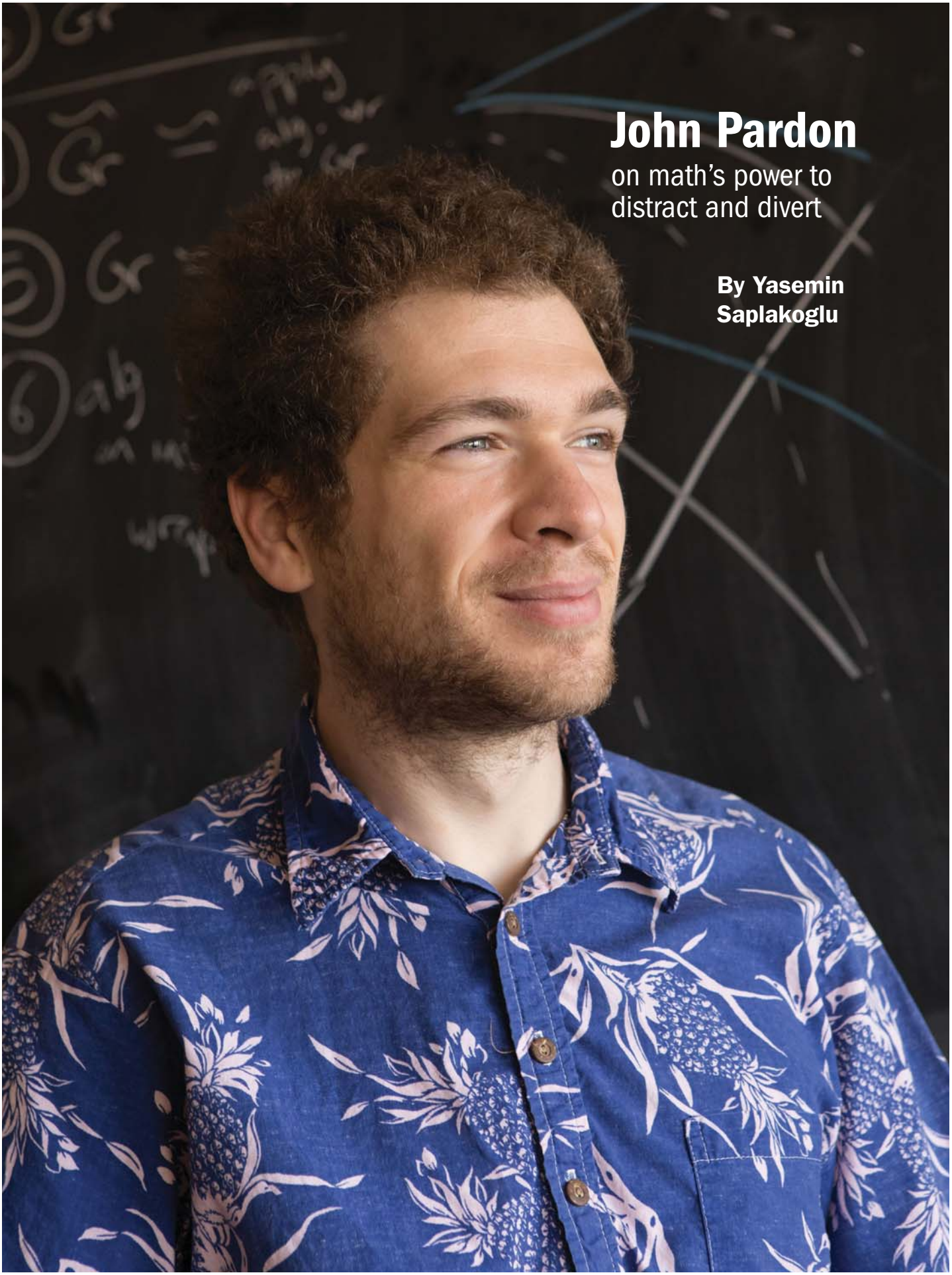

John Pardon

on math's power to distract and divert

By Yasemin Saplakoglu

GETTING A TIRED and hungry 12-year-old to hike another mile up a steep mountain is a daunting task. But John Pardon's parents quickly figured out a simple solution that saved many of their family vacations from stress and despair: distract him with math.

Pardon's father, William Pardon, a mathematics professor at Duke University, would ask him probing algebra questions as soon as his son's legs began to ache and his pace slowed down.

It was a tactic his parents used on many occasions. When he was 5, his parents whispered something in his swim teacher's ear. Pardon, too scared to tread water, suddenly found his arms and legs moving as he answered his swim teacher's multiplication questions.

Pardon, appointed a professor of mathematics in 2016 just five years after he was the valedictorian of Princeton's undergraduate Class of 2011, grew up in Durham, North Carolina. He spent his childhood solving puzzles, building circuit boards and robots, and eventually writing computer programs as he entered his teenage years.

During high school, Pardon took math classes at Duke and attended a handful of programming competitions, most notably the International Olympiad in Informatics where he won a gold medal three years in a row.

As an undergraduate at Princeton, his successes culminated in solving a problem posed in 1983 by the Russian-French mathematician Mikhail Gromov.

"I knew about this problem for a couple of years before I actually did anything about it," Pardon said, recalling how he scrolled through various math problems online in preparation for a national science competition as a rising senior in high school.

The summer before he entered Princeton, Pardon continued to think about the problem, which asked whether a specific type of knot without any ends, called a "torus knot," could be tied without altering its shape.

"The most interesting problems, like this one, are the ones where you have absolutely no idea where to start," he said. Pardon typically doesn't start on paper, but spends time working out the problem in his head and imagining possible directions it could take.

A few years later, as a junior who was not only majoring in math but also finding time to play the cello and learn Chinese, he almost figured out a solution. "I thought I solved it for like two weeks," Pardon said, laughing. "It was complete nonsense."

When his senior year rolled around, he finally figured out the answer. He realized that if he were to unwind the complex, mind-boggling mathematics, the answer was: no, you could not tie a torus knot without altering its shape.

"He walked into my office, handed me the manuscript of his proof and asked me if I could read it, without making a big deal out of it," said David Gabai, the Hughes-Rogers Professor of Mathematics and the chair of the department. "This exemplifies his modest, unassuming persona."

This finding was published in the *Annals of Mathematics*, one of the top journals in the field. The accomplishment landed Pardon a top honor for undergraduates, the 2012 Morgan Prize, given jointly by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

As an undergraduate, Pardon also received the 2010 Barry Goldwater Scholarship, a national award for sophomores and juniors in the natural sciences, mathematics and engineering.

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He also published a paper on a generalization of a solution to something called the carpenter's rule problem, which asks whether a polygon in a plane made of rigid metal rods connected end-to-end with hinges can be moved continuously so that it becomes convex.

Pardon later went on to receive a National Science Foundation Graduate Research Fellowship to support his graduate studies at Stanford University, where he became an assistant professor after receiving his doctorate.

At Stanford, Pardon proved a special case of the Hilbert-Smith conjecture, which involves the mathematics of "manifolds" — shapes that include spheres and doughnut-shaped objects. Then he began to explore a question about intersecting shapes.

Pardon brought this question back to Princeton, where he focuses on geometry and topology. He is now counting intersections in infinite-dimensional spaces. For example, the space of configurations of a piece of string, which has infinitely many points, on a plane are infinite-dimensional. "Ideally I want to develop a framework for doing this that just always works and you don't have to think about it anymore," Pardon said.

In April 2017, Pardon received the National Science Foundation Alan T. Waterman Award, a $1 million grant awarded to early-career scientists and engineers.

On the occasional evening, Pardon can be found in an empty classroom in the mathematics building, playing Bach or Kodály on his cello. "I really cannot think about math when playing music," he said. "Both require my full attention." D