

Critical Point Hello interflexionality

Robert P Crease relives the recent G4G14 meeting, where fun and science met

How can a set of spinning tops be made to equal Euler's equation? Kenneth Brecher – a retired physicist from the Massachusetts Institute of Technology – revealed all at the 14th Gathering for Gardner (G4G14), which was held from 7–10 April in Atlanta, Georgia. Inspired by Martin Gardner (1914–2010), who wrote the Recreational Mathematics column for *Scientific American* between 1957 and 1981, the biennial conferences bring together an unusual mix of scientists, artists and magicians.

First held in 1993, the conferences are always called “G4G” plus the suffix of the series number; this year's event was thus G4G14. In fact, the series number – in this case, 14 – is always a playful and recurring theme in many of the 100 or so talks. These are strictly limited to six minutes each, forcing presenters to be amusing, concise and instructive. As a member of the board of directors of the G4G conferences, I have given several myself.

Brecher, a self-styled “topaholic”, used G4G14 to reveal a pancake-shaped ellipsoid that he had made out of brass. He'd dubbed it *e*Top because its diameter divided by maximum thickness equals Euler's number e (2.718...). Brecher also explained how he'd created an imaginary top or “*i*Top”. Decreeing it to be the least imaginable object you could think of, he'd made it by machining a thin, almost 2D “tippe top” (a top that flips over when spun). He got the largest laugh, though, when spinning both tops – and two others from previous G4Gs – in a way that represents the Euler equation: $e^{i\pi} = -1$.

A question of handshakes

Brecher's talk followed the conference's opening address, which was given by Skona Brittain, a mathematician from the SB Family School in Santa Barbara. She'd written her talk before the pandemic when she'd assumed that a nice opening activity for delegates would be to shake hands and introduce themselves. How many different ways, she asked, could n pairs of people sitting around a table shake hands simultaneously without crossing their arms? She showed the answer is the n th “Catalan number” (a sequence of numbers in combinatorics) with the answer at a typical 8-person table being 14 different ways. The audience applauded the solution, fist- and elbow-



That's clever Delegates to G4G14 making a portrait of Martin Gardner from Rubik's cubes.

bumping in this wary post-pandemic era.

Adam Atkinson – another mathematician – described the science behind the inventions of Daedalus, the pseudonym of *New Scientist* columnist David Jones (1938–2017), who would propose outlandish improvements to everyday activities such as drinking, swimming and seeing. Can someone, Jones once pondered, survive in the Sahara desert by extracting water from the air? Yes – just build a 2.4 km tall column of a deliquescent substance such as sulphuric acid and install a semi-permeable membrane at the bottom. The pressure will make a constant stream of water flow out the base.

Can one swim and breathe at the same time without scuba gear? Sure! Squeeze xenon to the density of water and mix it with oxygen (the snag being you'd need the world's supply of xenon and you'd vomit). Want to see the back of your head without a mirror? Replace the atmosphere with sulphur dioxide, which increases the index of refraction so it can make light bend around the Earth.

Miquel Duran, a chemist from the University of Girona in Spain, used his six minutes to explain how he uses playing cards to teach concepts and calculations from quantum mechanics. Other speakers discussed the mathematics of various topics: snowflake growth, fibre arts, topological dancing, origami toroids, Escher-like mathematical walkable structures, and stretchable rulers for measuring graphically depicted graphs without digitizing

them. Others, meanwhile, talked about mathematics education, explaining how they react to complaints that maths is “boring/useless/difficult” or only for people who “don't look like me”.

Low Lefton, a mathematician and computer scientist from the Georgia Institute of Technology, spent his allotted time with a series of one-liners that made the audience chuckle. “You either believe in the law of the excluded middle or you don't.” Laughter. “That's the only time that joke has ever got a laugh.” Laughter. “That was my 14th joke.” Laughter. “That was my 15th joke.” Laughter. “Now you know the rest of my set by induction.” More laughs.

During his long career, Gardner invented a fictitious numerologist named Dr Matrix, who believed that numbers govern real objects and events. A traditional event at the G4Gs is the appearance of two versions of Dr Matrix, one of whom speaks for the series number and the other against it. As Dr Matrix pro-14 in Atlanta, I cited the indispensable role that 14 plays in human culture and science, naming important people (such as Donald Trump) who were born on the 14th. I also pointed out key events that occur on that day – including Valentine's Day – and the number's significance in religion, such as the 14 stages of the cross.

As Dr Matrix anti-14, Stony Brook philosophy graduate student Delicia Kamins named famous people, such as Stephen Hawking, who had died on the 14th, pointing out that Valentine's Day is often a disaster for couples, and noting that the 14 stages of the cross involve suffering.

The critical point

Initially, participants at the G4Gs were those who had been directly inspired by Gardner's column. As time went on, and especially following Gardner's death, attendees gradually became more and more drawn by the spirit of the conferences. I'd define that spirit as “interflexionality” – a word I've invented based on terms such as interdisciplinarity and intersectionality (where structures overlap yet depend on each other) coupled with flexion (the bending required to make something happen).

Interflexionality involves playing at the intersection of different fields; it might be fun but the activity enriches those other fields. As one presenter said: “Don't apologize for doing useless research.”

Robert P Crease is chair of the Department of Philosophy, Stony Brook University, US, www.robertpcrease.com, e-mail robert.crease@stonybrook.edu