



# TableAus

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# Memory Athletes

# Daniel Timms

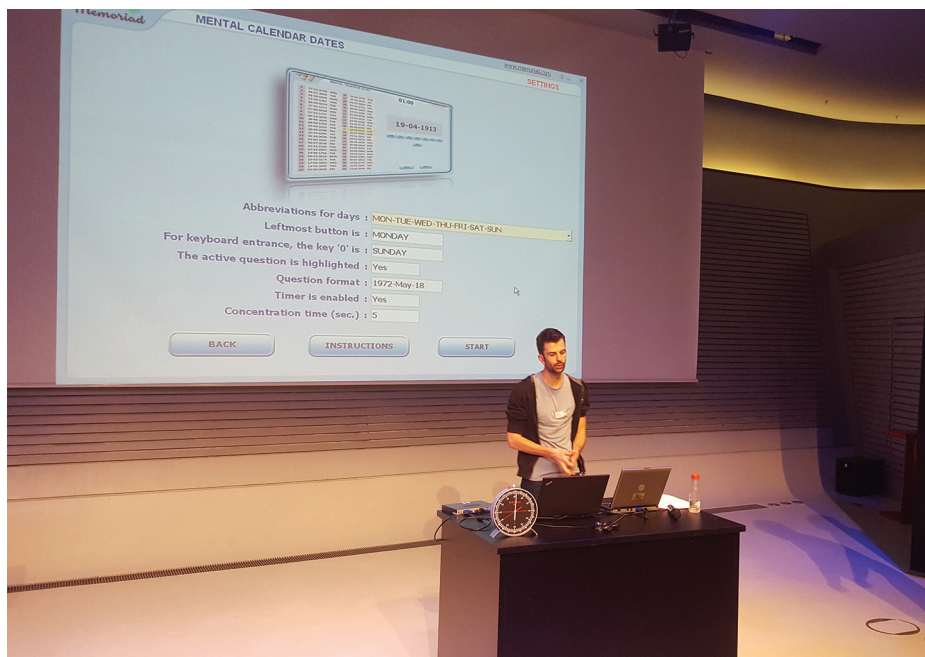
Interview by Daniel Kilov

Daniel Kilov is a Mensan from the ACT

**Daniel Timms is one of the most knowledgeable and creative mental calculators around.**

Since 2012 he's represented the UK in most of the major international mental calculation competitions including the Mental Calculation World Cup, the Mental Calculations World Championships and Memoriad, where set a new record in calendar dates and won a bronze medal in the Hectoc category. He also runs the biggest website for advanced mental math training and is an organiser and trainer for the Mental Sports Olympiad and Junior Mental Calculation Online Championships. I sat down with Daniel, a pure maths graduate from Cambridge, to learn about the unique perspective he brings to mental calculation training and his ideas regarding the upper limits of human performance in this domain.

**Daniel Kilov:** You and I have had a number of prior conversations about mental calculation and related topics and the story I have in my head is that you came to mental calculation via pure mathematics, which you studied at the University of Cambridge. On your website, you mention that, shortly after graduating, you began to wonder whether anyone had tried to get very good at doing maths in their head. This struck me as a neat story when I first heard it, but on reflection the path from pure math to mental calculation isn't all that straightforward. Most mental calculators are not mathematicians and although there are examples of mathematicians who were also exceptional calculators (Gauss, Euler, Ramanujan, etc) they are notable precisely for their rarity. What do you see



Daniel Timms, in 2018, setting a record for mental calculation of calendar dates.

as the relationship between your studies in mathematics and your training in mental calculation? Do the two interests inform one another? If so, how?

**Daniel Timms:** There's a joke amongst pure mathematicians that if you encounter a number greater than about 8 then you're no longer doing 'real maths'! Pure mathematics describes logical concepts that become increasingly abstract, and naturally this is a world away from the very concrete numbers that human calculators work with.

Likewise, human calculators don't need to understand the mathematics behind the methods they use—just as an athlete doesn't need to know much about biology as they can simply apply advice given by others.

However, my exposure to

mathematics has been super useful in my exploits as a human calculator as I can develop new methods and understand the limitations of existing ones.

In one World Cup, one task was to calculate cube roots to many decimal places. Some of the numbers, like 987654, are particularly difficult with the standard method, so I developed an alternative method for these—using the general binomial expansion—that enabled me to get accurate answers much more quickly.

The general binomial expansion tells us that if  $x$  is small,  $100(1-x)^{1/3} \approx 100(1-x/3-x^2/9)$ .

To find the cube root of 987654, we can take  $x = 0.012346$  to fit the left-hand side of the expression. Then  $x^2$  is approximately 0.00015 (I won't pretend to be able to compute that more

accurately in my head!) and we can proceed with the familiar operations of division and subtraction:

$$x/3 \approx 0.004115$$

$$100(1 - x/3) \approx 99.5885$$

$$x2/9 \approx 0.000017$$

$100(1 - x/3 - x2/9) \approx 99.5868$ , which is correct to 6 significant figures!

If you'd like to try this method for yourself, see if you can estimate the cube root of 991000—but you'll probably want to try it first with pen and paper!

**Daniel Kilov:** What was the first event you ever competed in? What was that experience like?

**Daniel Timms:** My first event was the Mental Calculation World Cup in 2012. I'd discovered it during a random internet search early that year, and had set myself the challenge of competing in it.

I had no idea what to expect! At the time, I believed that the top human calculators would be savants like 'Rain Man', and remember feeling the impostor syndrome kick in as I was travelling to Germany for the contest.

The reality turned out quite different! There was a bunch of interesting people from everywhere from Cuba to Japan who had simply trained like me to handle numbers, ready to compete.

What also impressed me was how enthusiastic everyone was for each other's success—it was more like we were all competing against the limits of the mind, than against each other.

**Daniel Kilov:** Since then, you've competed in every major international calculation competition, including the Mind Sports Olympiad, the Memoriad and the Mental Calculation World Cup. You've also won medals for mental calendar calculation and Hectoc events. How has your training changed since your first competition?

**Daniel Timms:** I used to just keep training the category over and over, in the same format that it would appear in the competition.

But these days, I split up whatever I'm training for into smaller components, find the weakest links, and train them separately. For example, when training square roots for Memoriad, I realised that one stage of my method was really slowing me down—holding a number in my mind

as I divide it by 20. So I built a little tool to specifically train that part, and saw a clear improvement in my scores.

Same story for calendar dates—calculating the day of the week for arbitrary calendar dates. To get faster I knew that while finalising the calculation for one date I needed to be looking ahead at the next. So I found an online metronome and practised with the rule that I could only type my answer on the beat. That forced me to look ahead while waiting for the regular beat of the metronome, and soon afterwards I set the current British record for that category.

**Daniel Kilov:** What is your favourite event?

**Daniel Timms:** My favourite events are the surprises in the World Cup, because not only do they test mental maths skills, but also the ability to quickly adapt your toolbox to new types of question. In some ways it's an ideal blend of calculation and mathematics.

For example, in 2018 one page had a list of multiplications of 10-digit numbers, with the answers. And our challenge was to identify the incorrect answers. While some contestants had to solve each multiplication and check against the answer, some of us used a mathematical trick to identify most of the wrong ones with only a fraction of the work!

**Daniel Kilov:** On your website, you've also written some really interesting stuff about the psychology of mental calculation, about the upper limits of processing speed and working memory. Can you briefly share your arguments here? Making predictions about the limits of human performance is always a dangerous game, but do you have any predictions about what limits these constraints might place on future records?

**Daniel Timms:** I like to think of the human brain as a type of computer. Sure, it has very different architecture to a mechanical computer, and it's suited to very different tasks! But it's still a physical object capable of performing logical operations.

And just as your laptop or smartphone will have some specs for its processing speed, RAM and hard disk capacity, our brains have physical constraints too.

Psychologists have long wondered about the 'specs' of the human brain. They've devised some ingenious experiments to discover that we can operate on about 60 bits per second, and it turns out there's not much variation between people.

A 'bit' is the simplest unit of information—a choice between a zero or a one—and 60 bits is equivalent to an 18-digit number, or to 13 random letters.

But competitive mental maths gives us an alternative way to measure this! For example, it requires 1306 bits of processing to multiply together two eight-digit numbers like  $12345687 \times 98765432$ , and the very fastest human calculators can do this in about 20 seconds. This is 65 bits per second, very similar to the figure suggested by the psychologists!

In fact, we find similar figures for addition, square roots and even day-of-week calculations. So I would predict that the 'sport' has reached its maturity, and just as athletics world records are only broken by small increments, we'll be seeing the same in mental calculation!

**Daniel Kilov:** You also run educational workshops for students of different ages. What role do you think mental calculation should play in education?

**Daniel Timms:** Even in this age of calculators, it's important to be confident with basic mental maths, like multiplications, subtractions and approximations. It just removes the friction when dealing with everyday numbers, especially when making plans or dealing with money.

For example, I'm often travelling abroad, and it's shocking how many places—like hotels and airlines—convert your money at an abysmal rate. The worst was an ATM in Budapest that tried to charge me 13% extra! These organisations know very well that most people don't have the mental maths abilities required to estimate the correct amounts, so they can get away with these scams.

I'd like to see mental calculation considered as somewhat separate from mathematics, so that students who perform poorly at things like trigonometry and algebra still feel encouraged to maintain their fluency with numbers.

Something else I hope to demonstrate

in my workshops is that success with numbers depends mostly on what you train your brain to do. To repeat the analogy with computers, it depends much more on the software that you install than the hardware you were born with!

And one way to see this very clearly is to learn to do a calculation skill, such as big multiplications, extremely fast. As you improve, you'll find yourself reaching and breaking through different plateaus, and each one represents solving a problem imposed by the limits of the mind.

**Daniel Kilov:** What advice can you offer to would-be calculators and readers who would like to improve their mental calculation skills?

**Daniel Timms:** Many people feel that mental arithmetic ability is somehow fixed—that however good they were at eight years old is where they are going to stay for life. But as an adult you have a lot more experience of learning than when you were in primary school, and can level up much faster!

For example, how well do you know your times tables?  $6 \times 7$ ?  $8 \times 9$ ? With a small effort you could memorise everything up to  $9 \times 9$  off-by-heart, and then you have the building blocks for all multiplications.

After that there are so many directions you could work in, but one thing anyone can do is to actually try to solve mental maths problems when they arise in your everyday life. Even if you don't have the confidence to split the bill at a restaurant or convert an old recipe into metric, you can always make a note of situations where lightning arithmetic skills would have been handy, and figure out later how you could solve them next time. ■

Mensa Daniel Kilov is a Memory Athlete. He believes that we are all mental athletes; in a competitive world, we all need to be able to remember more, to be more creative, innovative and focused. In this sense, the techniques used by memory athletes should be available to everyone.

For more, visit [DanielKilov.com](http://DanielKilov.com) and follow Daniel on Twitter at @DanielKilov.

## Contributions to *TableAus*

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Send articles to Peter Gibson, [editor@mensa.org.au](mailto:editor@mensa.org.au). The editor reserves the right to include, edit or reject submissions.

### Length

Short and long articles are welcome. Word counts: a full column is about 350 words (with a small headline but without pictures); a page is about 900 words (with a headline but without pictures); two pages is about 2,000 words.

### Submission deadlines

Submission deadlines are always on page 1 of *TableAus*.

### Checking your material

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