

The Power of Simplicity: Explaining All-There-Is with the most common thousand words

Roberto Trotta

Imperial College London
www.robertotrotta.com
r.trotta@imperial.ac.uk
@R_Trotta

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Summary

The book *Edge of the Sky*¹ recounts the story of the Universe — All-There-Is — and its outstanding mysteries by following a female scientist — Student-Woman — as she spends one night observing distant galaxies — Star-Crowds — with the help of a giant telescope — Big-Seer. The story is written using only the most common 1000 words in the English language. In this article author and astrophysicist, Roberto Trotta, reflects on how he came to write the book, why he chose this format and what he has learnt along the way.

A momentous discovery... or is it?

In 1965 Arno Penzias and Robert Wilson published a short article in the *Astrophysical Journal*, barely over a page long. The article was entitled “A Measurement of Excess Antenna Temperature at 4080 Mc/s” and behind its cryptic title lurked one of the greatest discoveries of all time. They had found the cold light left over from the Big Bang, evidence that the Universe had a beginning in time — not something easily gleaned from the title.

Fast-forward to 4 July 2012 when Joe Incandela, the spokesperson for the Compact Muon Solenoid (CMS) experiment at the European Organization for Nuclear Research (CERN), announced to a packed auditorium:

If we combine the ZZ and gamma-gamma, in the region of 125 GeV they give a combined significance of 5 standard deviations!

As everybody cheered — and Peter Higgs shed a few tears — it was not immediately obvious to anybody but the particle physicists in the room what the significance of this was. What Incandela had just revealed was that they had discovered the Higgs boson, the “God particle” that gives mass to all other particles. But, for the public at large to partake in these momentous discoveries, nothing short of a translation would do.

Public communication enemy number one

The obvious enemy to a clear communication with the public is jargon. As scientists, we are guilty of slipping back into it all too often, sometimes involuntarily. The above two examples were cases of scientists writing for or talking to their colleagues, and so in fairness they might not be expected to use language that a non-specialist would understand.

But as fundamental science is funded with taxpayers' money, I believe it is the professional scientist's duty to engage the public in a two-way discussion about their work, its objectives and the very reason for its existence.

The first obstacle to this aim is jargon.

As an astrophysicist with a passion for communicating with the public, I have been looking for novel ways of engaging new audiences with my science. For over a decade I have given public lectures to a wide variety of audiences; worked with film-makers, artists, designers and architects to create videos, artwork and installations inspired by cosmological ideas; and, most recently, as part of my Science and Technology Facilities Council (STFC) Public Engagement Fellowship, using cookery and food to approach astrophysics and cosmology with young audiences in a hands-on way².



Figure 1. The Student-Woman and Big-Seer, under a sky full of stars. Credit: Antoine Déprez



Figure 2. The Star-Crowds are running away from each other, as the space between them gets bigger and bigger. The All-There-Is is growing with time. Credit: ESA/Hubble and NASA

I now realise that for all this time I had been searching for a language to translate the often complex and abstruse cosmological concepts involved in my research — dark matter, dark energy, the Big Bang and the fundamental nature of the Universe — into something more pictorial. A language that would speak not only to people's minds, but most importantly to their emotions. My hope was to bridge the technical knowledge gap that is so often a barrier to genuine two-way dialogue between science professionals and the public.

Learning that less is more

There is an apocryphal story about Ernest Hemingway that has been a source of fascination for me for a long time. It is recounted that one night, around a dinner table, his friends challenged him to write a novel with only six words. After a moment of reflection, the great novelist grabbed a napkin and on it he wrote:

For sale: baby shoes, never worn.

His friends readily conceded the bet.

I loved the immediacy of what would later be called flash-fiction. Its economy of words leaves space for the readers' imaginations to fill the gaps — indeed it demands it. Somehow, this seems to promote a stronger, more active engagement on the part of the reader.

So I asked myself, was it possible to achieve something similar with science?

Then, in January 2013, I stumbled across the Ten-Hundred Words of Science challenge³ — a website collecting descriptions of peoples' jobs written using only the most-used 1000 words in the English language.

The format had come from a cartoon by Randall Munroe, the creator of the xkcd website⁴. This is a humorous site with original, geeky stick-like cartoons, often revolving around physics, maths, computer science and other technical subjects. Randall had drawn a picture of the Saturn V moon

rocket — or Up-Goer Five — and labelled its parts using only the 1000 word list. With this sparse vocabulary the escape pod, for example, became:

Thing to help people escape really fast if there is a problem and everything is on fire so they decide not to go to space.

I could see that this could be fun.

I spent a frustrating hour writing up my job with the 1000-word lexicon, and I found it harder than I had imagined. I posted a copy on my website, then forgot about it. The next month I gave a public talk at the White Building — an art venue in East London. The person who introduced me mentioned that he had found this unusual description on my website, and a member of the audience brought this up at the end — what was this business with the 1000 words about, exactly?

I read out the couple of paragraphs I had written:

I study tiny bits of matter that are all around us but that we cannot see, which we call dark matter. We know dark matter is out there because it changes the way other big faraway things move, such as stars, and star crowds. We want to understand what dark matter is made of because it could tell us about where everything around us came from and what will happen next.

To study dark matter, people like me use big things that have taken lots of money, thought and people to build. Some of those things fly way above us. Some are deep inside the ground. Some are large rings that make tiny pieces of normal matter kiss each other as they fly around very, very fast — almost as fast as light. We hope that we can hear the whisper of dark matter if we listen very carefully. We take all the whispers from all the listening things and we put them together in our computers. We use big computers to do this, as there are lots and lots of tiny whispers we need to look at.

I go to places all over the world to talk to other people like me, as together we can think better and work faster. Together, perhaps we can even find new, better ways to listen to dark matter. Most of them are good people, and after we have talked we go out and have a drink and talk some more.

I was surprised by the unexpectedly strong, positive reaction of the audience to these few paragraphs and it got me thinking that perhaps this was the new language that I had been looking for! Perhaps it could even be used to talk about everything in the Universe, not just my job.

The Edge of the Sky is the result of that small Eureka moment.

A new language

Over the next three months I dutifully sat down at my desk at the University of California Santa Barbara — where I was free of teaching duties during a research stay — and spent some time every day wrangling with the difficulty of talking about the Universe using only the most common 1000 words.

The first hurdle was to find a new word for Universe, which was not in the list. So it became the All-There-Is. A planet became a Crazy Star; a telescope, a Big-Seer; scientists were Student-People; our galaxy the White Road; the Big Bang the Big Flash — after my editor vetoed my earlier choice, the Hot Flash! — and other galaxies became Star Crowds.

As this new language started to emerge, little by little a new voice took over. It was a voice that I hadn't anticipated, and that was created by the poetic straitjacket imposed on me by my chosen format.

Not only did I find that limiting my lexicon to the most-used 1000 words swept the table clean of jargon, as I was sure it would, it also forced me to think afresh about seemingly familiar concepts. I was pushed to describe them in a more pictorial, metaphorical way and this gave me a fresh, childlike perspective on the Universe.

This is particularly important when talking about concepts that might be familiar to us — the professional practitioners of our discipline — but that are very far-removed from the everyday experience of the general public. We tend to get lulled into a false sense of comfort, by using terms that we mistakenly believe non-scientists understand the same way we do, like galaxy, electron, or black hole. So why not get rid of all those words and instead use simple language that everybody can understand?

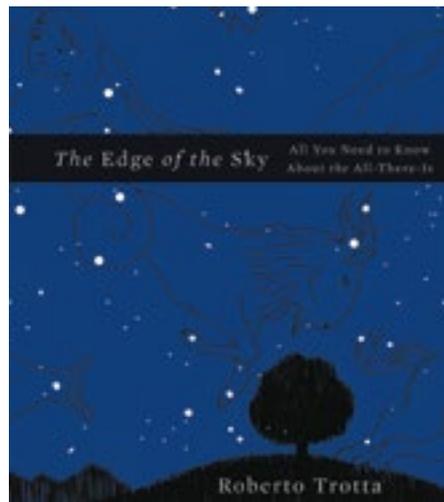


Figure 3. Cover of *The Edge of the Sky*. (Basic Books)

The All-There-Is in 707 different words

In *The Edge of the Sky*, I've tried to follow Einstein's advice, who reportedly once said:

You do not really understand something unless you can explain it to your grandmother.

And, a mere 707 words from the 1000 words list is all that I ended up using to do that.

The book tells the story of a Student-Woman who spends a night observing faraway Star Crowds with the help of Big-Seer, looking for dark matter.

She steps outside into the cold night, holding her cup of hot coffee with both hands.

The White Road is beautiful in the dark, clear sky, and, once again, she cannot help but be amazed by it all.

It does not matter how many times she has seen this before, or how much she knows about what is out there. The sight of the stars is enough to make her gasp.

"It all seems so still and yet it's changing all the time," she whispers to no one.

It is hard to believe that everything out there past the White Road and its stars is running away from us.

Yet, like Mr Hubble found long ago, the Star-Crowds are running away from each

other, as the space between them gets bigger and bigger. The All-There-Is is growing with time.

From sunset to sunrise, we follow her as she reflects on our Home-World and the other Crazy Stars around the Sun, and the many more that go around faraway stars; the way the All-There-Is grows, and how it began in a Big Flash; and all the questions we still have on it, like dark matter, the Dark Push and the existence of other kinds of All-There-Is.

Whether or not *The Edge of the Sky* succeeded in its goal is a question that only my readers can answer. If it will help them connect with some of the complex ideas of modern cosmology and generate curiosity and enthusiasm for fundamental science, my aim will be achieved.

Notes

- ¹ *The Edge of the Sky* is available from publisher Basic Books, ISBN 978-0-465-04471-9
- ² www.hands-on-universe.org
- ³ Ten-Hundred Words of Science challenge Website: <http://tenhundredwordsofscience.tumblr.com/>
- ⁴ xkcd website: <http://www.xkcd.com/>

Biography

Roberto Trotta is a theoretical cosmologist at Imperial College London, where he studies dark matter, dark energy and the Big Bang.

A winner of the I'm a Scientist-Get Me Out of Here! Astronomy Zone in June 2014, Roberto is a passionate science communicator and the recipient of numerous awards for his research and outreach. These include the Lord Kelvin Award of the British Association for the Advancement of Science, the Michelson Prize of Case Western Reserve University and the awarding of a Science and Technology Facilities Council (STFC) Public Engagement Fellowship.

His first book for the public, *The Edge of the Sky* endeavours to explain the Universe using only the most common 1000 words in the English language.