

INTERVIEW: TRISTAN PANG

14 years old, he is currently majoring in maths and physics at the University of Auckland. Always curious, always inquisitive, Tristan has created a great amount of educational materials in the STEM fields for children; produces and broadcasts a radio programme; has given speeches in many conferences and events (including TED Talks); tutors other students... His widespread curiosity for and fascination by the world that surrounds us makes him, we dare say, a true "Renaissance Boy".

Thank you very much for agreeing to our interview. You are definitely what many would call a "child prodigy". Did you feel particularly different while going through childhood?

It's such a great honour to be interviewed by OMNIA. Thank you for having me Jose.

I am humbled to be called a "child prodigy". Everyone here in Mensa is in fact a "child prodigy", either now or in the past. It just happens that I am growing up in the digital era. With technology, news spreads quickly around the world.

I do in fact find it hard to connect with people my own age. Their interests and what they want to talk about normally don't appeal to me. They don't like my interests either because they don't usually understand what I am talking about. The books I read, the games I play, the topics I explore, the issues I am concerned with are totally different from theirs. While they are talking about 1D (One Direction – English-Irish boy band), I am thinking about 11D (Eleven Dimensions - Superstring theory).

It was a bit lonely at school but it didn't bother me too much. It was a good place to practise my nodding.

Did your family encourage you? Or were they perhaps a bit "taken aback" in the beginning?

I am my parents' first and only child. They didn't know much about child developmental stages. They thought it was normal for a three month old to recall a song, or a one year old to count and read, or a two year old to do Sudoku and Algebra.

When I was about one, I gave my Mum and her friend a surprise when I "told" them we were going in the wrong direction. We were on the way to the leisure centre where I had only been once before. My Mum was too busy talking with her friend while driving and didn't realise she missed a turn. I screamed widely. They thought I was just grumpy and tried to calm me down. But I still kept screaming. They then found that I was pointing in the direction where we were supposed to go. They were in great shock and couldn't believe a baby could remember the road so well.

In fact, they were not quite correct. Honestly speaking, I don't think I have an extraordinary memory. On the contrary, I am very forgetful. It's only my good sense of direction and visual-spatial skills (as most of you will have) that help.

Even now when we are driving to a new place my parents seldom use a GPS. I am their GPS. Their trust in me is the biggest encouragement they have given me.

When did you first experience deep curiosity about what surrounded you?

I explored maths myself out of curiosity. I could see "maths" everywhere from a very young age, which was even before I could walk or talk.

I realised everything has a pattern. I was fascinated by the "imaginative" patterns around me. I amused myself by playing around with this idea. When I look at a cloud, I imagine it as an oval. I then imagine a triangle inside the oval, and then a square inside the triangle, then a hexagon...and so on, until I have run out of ideas. I then started thinking how many shapes of different sizes I could put inside the cloud. It went on and on and on.

And what was the first thing that you decided to experimentally test or demonstrate?

My first experiment was to test my parents' limits when I was a toddler. Haha. Just kidding.

Something that is quite unusual is that, unlike most gifted kids, I seldom take things apart. Club days where kids can dismantle electronics are the most popular at my local branch of the Gifted Children's Association. But I'm not that interested as I don't understand what the point of dismantling things is if I already know what is inside and how it works. You then have to take a lot of time just to reassemble. For me, that's just a waste of time.

I did do a lot of experiments on my own but they are not important enough to mention. However I do recall one clearly as it led to some very challenging opportunities. A few years ago, one of New Zealand's biggest publicly listed companies Fonterra launched new packaging for their milk called the "Triple Layer" milk bottle. Traditionally milk containers are semi-transparent or Tetra packs. Fonterra launched a new package claiming they can protect the milk from sunlight. I was curious about what the three layers actually are. I spent quite some time cutting out each layer and found that there is a black layer in between two white layers. I wondered if that black layer would create the opposite effect to what the company had claimed, because black colour absorbs heat faster. I tested my hypothesis doing a few different tests on different types of bottles.

One of these tests was a light test. I put a light source inside the bottle and found that the triple layer milk bottle was the most effective at blocking light. But when I put the bottles under the sun for a long time, the results were as I expected. The temperature of the milk inside the Triple Layer milk bottle rises quicker than the other bottles. I was so excited, but on the other hand I couldn't believe that an 11-year-old could think better than a big company like Fonterra!

I was lucky that the Photon factory at the University of Auckland allowed me to test these three different materials in a scientific way. I used lasers which provided very accurate results and proved me right. The PhD students asked if I want to publish these findings but I decided not to, because I believe such a big company should already have scientists. In truth, the packaging was probably a commercial decision to attract more customers. I decided to move on to more important experiments.

Some of us have had hard times at school; mostly problems with bullying and unsympathetic professors. Did you ever experience something like that?

I was lucky that I studied at a very small private primary school. There were only about 120 students from year 1 to year 8. I was there for 8 years. Everyone knew each other well across the whole school. We grew up together. Although I was sometimes different from my peers, they accepted me for who I am.

I skipped all five years of high school and went straight into university, which I think is lucky again as I know high school is where most bullying happens. Some people dislike tall poppies and want to cut them down which can cause trouble for some outstanding students.

I sat exams as a private candidate since the age of nine. I went into the exam hall alongside the high school students who were six or seven years older and were twice my height. I was a bit scared at the beginning as they were looking at me in an unfriendly way. I heard some guys whispering to each other, "Hey, we have a dwarf here."

Now you are in University. I imagine that you might have had people saying to you "you're too young! What are you doing here?" Do you still experience that kind of reaction?

I was twelve when I started attending classes at the University of Auckland. As per New Zealand's Vulnerable Children Act, I was supposed to be at school with teachers looking after me. But there are no people like that at university. The university requested that my mother stay on campus (not necessarily sitting in the class) whenever I was there until I turn 18. In the beginning, some people thought my Mum was the student and bringing her son with her.

Later after they found out the truth I was no longer the centre of attention. Now, no one really notices the difference as my voice is deeper and I am even taller than some of the students.

The university professors and lecturers I have met are all great people. They believe in me, support me and give me lots of opportunities. I have five mentors at the university now including a Head of Department, two lecturers, and two PhD students. I believe that if they didn't think I have the potential, they wouldn't waste their precious time on me.

And now, let us talk SCIENCE! What is your favourite field?

I like almost everything but theoretical physics and pure maths are particularly interesting.

Recently I took part in a huge worldwide video competition, the Breakthrough Junior Challenge. I was a finalist and my video was selected to be uploaded to the Khan Academy website (<https://www.khanacademy.org/partner-content/bjc/2015-challenge/2015-physics/v/breakthrough-junior-challenge-2015-the-theory-of-everything-an-introduction>). I chose String Theory for my video. I did extensive research on this topic and I just loved it. The Theory of Everything/String Theory is one of the most important but complicated concepts in physics as it unifies everything in the universe. The discovery is important as it explains how, what and why all matter is what it is. It changed our understanding of everything and is crucial to our view of the universe. It's not just a theory, but it's a solution to the problems in different areas of physics.

I am interested in completing the String Theory from the perspective of a pure mathematician.

Who has been your inspiration in life, the people you look up to? Who has had the strongest influence on you?

I have read lots of books written by Stephen Hawking, Roger Penrose and Ian Stewart. They are very inspiring but I haven't had a chance to personally connect with them yet. There are some inspiring great people I really look up to and have connected well with. They are mathematician Professor Eamonn O'Brien, scientist Dr Cather Simpson and Professor Richard Easter, and broadcaster and president of the New Zealand Association for Gifted Children Mr Andrew Patterson. They are my inspiration to continue my quest through the wonderful world of maths and science.

The person who has had the strongest influence on me is definitely my Mum. My passion for reading, love of learning and eagerness to help others comes from her. She also influenced my own values, including trustworthiness, reliability, honesty and kindness.

Do you think that certain subjects could be taught to children in a better way than they are usually taught?

In our existing curriculum, the same topic is scattered over a number of years and there are often jumps between topics. I know some of my friends find it hard to see the connection between each topic.

To me this method is like reading a chapter of a story book but you have to wait until the following year to find out what happens next! It is extremely frustrating. As for me, I like to understand the whole story or picture, and achieve a complete ending.

I have my own way of learning. I call it “vertical and in-depth learning.” I started my education pathway before I was two years old. I knew nothing about what year levels meant. I simply kept exploring upwards in a very in-depth manner. When I was nearly five, I started to go through the maths topics strand by strand. The main strands in maths are geometry, algebra, and statistics. When I finished the strand of “algebra”, from the year 1 book to the year 13 book, I then moved onto the strand of “geometry”, again, from the year 1 book to the year 13 book, and so on.

Because I was eager to find out what happened next in the strand “story”, I finished all 13 books in only a couple of weeks. I then had many years to strengthen my knowledge and skills on the harder topics.

In my opinion, learning is all about exploration. Learning maths or any other subject should not be bounded by the curriculum. The barriers of age and year levels are set by schools and the learners themselves. We should free ourselves from academic pressure as this is far more effective in unlocking someone’s full potential. If the schools don’t provide this opportunity for the children, the children themselves should explore by themselves. These days, students can easily learn from the internet. There are so many good educational videos on YouTube and great courses from the Massive Open Online Courses (or “MOOCs”), to name a few.

Please tell us about your activities in tutoring, education, and divulgation.

I have delivered talks, workshops and also tutoring sessions in many different schools and organisations locally and internationally since eleven. One of the most recent ones was a talk in the United Arab Emirates.

It is sometimes far more effective for the students to hear from me rather than from the teachers. I am able to inspire them as I am at a similar age. Due to the effectiveness of peer-to-peer influence, I built a website called Tristan’s Learning

Hub (www.tristanslearninghub.org) where the students can watch videos strand by strand in my way of learning which I mentioned before, the “vertical and in-depth learning”.

I also run a monthly radio show “Youth Voice with Tristan Pang” with the aim of inspiring young people to think big and work hard. Additionally, I built Quest-is-fun (www.quest-is-fun.org.nz) with the same objective.

What is, in your opinion, a scientist's duty to society?

Scientists have many diverse roles in society. Essentially, they make scientific information available and easily understandable to the general public. Scientists in these roles need good communication skills.

What do you think is harder? University studies, producing and broadcasting your radio programme, teaching and tutoring, or giving speeches?

They are all challenging but not too hard. The hardest part is trying to juggle everything in a very limited time. I still sleep like a 14 year old, but I need to work like an adult. I have a short day as I spend about 10 hours in bed. To keep myself focussed and efficient across the 14 hours, I swim at least 2 km a day.

What new projects do you have in mind?

I wrote an Arduino programme recently for a farm, so they can test the conductivity in water and monitor any impurities. It is a very cost-effective method (only less than NZ\$200). At such a low cost, primary industries, commercial operators and households may be able to use this in future. I will keep modifying it as I go. My ultimate goal is to improve our environment and ensure our ecosystem is sustainable.

Now, this may sound like a weird question, but what is in your opinion the most beautiful proof in mathematics? And the most beautiful theorem (or law) in physics?

Really great question.

In maths there are many different proofs and all of them are beautiful in their own way. Here is one that I find quite fascinating; why $0.\dot{9} = 1$. There are many ways to prove it, here is a simple way...

If

$$\frac{1}{3} = 0.\dot{3}$$

Then

$$2 \times \frac{1}{3} = 2 \times 0.\dot{3} = 0.\dot{6}$$

And

$$3 \times \frac{1}{3} = 3 \times 0.\dot{3} = 0.\dot{9}$$

But also

$$3 \times \frac{1}{3} = 1$$

Therefore

$$0.\dot{9} = 1$$

As for physics, the standard model is, to me, beautiful and useful. It shows all the forces of nature and particles that we know of. It can also help predict new particles. For example, the Higgs Boson discovered in 2012 at the Large Hadron Collider was predicted a while ago.

And, related to the previous question, which are the most important proof in mathematics and the most important theorem (or law) in physics?

All proofs, theorems, and equations are important, otherwise there would be no need to explore and discover them further.

In maths, the laws of Calculus are a foundation for higher level maths. These lay the path towards many aspects of applied maths as well as parts of pure maths. For example, trigonometric functions can be estimated using calculus and series to help solve limits.

In physics, I believe Einstein's $E=MC^2$ is very important to modern science. This explains the relationship between E, the energy of a body, and M, the mass of a body. C is the speed of light. It shows that mass and energy are very closely related. This is used for many things, including predicting what happens to a black hole, predicting the reaction of particles when they collide, or how to make nuclear bombs.

The hugely influential theoretical physicist Paul Dirac said: "*What makes the theory of relativity so acceptable to physicists in spite of its going against the principle of simplicity is its great mathematical beauty. This is a quality which cannot be defined, any more than beauty in art can be defined, but which people who study mathematics usually have no difficulty in appreciating.*"

Quite a lot of people nowadays look at science with mistrust. What would be the best way to counteract that perception?

This is one of the best examples. Once upon a time in the mid-19th century, people believed that asbestos was the best composite material and it became a common material in buildings and industrial plants. But then, decades later, asbestos dust was found to cause serious illnesses like cancer and is now a well-known silent killer of a large number of workers. It has cost countless lives, as well as resources in paying compensation and demolishing the structures containing this material. The root cause of the problem was the insufficient research carried out before asbestos was widely used in our living environment.

If proper research was done before its general use, then a lot of people would not have suffered or died as a result. This is just one of the many examples of the so-called “great human inventions” by scientists and industrialists used in our recent past. There are many inventions which are similar in that they were driven by concerns about cost.

In my view, all leading research should be done without any financial burden and without the fear of upsetting any provider of funds. The Government and industry should provide funding to an independent fund administrator to allow research and development to take place without external pressure.

One of my ambitions is to become an academic researcher. I would like to carry out independent research for the good of the humankind and the Earth.

What is your biggest dream? What is what you would like to do most?

As I go forward in my career, I wish to carry on Albert Einstein’s incomplete third theory; the Unified Field Theory. This is important as the two most successful theories in physics, general relativity and quantum theory, contradict each other. After decades of hard work, the scientists found the Theory of Everything/String Theory. I believe this theory can unify everything in the universe. By finding the smallest “thing” in the universe, it explains how, what and why all matter is what it is. It can change our understanding of our universe and can solve the problems in different areas of physics as well as global issues. We can also predict how, what and where our universe will go. This is strongly related to our future and can ultimately improve our world.

The recent giant leap forward in this field was the detection of gravitational waves. These were detected at LIGO in the US when two black holes collided a long time ago. The detection of gravitational waves may lead to the proof of the existence of gravitons, which is part of the string theory. Gravitons are theorised to be able to travel into higher dimensions. If they exist we will be able to explain why gravity is weaker than electromagnetism.

There are still so many tasks to finish before this theory is finalised. I wish to complete my quest by becoming part of this exciting collaborative effort.

Where do you see yourself 10, 20 years from now?

Discovering, contributing and sharing are my lifelong goals. I am on the way to becoming a mathematician and scientist with global ambitions.

In 5 years' time when I am 19, I will be doing my PhD and at the same time will probably be teaching part-time at the university. It will be quite fun for a 19-year-old lecturing my 19-year-old peers at the university.

I aspire to make a difference in the world. I want to share what I have discovered. I hope I can contribute to a better world from a scientific perspective. After I complete my PhD when I am about 21 or 22, I would like to remain in academia to teach and continue my research. I would also like to fulfil my social responsibilities. Global child poverty is one area where I am keen to help. I believe that education is the fundamental solution to break the poverty cycle. In the 21st century digital age, a strong knowledge of maths and science is vital. With my passion in maths and science and also in education, I believe I can help.

What would you say has been the best moment of your life so far?

The moment I found out I achieved the highest attainable grade of A* (97%) on the Cambridge International Maths Exam when I was nine years old, an exam which is normally sat by 16-year-old high school students. That was the first time I sat a public exam and I had studied for it on my own. This result meant a lot to me. It gave me confidence to face future challenges.

Another best moment for me was when I received a Certificate of Merit (A+) issued by the University of Auckland for my first maths paper. This proved my ability and was a great encouragement and inspiration for my future studies.

What advice would you give to someone who, inspired by your example, wants to understand the world around them?

Life is full of fun. I enjoy every bit of it. This is my motto:

"It's fun to be inquisitive.

Be nosy!

Stick to your passion.

Find out more for yourself.

Quest is fun!"

Let us now talk a bit about Mensa. How did you learn of its existence, and what made you try to be part of the association?

When I was four, my kindergarten principal asked my Mum to take me to a psychologist for an IQ assessment. After getting the score, the psychologist suggested that I join some organisations. One of those was Mensa. But my Mum thought I might be too young to join at that time because my cousin (who is also in Mensa) told her he always played 500 (a popular card game in New Zealand) with the local Mensans until 3am. Their get-togethers were also sometimes in the pub.

However, I was keen to meet some like-minded and intelligent people so I joined Mensa at age eleven when my parents saw me getting along well with older people.

Can you tell us in a few words what does Mensa mean for you?

Mensa is surreal to me as it confirmed that my intelligence is in the top 2% of the population.

What has Mensa given you?

Mensa membership offers me intellectual stimulation via Facebook, magazines and face-to-face. It has also given me international connections. It's so good to talk with the Mensans in Spain.

I have found that Mensans are all interesting people. Mensans do not only like to talk but usually have strong opinions and have a lot to express with a good sense of humour. A single topic can be discussed at great length. We express ourselves freely without having to worry about upsetting anyone.

The Mensans I met are humble and sincere people, particularly the editors of the Mensa's publications. For example, I have been interviewed by highly intelligent people, José Beltrán and our New Zealand editor Ben Booker, asking about experiences that they have already gone through themselves.

Thank you very much for your kind cooperation. Please tell us what are your favourite words to say "goodbye".

Adios. Ustedes hasta pronto. Muchas Gracias por invitarme , José.

José Beltrán – Editor – OMNIA