Transcript

Hi, everybody.

My name is Dr Stephanie Malone, and I work at the Autism Centre of Excellence at Griffith University.

So today I just want to give you some information about what we know about mathematics development in children on the autism spectrum.

I'm very much going to be focusing on those primary school years when children are first learning about numbers and how to do addition and so on.

So today I'll first talk about why maths is important.

We'll then think about the different skills that contribute to the development of our mathematics ability.

And then I'll talk about what do we actually know about maths for children on the autism spectrum?

Finally, I'll give you some hints and tips based on the current research about different learning supports that are showing promise in helping support kids on the spectrum in their maths development.

So, first, why is math so important?

We know that maths is such a central skill.

It's something that is one of those key foundational abilities that we learn during our primary school years, and a multitude of research has shown that mathematics ability goes on to predict our self-esteem, our school success and also our employment opportunities after we finish school.

So, it shows that maths is something that is very central and key to our development.

So, a commonly held belief is that individuals on the autism spectrum all excel in mathematics.

So, we know that this actually isn't the case.

There's a wide variability in children's performance on mathematics assessments.

While some children do really well and show that they have gifted areas in mathematics, there are other children that may be performing in maths at a lower level than what you would expect, given their cognitive ability or their IQ and their age.

In fact, we know, based on research, that children on the autism spectrum are four times more likely to be diagnosed with a mathematical learning difficulty than their neurotypical counterparts.

Well, why is this?

We don't have a really clear understanding about why children on the spectrum may experience these challenges in mathematics.

There's very limited research that's looked at this.

In fact, in the primary school years, up to about 11 years of age, we actually only have about 30 research articles that have looked so it's definitely an area that we need a lot more research in, so we're better able to know how we can support the maths development for kids on the spectrum.

But a good starting point is to look at how neurotypical children learn maths. Now there's been a lot of research that's looked at this, and it's identified that there are two different categories of skills that actually predict maths development.

We have what's referred to as a domain specific skill.

So, these are all those skills that are clearly related to math.

They include numbers and quantity and all those things that are specific to mathematics ability.

We also have domain general, so these are more the general skills that we use across our daily lives.

So, I'll talk about both of these a bit more now.

So, domain specific skills.

What sort of skills have we found in research to support the maths development of neurotypical kids?

So, we have what numbers look and sound like.

So, if you are able to recognise the number five written on a piece of paper, or to understand the word five, then that's actually been shown to predict how well children perform in mathematics assessments.

Now this is clear.

If you don't understand what the number looks like or what it sounds like, it's going to make maths a little bit more challenging.

We also have the quantity and that numbers represent.

So, if I say the word five to you, you can picture what that five means, whether it's five balls or five candles on a cake.

You understand the quantity, the amount that's related to that word.

We then have something that's referred to as verbal subitizing.

So that's a bit of a technical term.

But basically, all it means is the ability to know how many objects are in front of you without counting.

Now, we can only do this for the smaller numbers, but if you look at that array of flowers on the screen there, you'll easily be able to tell me,

"Oh, that's three".

That's you using your verbal subsidising ability, your ability to tell me how many are there without actually having to count them. And then finally, counting ability.

We know counting is obviously important to mathematics because it allows us to work out that one plus two is three.

The counting ability neurotypical kids has shown to relate to math.

Well, what do we know about kids on the autism spectrum?

So, as I said, there is very limited research in this area.

But one research team that's really making leaps and bounds in this area is Titeca et al.

And so they actually looked at a different array of skills that we know should predict mathematics.

So, they looked at counting ability, quantity understanding and those verbal subitizing skills.

And they looked at how those skills relate to maths for children on the autism spectrum. And what they found was that counting and verbal subitizing really seemed like key skills to help children develop those maths abilities.

However, as I said, there's not that much research in this area, but this is pointing us in one direction that we might like to think about more as to how we can help support children.

So in terms of domain general skills, we have executive function.

So again, this is one of those technical terms.

But it basically just is the abilities or the skills that we have that allow us to make plans to organise our thoughts and to pay attention to things – so that's referred to as executive function.

Now we know for neurotypical kids, that is a really good predictor of mathematics abilities.

We have general attention.

If you can pay attention, then your maths is potentially going to be better.

We have language ability, so your ability to understand what is being said to you and to interpret what exactly you are being asked to do - that is related to your maths ability as is reading.

If you think about when you're in school, a lot of the maths questions that you get asked, especially in those primary school years, are very word related.

It could be "John has five balls and he gives two to Nicole. How many balls does he have left?"

So clearly reading has an implication with mathematics too. So what do we know about those skills for children on the spectrum?

So this is a very new emerging area of literature.

Well, we know that attention seems to have an impact on maths for kids on the spectrum, too.

Those children who have lower attention skills typically have lower maths ability as well.

We know executive function is important so people's ability to plan, to organise, those kinds of things actually go on to predict their later maths abilities.

And we also know language is important.

So, children's sentence comprehension and understanding of maths related words (so addition, subtraction, that kind of thing) actually goes on to predict their maths ability as well, as does their reading skills, thanks to those word problems that we always come across in school.

So from that we can see that there are many, many different skills that could be implicated in why some children on the spectrum find maths to be an area of challenge.

But as I've said, we need a lot more research to better understand how it is that children on the spectrum are learning mathematics because it's only through understanding how they are learning that we're really able to target those skills that are going to best support them in facilitating that mathematics development.

However, this neurotypical literature does provide that really good starting point to identify and how we could potentially help support children.

So King et al. in 2016 did a beautiful study where they synthesised all of the best available evidence looking at the use of support strategies for children on the autism spectrum.

Now you can see here that across all of the studies they found there were 28 different strategies that had been researched.

But across all of those strategies there were only 28 children on the autism spectrum that were involved in that

So that's only a very, very small number.

So that makes me think that this obviously is a new and emerging area.

But it makes me feel a little bit cautious because we can't then over generalise the findings because we don't know if the findings from this particular study are going to be generalisable to a wider group of individuals on the spectrum.

So, this is one of the reasons why we can't consider these strategies as evidence supported yet.

But they are definitely showing promise as being potential strategies that can help support children on the spectrum.

We just need to show that they work with more children and it can be replicated, so hopefully that's where the research is going to go now.

But what we do know from this study is of those strategies that had been implemented, there is a link between the use of the intervention strategy and a positive increase in children's mathematics ability, and that was found in 71% of the participants in this study.

So, it's definitely an area of promise, and it's given us an idea that there are potential strategies that may help support Children on the spectrum

So, what did these strategies look like?

So often we find that in the research, people use multiple strategies at the same time.

We often use contingent praise and prompting in conjunction with a lot of other different strategies as well.

So, they found lots of different ones have been used, but the ones we're going to focus on today are least-to-most prompting, strategy instruction, computer assisted and video based.

So what was the least most prompting?

This is where you provide prompting to the children.

If they're having difficulty completing a subtraction problem, you provide a prompt to give them a cue as to what to do.

So, using that least to most methods, you start with the least prompting, in this case providing a verbal instruction on how they can do that subtraction task, moving all the way up to a physical demonstration where you would show them how to do.

We then have strategy instruction.

So, this can be simply teaching a strategy as to how to complete that task, such as when you're working on addition, you could say "Okay, take the biggest number" which in this case, my example, is five "and then add the smaller number".

So, three so 5678 that counting on strategy so it can be just teaching them strategies.

But in this particular research piece here, they used modelling - so showing people how to do it, prompting, the use of graphic organisers and different techniques for memorising the steps of how to complete that maths problem.

So, in terms of those graphic organisers, you have an example just down there at the bottom of the screen so you can see on the left-hand side that we have and the largest rectangle is all.

So, that is all of the objects together and above that it's been divided into two separate sections, which are the parts.

So, this is to show Children how they can do addition problems or group problems as it was termed here.

So, if Jen bought 12 apples and 15 oranges, and so overall, Jen bought 27 pieces of fruit.

So in those parts sections the Children would understand.

"Okay, so 12 needs to go in one part, 15 goes in the other part, and below that, that means that all together we have 20."

We also have computer assisted.

So, one particular study looked at the use of computers and virtual manipulative, so different objects to help with those addition and subtraction problems.

And they found that using a computer programme and also using concrete objects so like little blocks that they can play with actually in school.

Both of those led to an increase in the subtraction ability of the children.

And we also have video based.

So, in this particular study, the little boy loved angry birds, and what they wanted to know was how they could help support his understanding of how to identify numbers, how to write them and how to understand the quantity that goes along with them.

So that figure on the righthand side shows you the steps in that video. So you can see it introduced angry birds, a picture of the boy himself, and then it moved on.

It showed him the number two and what that represented in terms of quantity.

It showed him how to draw the number so he could practice it himself and so on and so forth.

And so using that actually helped to really enhance this little boy's ability to identify, write and understand the quantities of numbers.

So we do still have a lot to learn.

We are very, very much in the infancy of this research area.

We need to know a lot more about the skills that help children on the spectrum learn and whether they're different to their neurotypical counterparts because with that knowledge we're better able to identify support strategies.

Now they're going to help to facilitate their learning in maths, which will hopefully have those lifelong benefits.

But at the moment, the studies that have been done show that these supports are showing promise.

We do need a lot more replication of these studies with a wider group of children on the spectrum before we can consider them to be evidence-based strategies.

But they are showing promise.

So, it seems like we're headed in the right direction.

So, these are the references from today and thank you so much for listening to me.

Bye.