Inglis: Ok. Hello, everyone. Thanks for watching. So I'm very pleased to introduce Vic Simms, who is a reader in the psychology department at Ulster University, and we're here to talk to her about her paper, the nature and origins of mathematical mathematics difficulties in very preterm children. So welcome, Vic..

SIms: Thank you very much.

Inglis: Maybe we could start by you talking us through how this paper came about.

SIms: So basically, what had happened was one of the PI on this project was Sam Johnson, and Sam has a kind of long history that makes for her sound very old, but she's not, in pre-term research. So focusing on children who are born very early and the kind of long term neurodevelopmental and educational outcomes of children who are born very early. And when we're talking about these children, we're talking about kids who are born at less than 32 weeks gestation generally, so at least two months early. So Sam was very interested in educational outcomes of this group of children. And one of the things that had been seen globally across multiple international research groups is that very preterm children as a group of children seem to underperform in school achievement. And whats important to note that not every child born very preterm will struggle in school, but as a group, they seem to have difficulties. But one of the things that really stood out to some was this difficulty in mathematics is something that's out of proportion to their difficulties and any other topic in the curriculum. So Sam was very motivated to try and understand this. And really, I suppose no one before we did this study had really looked in any great detail at what might be the drivers of this difficulty in mathematics and what specific areas you knwow children who were born very preterm, struggling with. Was it just kind of a global difficulty with mathematics in general? Or were there very specific issues with mathematical topics, for example? So Sam was really motivated around that, and the charitable partner or the funder of this grant is actually medical research, and they have focused a lot and obviously medical on the medical research in keeping very preterm babies alive, making sure that they have good health outcomes, but hadn't focused so much on the educational outcomes. So they were very interested in doing something more around education. So that kind of combined Sam's interest and motivation from the literature, but also with the funders' interest in terms of looking at educational outcomes, more long term outcomes for this group of kids.

Inglis: Yeah, because I guess if you're keeping a load of people alive who previously would have would have not been alive, then you start worrying about their Quality of life as well.

SIms: Yes. And I think that's a really important point is basically over the past 20 years, there has been a huge increase in survival rates of children born very preterm, especially at the extreme ends. Babies born at twenty three weeks gestation. Twenty four weeks gestation, which is just right on the line of viability. And so we've seen massive increase in survival rates because of drug developments. Surfactant is a drug that we can give these little babies to help their lungs protect their lungs. But what we have seen across the globe again is kind of stagnant neurodevelopmental outcomes. So no real kind of improvement in long term developmental outcomes, but definite increases in survival rates. So these children are entering into the school system may be struggling within the school system on increasing levels of numbers. So, you know, maybe in England, we reckon around every classroom, every primary school classroom has two children who are born at least preterm, so at least less than thirty six weeks gestation.

Inglis: Yeah, that's a lot. That's a big issue, isn't it? Yeah. Okay. So let's talk a bit about the paper. So basically, the structure of the paper is you have a control group of typically developing children and an experimental, I guess you could call them control and the experimental group of preterm children. And then you compare their performance on a range of domain general cognitive batch of performance on a range of domain general cognitive tasks and also some mathematical specific tasks. I'm curious, how did ... I mean obviously there's a massive array of possibilities there... How did you choose which ones to select to compare?

SIms: So I think the first thing I'd like to point out is the kids who were control kids were kids from the same classroom as the child who was born very preterm. So for that, that's quite important because we're trying to control for educational experience. So that's one thing. Then when we look at those cognitive factors, really, we knew quite a lot in the literature around your developmental outcomes for preterm children because standardised assessment of neuropsychological measures is kind of quite typical within that literature. So we knew that there would be some areas that we could predict we

could try and replicate to find developmental differences within working memory and visuospatial skills, for example. And then so we were quite motivated by that. But we also knew that those from the literature around just general mathematical cognition, we knew that they were also important factors for predicting more general mathematical learning anyway. So kind of to to decision making process going on there in terms of what we know about very preterm brains and what we know about what's important for for mathematical learning more broadly and then for the mathematical specific skills. No one could really assess these before within a very preterm group. So it was difficult to be motivated at all by the literature in prematurity. But all of those skills are component skills that we know consistently come out from the kind of mathematical cognition literature as being important, kind of confidential or foundational skills for more sophisticated mathematical achievement. So we were kind of motivated mainly by the general mathematical cognition literature for test selection. But then obviously as well, we really wanted to assess that kind of and try and replicate those kind of neuropsychological difficulties that we have been find previously in the very preterm groups within. just more broadly as well, we know that very preterm children have a kind of phenotype of being inattentive. And so we had additional measures that were in a more kind of new screening paper that we also were able to measure at the same time. And these were kind of parent reports rather than this task that we did with these children within this paper are very much one to one standardized assessments.

Inglis: Ok. And in terms of the mathematical tasks you talk about drawing from what we learned from the numerical mathematical cognition literature on foundational skills, but how easy do you think that was like, you know, how how coherent do you think that literature is to draw on for that? I mean, it strikes me as the way you described it then probably makes it sound easier than it was. I mean, the literature there was like a bit of a mess to me. Is that fiir,

SIms: No. I think that's a fair assessment. I think that so even just more recent work that we were doing with preschool children, it seems to be that there is this kind of coherent story around what are foundational skills for early years learning. And actually, when you look at the literature, there's very little longitudinal data collection and there's very few studies that measure multiple skills at the same time and track those changes over time so that we can actually concretely say these are the foundational skills. So yes, it's having to be quite broad in the literature review and in order to be able to capture what

are things that are consistently being pulled out through different research groups as being important. So yes, we couldn't say that there are these kind of The the the papers that exist in terms of foundational skills are selective and the measures that they use in the first place. So therefore it's very difficult to be able to say these are definitely the things that you absolutely need to measure. But I suppose it's trying to get that broader overview of the literature to be able to assess things that you think have most evidence to suggest that they are important for the for the further mathematical achievement or the higher level mathematical processing.

Inglis: Yeah. Ok, thank you. And I think one of the things you say in the paper towards the end is that a big goal of that project was to develop interventions that at least inform the development of interventions that can help academic performance in pre-term children. So how have you? Could you tell us a bit about how you imagine that working or how that has worked since you, since you wrote that paper?

SIms: Yeah. So I think for me, this this this collaboration was really fortunate for me or whatever. I don't even know if that's a word. And but I was a postdoc at the time and I saw this this post advertised come and work on this PRISM study. I'm really at the time when I saw that job advertisement it was I was very motivated because I assumed and the literature suggested at the time that children born very preterm were dyscalculia, shared the kind of underpinning mechanisms of their mathematical problems. That was the kind of current thinking in 2013, 2011, 2013 that dyscalculia was driven by weak numerical representations. So that was kind of what motivated me around joining this research team. And therefore, at that time, the suggestion around intervention was the kind of dyscalculia intervention of maybe training these representations, trying to really go down deep, low in terms of numerical processing. And so, you know, the idea maybe at the outset of the study was if we find that difficulty in numerical representations, do we have this kind of quite tailored specific training for very preterm children? And what came out of this study was the absolute reverse was that the actual foundational skills were not so problematic. There were no differences in terms of very preterm children on their term born classmates in terms of doing non symbolic comparison or some bullet comparison tests or no line estimation. Even so, what we saw was actually the drivers where general cognitive skills, working, memory, visuospatial processing. And so I think that really flipped on the head the way we approach thinking about intervention for these children, and it's much more systemic. It's much more thinking about the classroom

environment and how we, you know, there have been suggestions to do working memory training. We see that that's really ineffective in large systematic reviews. We know that the evidence of transfer from working memory training is no, basically. So what can we think about supporting children's working memory in the classroom? How do we break down instructions? How do we break down problems? How do we support very simple things or visuospatial processing? And many parents have reported around their very preterm children that they find it very difficult to align digits and column on blank pieces of paper. Simple intervention use graph paper helps alignment. That's a very simple visual spatial intervention. So those are the types of things that we think about in terms of intervention. We haven't trialled an intervention. But what we have done is developed a kind of teacher friendly resource, an online resource training program last set by an hour. And teachers can engage in understanding what prematurity is about and the types of educational issues that some preterm children might face. And then that also provides them with resources. I'm really practical ideas, such as what I just explained or I'm working memory and visuospatial skills. So it's kind of moving from my very cognitive approach and thinking more about the child in the classroom has been the kind of suggestion for intervention from from this study.

Inglis: Mm-hmm. But it's worth highlighting that, you know, a negative contribution like this sort of training probably is not going to work is actually really essential because as we know, many, many large scale trials in education fail, possibly because they've that kind of work has not been done to test the proposed mechanisms of.

SIms: And I think that this is where this type of research, I suppose if we were in biomed or something, we would call, we would call it bench science. You know, it's basic. Science is really, really important because if we don't understand the mechanisms that we don't understand the underpinning cause, we can never generate interventions effectively. And so therefore, being able to really understand that this group of children are not showing issues here they are showing issues here is really important to tailor those interventions. But also, I suppose it's thinking slightly outside of our kind of or I suppose I'm specifically coming from a cognitive psychology background, developmental psychology, background, thinking about how this works in practice and how it can be scalable. And so therefore sometimes not thinking about this kind of individualistic. Training up a system, but more thinking about how the broader system could change is quite important as well.

Inglis: Yeah, that brings me on to my next question, actually, because this week we're considering your paper as an example of what I'm calling contemporary mathematical cognition research. So I'm kind of you've used that, that terminology. Well, these mathematical cognition already. Maybe I can ask you because for some background, so you work in a psychology department, not an education? Yes. Yeah. Which raises an interesting question about what mathematical cognition is, whether it's a branch of education or psychology or some combination. How do you know for someone who's new to mathematical cognition, how would you describe it?

SIms: So I suppose that's a really interesting question, I think that I see mathematical cognition as being a fundamental component of cognitive psychology research. It's something that has been historically, you know, even though we've only really made great leaps in progress over the past 20 years. Historically, there's great history in terms of understanding mathematical concepts, mathematical. If you want to call them representations, you're going way back over a hundred years, which I think is fascinating. But I suppose I sit comfortably within a school of psychology because of the kind of cognitive influences within that. But I do see it as a very interdisciplinary field because we have to work with with our educationalists. We have to. The philosophers have given us great insight into mathematical cognition. And so I think it's much broader than psychology, it's much broader than education. And I think as well that more and more as we recognize this, you know, some of the work that we've been doing around kind of more social influences on development, and we're seeing some really interesting work coming from ethnographers, for example. So yes, mathematical cognition core is the mathematics, which is an educational topic. I suppose you could describe it as that and cognition, which is pure psychology, married together. But then we have all of these other domains and disciplines around it that are really, really essential for us to fully understanding how the human mind processes mathematical content.

Inglis: And that's what you would describe as the sort of core goal of of the Mathematical Cognition Research Program with you, how the human mind understands mathematicsIf it have no education.

SIms: So that's the motivator for me, and I suppose that many people are motivated in different ways or on research, you know, and I would say that I'm very theory driven. I'm

really interested in psychological psychological theory. Or it could be educational theory if you were coming from a slightly different background and the theory, the theoretical element for me really motivates me. And that's not to say that the intervention and the improving children's outcomes is not also a motivator, but for me, my primary motivator has always been about that theory and understanding how these things work. And whereas some people may be more slightly more motivated by improving outcomes, that makes me some kind of cold hearted science. But that is my driver. But with but with the long term aim of doing good interventions, and I think that this is a really important point that we have sometimes rushed to intervention with, as I've said before, understanding the mechanism. And then we were surprised that the intervention doesn't work when we don't really understand the underpinning. Sometimes intervention can help us understand the mechanism. That's really important. It's experimental psychology, but you I think for me, the motivator is to understand that the human mind is processing that information. What are the mechanisms that are being used and therefore then that will help guide us in terms of improving, improving children's outcomes.

Inglis: Let me ask you a bit about how ... so in some some times, people who don't work within a sort of cognitive within a cognitive research program in education circles are worried about cognitive research because it isolates individuals and children are considered a single, you know, people who don't do anything apart from contribute to a mean and they say, perhaps, you know, classrooms are really complicated places with massive interactions going on, and you can't really understand education without engaging in that kind of social interaction. What's your response to that kind of critique?

SIms: So I think I've always taken the approach in, well, I suppose over the past six, six years since I joined Ulster University, there's a development. There was a developmental psychologist who's now retired, Christina Dale, who always worked from Bronfenbrenner bio ecological model of development. And I love it. It's how I kind of position most of my work. And really within that model, you have the child in the centre and then circles of influence where the child is pushing out and the circles of influence are pushing in in terms of their development. And so my argument always around the kind of argument that you've just sat around, you know, the complex systems is absolutely there are complex systems that are going on around the child, but the child themselves is a complex system. And if we don't understand the child themselves as

complex systems, we can never really understand their influence out and the influence in from the the broader context in which they're in. And Bronfenbrenner is all about the individual child and the processes and the mechanisms that's going on within that individual child and the context that that child is in. So as a cognitive developmental psychologist, I really do want to focus on the individual child because they need to understand the profiles of development, the profiles of skills that those individual children are bringing in to the very messy, complex system that is the school environment or the home environment or the workplace. And so my argument is we can we can never focus on one or the other. We have to be able to both have to contribute to the. Understanding human development.

Inglis: Lovely, thank you very much. Well, we've we've gone over time, so apologies for. Sorry. No, no, no. That's very, very generous with your time, and I appreciate that very much. So thank you very much. I will. I'm sure the people watching this will have a very much appreciated you giving up your time to talk to us. Thank you.