Making Math Meaningful for Autistic Students

A presentation by Jenny Root, PhD, BCBA on April 17, 2024.

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Most of you are here now. Let's go ahead and get started. Again, to those of you who just joined us. Good afternoon and welcome to today's webinar, Making Math Meaningful for Autistic Students. My name is Rachel and I'm your host for today's event. It is so great to have you all here today, and I have the distinct pleasure of introducing today's speaker, Jenny Root.

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Doctor Jenny Root is an associate professor of special education at Florida State University. Her research focuses on supporting the development of meaningful academic skills for students with autism and intellectual disabilities. Before going into higher education, Doctor Root was a special education teacher at a public middle school in North Carolina. Without further ado, I will now turn it over to Doctor Root.

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Go ahead and take it away. Hi everyone. Thank you so much for joining me. This is always really exciting when I get to talk about one of my favorite topics which is how do we make math meaningful for our students with autism? So I want to start by, posing the question that I'm often asked, which is why math?

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Why should that be the target? Why is that the focus of your research or professional development? And it's a logical question, especially when you look at how time and resources are spent within schools. The majority of that is put on literacy, which is important. I don't think anyone will ever say that reading and writing are not important.

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But what I hope I'm able to communicate with you today is that math is also really important and that it can serve as a vehicle for improving quality of life and increasing opportunities. Another reason of why math is because, another reason for that question is there are so many other areas that teachers, parents, support providers if people with autism need to address and support.

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So speaking for my experience as a special ed teacher, you know, it wasn't just the core content that I was responsible for. It was also all those other areas of daily living, self-determination, mental and physical health. I taught middle school. We spent a lot of time on hygiene and

personal care. But math really touches all of those other areas.

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So what I want you to think about, on your own, is what makes math meaningful to you? So perhaps think about in the past 24, 48 hours, how have you used math to go about your daily life? I know, myself, I talk a lot about, like, calendar and clock math. As far as knowing what time do I need to leave the house?

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How long is it going to take me to get ready? How long does it take me to get my children ready? You know, kind of doing the backwards math from there. There's also I had to stop and get gas this morning. Right. And so thinking, wow, it's gone up quite a bit per gallon. Right. So I'm looking at like unit rates and, the another common example that I give is when you're in a hotel, right.

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And you need to be able to find your floor and maybe you get your room number. That's 1350, right? So there's some, apply generalizable knowledge there to know that when you get into the elevator, you're probably going to be on the 13th floor. Right. And so being able to find that button, and then when you get off the elevator and there's often sort of the signs that say, you know, rooms 1325 to 1300, go left, 13, 26 and above, go right, right.

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And being able to know like, oh, my time in 1350. And so I need to take a right. And so what makes math meaningful for all of us is what makes any skill meaningful. And that's when we can actually use it, right? It's when we can use the math skills that we have developed to, in relation to hygiene and personal care, in relation to daily living skills and social skills in our transportation and employment related skills.

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Right. So what makes math meaningful is the ability to apply and use it. And so I would take it a step further and say that what makes math meaningful is the ability to problem solve. And by that I mean the ability to well, one, we have to recognize there is a problem, right? So we have to have some goal directed behavior of knowing what it is that we want to do.

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So taking it back to the simple, finding your hotel room example, you need to have that goal of I need to find I need to get to my room, and then we break that down. I need to be able to find the elevator or find the right floor, know which way to turn right and choose a strategy.

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So say we get off the elevator. We look at the room and I choose a strategy. I'm going to go left, but I see the room numbers going, decreasing. 1320 1319 1318 I am not getting towards my room. That's monitoring my progress. And then I need to make a change, turn around and walk the other way. Right.

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Probably just wasn't paying attention. Or there were two children talking to me at the same time or, you know, whatever the situation is. And so this is a very simple example, but this is the case for any aspect of math. It's being able to know that there's a problem, that I can use these skills to solve.

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What strategy should I use? Am I moving towards my goal or not? And then how do I maybe need to make changes, which requires metacognition? So what makes problem solving then meaningful is the ability to generalize, right? I don't know about you, but when I was being taught those basic foundational number sense skills of counting acquired analogy, cardinality, order of magnitude of numbers, it was never done within the context of finding a hotel room.

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Right? We cannot possibly teach every scenario and situation where a student might need to apply math skills. It's impossible. But we do have to make sure that after they first initially acquire the skill that they're able to actually apply it and generalize it. And what we often do is we teach for acquisition, and then we're frustrated when there's no generalization. In reality,

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if we haven't supported that, if we haven't made the math meaningful and built the skills up to where they can be generalized, that it's an instructional failure. So I want to briefly go through sort of reviewing what these four phases of learning are.

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I'm having a lag and changing the screen. Can you help me Rachel?

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So acquisition is the most basic stage of learning a new skill or concept. So these stages of learning that white and hearing first proposed in the late 70s, they aren't new. so and they aren't only applied to math. So, when I talk about these phases of learning, it's anything any adult learns, as well as any child.

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So when we're acquiring a new skill, it just means that it's just that it's new. Students, people are often going to make a lot of mistakes, and they're going to need a high level of support. I like to think of it similar to teaching a child to ride a bike, right? So my seven year old right now, it's beautiful springtime here in Florida.

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And that's one of the things that we are working on. And we do it in, we go to a parking lot, at the pool in my neighborhood where, you know, there's no cars, there's no traffic. We're not doing it at night on a busy street. You know, it's those ideal conditions and any little bit of success we get, we are celebrating and praising.

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Right? And just like this parent is showing in this picture here, I'm right there with them. It's that high level of support. And it's the same case when it comes to supporting math instruction or any academic skill.

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So fluency then is the next phase of learning that we want to move into. And this is actually when the skill begins to be useful. It's how anything that we've learned is when we can use it at an appropriate rate. We often think of fluency when it comes to like, reading and words per minute, which certainly is one measure of fluency.

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But it's a little bit more than just that discrete skill. We don't always have to have a stopwatch with us. And it means can we use the skill with ease and efficiency? Which is particularly important for academic content, like math that might be new to, to an individual or for in the case of students with autism, requires many, many skills at the same time can be difficult.

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It requires quite a bit of executive functioning. Math places a lot of demands on working memory. And so a benefit of making sure that we're building skills up to fluency is that then they aren't one of, they aren't having to put so much cognitive energy on, let's say, more basic foundational skills. Instead, they're able to focus on that reasoning and problem solving.

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And we don't want to be, build speed at the expense of accuracy. Once students have or anyone has built up to a level of fluency, we then want to make sure that they are able to maintain those skills. And that's not just like a one time peak. So this is that ability to perform response over time without any reteaching.

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And if fluency is when learning begins to become useful, maintenance is the bridge to generalization. Because if we have to reteach something every time it's encountered, then we can kind of consider it not really learned. And we're certainly not going to be able to generalize that to a different setting or, you know, different, group of materials. When someone is at sort of that maintenance phase, you can see it, you can think of it as is it a habit.

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Are they able to self initiate? Are they accurate and consistent over time without having to go back to reteaching or high levels of support? And then finally, generalization is that final stage of learning. Some people also refer to it as transfer. And that is the most important part. That's when not only is it useful, in the context in which the skill is taught, but I can now apply this skill whenever it might be appropriate.

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So it's being able to consistently, accurately and independently perform a skill, under different conditions from what you learned them. So being able to use your number sense and reasoning to able to know which way to turn when you get off the elevator.

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So the phases of learning to me really anchoring our instruction in where is the student, is this a brand new skill? Do we need to support them to acquire it? Are we focusing on becoming more fluent and maybe decreasing some of the supports we put in place? Are we focusing on making sure that they're able to maintain it over time, or generalize?

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All of that is based on a condition of what do we teach them in the first place? And so what I'm going to emphasize is that in math instruction, we are not only focusing on what to do. So the procedures how do you add with regrouping? How do you use a calculator to find a percent of a number?

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But when or why would you actually need to use that skill? And being able to appropriately select strategies based on the given situation that they're in. So when we think about some of the individuals that you may support in teaching or in providing services or your own children, we might wonder, like, well, why aren't students with autism able to meaningfully problem solve?

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Why am I not seeing this generalization? And I would say we have to go back to, how are they taught? If we want meaningful problem solving, then the instruction should be within a meaningful task that we need to make it really clear the so what or when am I going to learn or use this? It needs to be explicit and considered right from the outset

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when we're designing instruction. However, there are kind of two main reasons that I think about why this isn't taking place. And you'll see from the year one impacts, the other is this negative circle that we get into of often there's a very limited conceptualization of what math instruction will be meaningful for an autistic student. And often what I would consider meaningful math word problem solving, grade aligned skills is not a priority, maybe for that student.

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So it's based on what the curricular focuses. What have they been taught before? How has that instructional time been spent? Now, for some autistic students, this might not be because the teacher just didn't value math or had a deficit view of them. It may be that out of the hours of the school day, we have competing priorities and focusing on perhaps communication, adaptive skills, decreasing challenging behavior, increasing the ability to demonstrate learning skills.

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Maybe that was the focus early on. But I always counter that also with if they're not learning something meaningful, if it's not clear why I'm doing what I'm doing, why I'm learning what I'm learning, why would I be engaged with it? So we have this curricular focus issue of where we might have students in upper elementary, middle high school who are lacking a lot of foundational number sense skills because it hasn't been a priority.

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But then at the same time, their perceived ability keeps them from also having more instructional opportunities. So they're seen as well. They're not ready for that yet. The most of my research right now takes place in middle school classrooms and we're teaching skills like, that are based on multiplication. So understanding ratios, unit rates, proportions, understanding percents and percent of change like in the context of leaving a tip, or you know, finding out at discounted price.

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And I'll often have teachers say, well, my students aren't ready for that. They aren't firm in their addition and subtraction. Right? So we have these preconceived notions of what it who gets to be taught what and what needs to happen in order for a student to have access to meaningful math instruction that our, just falls. I really like this quote from Jose Vilson, and it says, "There's a lot of people right now who've been given permission to be innumerate because society has deemed innumeracy as OK. As long as you're not a math person, it's perfectly fine to fail math."

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And this is very much my identity. I kind of historically said I'm not a math person. I'm not good at math. I thought, and this is just an example of the inherent ableism that I had, was that, I thought, well, I want to become a special ed teacher, so I don't need much math anyway. And that's okay, because I am a girl and I'm good at writing and reading, and I have these other strengths and there's not the same stigma of saying, like, I'm not good at reading like there is

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I'm not good at math. And so I think we use these biases that we have and these views we have with ourselves, and they impact the opportunities that we give other people. the other thing to consider is how sort of the the history of where our focus has been in special ed, particularly in determining instructional priorities.

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It's kind of like walk you through the decades, in the 1970s when we were, you know, it was the deinstitutionalization movement. It was the first time that, schools had to educate and provide free, appropriate public education to all students, including those, with autism and intellectual disability. At that time, you know, there wasn't a lot known about how to support, skill development, particularly for those who previously would have been in institutions.

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And so that was very much a developmental focus on curriculum. You know, this emphasis on mental age, that the mental age of an individual is at like a 2 to 3 year old level, then that must mean from this bottom up approach, that their instruction needed to target 2 to 3 year old skills. Right. And we kind of see artifacts of that still when we see, age inappropriate tasks or things that are this false belief that you have to be able to do one thing before you can do another that mathematically isn't true.

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In the 1980s, Dr. Lou Brown, graduate of Florida State, proposed the criterion of ultimate functioning, which was basically, what do we want individuals to be able to do when they leave school? Like, what is that criterion? Where do we want them to get? And and maybe we should prepare them for that. And that's where we saw a shift into portable functional skills.

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Functional curriculum. A lot of community based instruction realizing that maybe the instruction needs to take place in the community, where the skills will be applied. The 1990 saw a growth of social inclusion, the focus on self-determination and social skills training, but not from a perspective of we're all going to be learning the same things. In the 2000, as we saw federal policy changes, things like, the authorization of IDEA, the No Child Left Behind act.

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The increase in accountability for school, at the school level changed the instructional priorities. So there was an attempt to balance academic, which was sort of this new demand with functional skills, despite a lack of research and training. It was a totally build the plane while you fly it situation as then, those the growth of evidence based practices and researchers like my mentor Diane Browder starting to, you know, chip away at how do we teach academic skills that previously individuals had not had the opportunity to teach, to learn?

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I think we're now moving into this focus on grade aligned academic standards using evidence based practices. The advent of technology has certainly increased opportunities, but I think we also need to look at sort of a larger societal context of what's changing, and that is increased opportunities and expectations for post-secondary lives. So autistic students graduate. And then what?

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And we know that often transition is the transition to nowhere. And my perspective and my goal is that when students with autism are experiencing their K12 math instruction, are they being provided with meaningful, useful skills so that they're able to take advantage of the opportunities that, frankly, we can't even imagine yet? You know, I think five years ago, just thinking about something like ChatGPT, but a lot like was not even in, you know, on the radar for me, maybe for other people

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it was. And so I want us to kind of go through this walk in history to challenge you to think about what assumptions are you making about the skills that autistic students need? And is that based on your understanding of, what you were taught or like, what things were when you were trained? Are we preparing students for their adult lives in 2032, or are we still kind of stuck in 1992?

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So in order to have meaningful problem solving tasks, excuse me. In order to have meaningful problem solving, the task matters. and so you should be seeing a poll pop up on your screen. And I'm curious how you would describe your K-12 math experience. Right. So you could say, are your math experiences great? And you love math or your math experience is great, but you still don't love it?

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Or are they okay? Just kind of made it through? Or was it awful? But you still like math and or were they awful and you hate math? That last option is probably what I would have chosen. For a very long time, up until, I started doing research in this area and realizing, I wasn't bad in math. I was actually very good at it.

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It was just the way that it was being taught to me. It did not seem meaningful. And what was expected was compliance and turning in work was reinforced over actual conceptual knowledge of what it was that I was learning.

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So I don't I'm not able to see the poll results. They all say 0%.

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Sorry about that. So we have 31% of our attendees say that their math experiences were great and I love math. 4% of the math experiences were great, but they still don't love it. 43% of the math experiences were okay. I made it through. 12% my math experiences were awful, but I still like math and 10% my math experiences were awful and I hate math.

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So I would say based on my experience, giving very similar poll questions over and over, that seems about typical. And I think kind of the really interesting piece there is the people who had positive experiences. Very few of them still hated math, obviously. No, like conclusive, can’t conclude anything from that. But I think it's an interesting pattern that I repeatedly see.

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As Thomas and Berry say, “The ways that we experience our math instruction influences how they identify themselves as doers of math.” I experience math instruction as being I sit at my desk and my teacher is at the overhead projector and, solved a few problems. I was supposed to watch. I supposed to have learned, ask questions about questions I didn't understand, and then I'm supposed to do it independently?

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Probably do like ten more problems when I got home, which I never did. And then come back and ask, right. So the way I experienced that math instruction told me I'm not good at math. Reality was, I had ADHD and I wasn't paying attention. It wasn't interesting to me. I was also probably reading a book under my desk.

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So our beliefs and our assumptions influence outcomes and what we think and what what conclusions we draw, right. So we are constantly bombarded by stimuli in information in the environment. And then our, brain selectively choose what we pay attention to. And then we assign meetings to that that are very culturally and personally loaded, those meanings that drive assumptions, conclusions, beliefs and actions.

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And so that's why I want to take the time that we think about what assumptions we're making about math and its meaningfulness or not, based on our own experiences and how that influences what we determine is meaningful for someone else. Often, we come from a very deficit perspective in special ed of what an individual can and can't do. And...

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It's important that we do identify skill needs, strengths, weaknesses and then areas of improvement because that is our that is our job. That's the function that we play with the school ecosystem. But I think that the way that we phrase that makes a big difference. So I like to kind of present it in this way.

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Each of us ideally have an alignment between the demands of the environment that we're in and our own personal competence. Okay. So if we say, like, is a student able to do math or you can put me like it, are they able to teach at university courses? Right. So, yes, I have self-selected into a job that where the demands in the environment pretty much align with my own personal competence.

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Sometimes our personal competence isn't what changed. It was the demands of the environment. So COVID is a really good example of this, where, the you know, how effective is Jenny in teaching university courses? Well, my competence didn't change, but all of a sudden I needed to be doing that, all of that entirely online, asynchronously often. Right.

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So sometimes the demands of the environment change, not our own personal competence. It's the same for students. Other times, perhaps the demands of the environment have remained the same, but our personal competence has decreased. And I think this is where we don't think enough about the impact of executive functioning, working memory, cognitive load, and even our own like social and emotional states as the adults, much less for the children.

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Right. Or, students. And so the way we think about my personal competence, the way that I can do my job is quite different on like a Monday afternoon versus a Friday afternoon. Right? Or when I'm not feeling well or hungry or tired or feeling overstimulated or I have this other stressor going on in my life because we are whole people, just as children are whole people.

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and so we hold people with disabilities to very different standards of, oftentimes than we do ourselves. So really, what we need to think about is, versus thinking like, what is the student able to do? Sort of a deficit based, because you're then coming from a perspective of assumption, assuming that there are things that can't.

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Instead, let's think about a strengths based approach where we phrase it more as what supports does a student need in order to do math? So rejecting the premise of whether they're able to do it or not? When I think about what supports might they need? And that also is taking the blame away from the individual, like, oh, well, they're not able to add and subtract versus thinking about, okay, well we're focusing on ratios because that's the grade level standard.

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What supports are they maybe going to need in order to be able to gain proficiency in ratios? Which might mean that we need to consider their foundational number sense or their skills and in addition subtraction and develop some compensatory supports. So I take the social ecological view where we have the demands of the environment and an individual's personal competence.

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And we can look at both of those things. Environment and systems are disabling when students with autism are not provided meaningful access to the general curriculum and opportunities to learn math, we have disabled them. We have often in elementary school, determined with the entire life trajectory will likely be because of the instructional opportunities we did or did not provide.

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But then there's also personal competence, right? So it's not that I think the environment, if it's just more and more inclusive, it would erase a disability. No, there's still going to be a pattern of strengths and weaknesses, capabilities and limitations for individuals. And so we want to look at what's that mismatch. How much can I adjust the environment.

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and then how from there, what do I need to do to be able to increase an individual's personal competence? And we signal our views about people, through the words we use, the expectations we have and the supports we put in place. So if we think about the words that we use, instead of saying like, well, they're a Gen ed student or they're a special ed student or, you know, they are well, they're nonverbal, right?

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That's not really helpful if we're just saying, well, they can't learn to read or write, like, what's the point of what we're doing at all versus if we view it as students who need support in X. So it's a is it an instructional failure happening? The student isn't able to do...there are barriers to them achieving this goal.

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So why and how can we maybe solve that? And I appreciate what Marty Snell says which says, “In addition to their collective diversity and need for lifelong supports, individuals with extensive support needs, which includes those with autism, share fundamental human trait. And that's the capacity to learn.” So I think we have to start from the position of assuming everyone can learn, and that math is meaningful and beneficial for everyone

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depending on how it's taught. So it also challenge us to think about the language that we use generally to talk about autistic students. So sort of reframing and reconsidering things like, “Oh, he's obsessed with cars” versus like, “He's very passionate enthusiastic about that.” Thinking about, you know, the he has severe meltdowns, right? Or he's

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now, what if like we just feel emotions intensely and that can be a strength because we also feel good emotions intensely? It really bothers me to talk about like, well, they're rigid with routines and not flexible. Well, like, maybe they prefer consistency and sameness. Who doesn't? Who doesn't like predictability? and so the impact of sort of these maybe unconscious thoughts that we have are that we, as I said, from a very early standpoint, are determining sort of who goes where.

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So I think about this, in the context of supporting inclusion, where why why would we have students in the same classroom who aren't going to the same place, who who aren't learning the same things? I equate it to a road trip, right? If we don't have the same final destination, why would we ride together? versus maybe eventually we're going to have like, different destinations.

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But we don't have to determine that in kindergarten or sixth grade or probably ninth grade. and then beyond that, why are there only two choices? And who says who has to go to each place? Particularly given how technology is rapidly evolving and changing and increasing opportunities and so we might be making these decisions really quickly in a very uninformed way.

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I like to bring up the criterion of the least dangerous assumption here. and this is from Anne Donnellan. So the criterion of least dangerous assumption, it's got a lot of, double negatives, but it's in the absence of conclusive data, educational decisions ought to be based on assumptions which, if incorrect, will have the least dangerous effect on the likelihood that students will be able to, and I say, have enviable adult lives.

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So essentially with the least dangerous assumption is saying is that if we don't know, if we don't have conclusive data.

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Which decision can we make that's going to have, the least harmful repercussions if we're wrong? And so we want to present either the instructional strategies that we use to what it is that we're actually teaching. We want to certainly collect data so that we can then use that to inform knowing what is effective, what's not effective, what students can do, what they need support in.

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But let's be careful to think through what the implications are of our choices.

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So Cheryl Jorgensen in her commentary on the standard assumption said that if a student doesn't learn the quality of instruction, then I would add, as well as environmental demands and supports should be question before the students ability to learn. Right? So are we taking a look at everything that sort of the adults in the room have the ability to control and seeing what can we do to ensure that the student is learning and use that to drive

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what supports that we provide? I think the other thing that this does is to help center variability. So versus seeing, you know, I what maybe works for, gen ed students and then oh, then the but then the student with autism isn't working for them. Right. And very much others stem...it presents their need for supports as a as a deficit or a burden.

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Instead, take the perspective of variability is just a natural part of the human condition. Everyone who comes into any classroom is going to have strengths and needs. Certainly, knowing that someone has autism can help us to predict what some of those might be. But everyone has strengths and needs, and needs different supports at different points in time.

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So what I want to leverage then is as we're thinking about this natural variability, and not wanting to make a dangerous assumption, then let's use the data that we do have and the evidence we do have for effective instructional strategies. So I'm assuming that most of you have probably heard about the science of reading. It's in popular media and popular press now, which is fantastic.

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And if you're not familiar, not sure what it is, the science of reading just means a body of research that relies on knowledge accrued across disciplines - gen ed, special ed, ed, psych, communication sciences, neurosciences. And the focus is on how people learn to access and comprehend text. Science of reading is not a person. It is not a group.

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It's not like a trademarked thing, right? It's about talking about the body of research. Similarly, we have the science of math. It's a body of research that relies on knowledge accrued from multiple disciplines to focus on how people learn to be doers and thinkers of math.

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So proficiency, then, should be our expectation for all learners. We should have the expectation that all students, when provided with, high quality instruction and supports, should be working towards the same things. They should have conceptual understanding in math. They should be able to have flexible strategies that they use, procedures to solve the problems. They should be able to choose one strategy over another reason and explain and then see math as sensible, useful, and worthwhile and see their own identity as someone who can do math.

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So, in order to have meaningful problem solving, we need to have these meaningful problem solving tasks. All right. So I love this peanuts cartoon that says, “Only in math problems can you buy 60 cantaloupes and no one asks what the heck is wrong with you.” Right. So when we think about what is a meaningful problem solving task, often the word problems that are created as a part of like Basil curricula, even curricula that are designed for students with disabilities often are not realistic.

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You know, why do you need 60 cantaloupes unless maybe you're like a caterer? Are you doing bulk purchasing for a grocery store? Like when in real life, why do we actually need to do that? So instead, the first step to having a meaningful problem solving task is to select a real world context. When might a person actually need to use these skills?

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Are there activities or routines? Things like...feeding pets and animals. Maintaining a garden or a yard. Right. There's how can we use that context to make the math or teaching meaningful? Are there relevant IEP goals? And then importantly, are their independence opportunities? So for example, being able to manage medication or even if it's not totally independently understanding that, you know, some that the amount of medication that you take matters. You have to follow the directions.

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Right. Being able to know different milliliters, how to find that on a syringe. So having young children that's what most medicine we administer looks like. Right. Even being able to estimate.

I remember getting a call from my husband when I was out of town and one of my children was sick. I need, you know, he asks like how much Tylenol or whatever to give him. That's on the box, but, I think it was like 7.5ml.

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And he said, well, that's not on here, right? We only had the cup. So he needed to be able to estimate, you know, if the cup only has the marking for five and for ten being able to estimate and understand where 7.5 might be. So an example of a real world context that estimation is important as well as fractions. And ways that we can think about how do we solicit or what's the importance of using a real world context.

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One is it's making it immediately clear, like, so what? Why does this matter? It's what makes learning truly functional. And we can use that to make instruction, culturally and personally relevant as well as a way to address multiple priorities. Going back to what I talked to at the beginning of the webinar where individuals with autism have more than just math, science, social studies, and reading to learn in school.

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And yet, and especially teachers, we had the same amount of instructional time as everyone else. And so I joke that efficiency is my love language. And I think it comes from this constant feeling of I have more to do than time and capacity. And so we can address multiple priorities at the same time through our math instruction.

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One of those that makes a lot of sense is, is self determination. So goal directed behavior, as well as things like our transition goals or personal finance related things, I like to use the example of concert tickets, especially now that, you know, we're back to having live music again. And I can remember having, working in a high school classroom and having students, who, really love seeing live music.

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And so that was something he was saving up for. And so we could think about, like, how much money you earn per hour in a job to be able to afford a ticket. The teacher was really great about teaching them. You know, the tickets don't just show up on your parents phone. We don't print them at all anymore, right?

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They don't just show up. You can actually select which seats you have and find them and compare prices. and so there's a it's just one like small example of how you can incorporate preferences and meaningful activities within, whatever the math standard that you're using is. So the real world context can come from video problems are great example.

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Even just using videos or like real world stimuli to look at. So things like using menus, using going to weather.com and looking at, you know, comparing the temperature across the country. And what does it mean for to be a negative temperature. Right. Where would it make sense for that to happen? And how does that relate to the seasons.

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As well as word problems. So word problems are the context in which problem solving is primarily assessed in school. So it's a really important skill that we teach students to acquire. You'll notice perhaps what's missing from this. So what I'm not saying is actually go into the real world. There is a role for community based instruction.

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But it's not very efficient. It's resource intensive. There's often a lot of transition time, transportation time that is lost time. And I think instructional time is a precious commodity. And so particularly in a school based setting, there's ways that we can sort of bring the real world into us versus focusing on just taking students out into the world.

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Further, community based instruction is really only effective for supporting maintenance and generalization. It's not the appropriate format of instruction for initial acquisition. So we want meaningful problem solving tasks. In order to have meaningful problem solving, we also need to proactively support students independence. Again, coming back to simply knowing what to do, when or without, when or why is insufficient.

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So we need to make sure that students have conceptual understanding, meaning they can like, really understand, and model what's happening. So for example, let's say a birthday party is coming up and, they want to give treat bags to the, to people who come. And so knowing like I have seven friends coming and I want each one to get two Pokemon cards and four pieces of candy.

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Right. That is an equal group multiplication problem. That's where you have several groups with an equal amount in each group. So you could have a student who maybe can, like, draw you a picture of what that looks like or explain it, but that's not enough. They need to be able to actually procedurally solve the problem and find the answer, and vice versa.

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I have had many students, particularly with autism, who might be hyper like sick or have really strong recall skills, who have memorized their math, their basic multiplication facts. Fantastic. But but then when I ask them to like draw a picture of that shows like five times seven or tell me an example of like when you may encounter that in real life, they can't. Right.

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So these aren't two separate things and they develop together. We need to make sure that when we put the math into a real world context, that we are also our instruction supporting them conceptually, understanding like what it is they're actually doing and why, and that they're able to, with as much independence as possible, arrive at the solution.

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So there are some potential barriers that we can anticipate based on understanding the learning characteristics of many students' with autism. One is the numeracy. So their knowledge of math facts number ID, rote counting, cardinality, counting with 1:1 correspondence. That's a potential barrier to anticipate because it impacts their ability to use manipulatives for an evidence based support. We also need to consider literacy demands.

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So word problems or math in general is very language heavy. And I love my colleague Elizabeth Hughes says every student is a math language learner, right? That we have this specialized way of using words in a math context that's different. And that needs to be explicitly taught, particularly for students who might have, very concrete understanding, and have difficulty with nuance or abstract or, language or inferencing.

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Obviously, the ability to read is going to impact word problem solving doesn't mean that the student can't read independently. They're not going to solve word problems. It means that that should drive the supports that we provide, which provide read alouds, teach them how to use accessibility features. We can rewrite work problems to simplify the text. And then we need to consider, of course, executive functioning.

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So, working memory, shifting attention, mental flexibility. What supports can we put in place to help, particularly with things like word problem solving that are comprised of many steps that need to be done in a specific order. On top of all that, we have the variability in metacognition. You know, it's it's hard to assess and to know what students know and what they're thinking about when they're not able to vocally tell you.

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Does it mean that they aren't thinking there is still reasoning happening, but we then need to think about how can I support them to show what they know. So while building conceptual understanding and procedural accuracy is important for all, all of us. For students with autism, they're unique considerations that we need to have things like self-determination that, self-monitoring, perseverance, goal directed behavior, executive functioning, their ability to generalize, and knowing that, we may need to be really intentional in how we, and how we teach and to make sure that we aren't teaching in a way that's actually going to fail them later on.

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Things like teaching the key word strategy, where students are taught to look for explicit words like, if you see total, that means you add, or if you see, how many are left, that's automatically subtract. That's not true. That's a really...that's faulty stimulus control and that's giving strategies that aren't going to support them moving forward.

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And then we need to support their access, particularly for students who might, still have fragile, literacy skills.

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So, the variability that makes, that is what I love about, you know, my friends and my students with autism also is the part that can make instructional design difficult because there is variability and support needs. What I have here, though, is a, adaptation from an article that, I'll, we'll have a link for at the end that you can access that has these various evidence based practices.

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and it aligns them with phases of learning. So going back to what I said earlier about we need to think about it. Where is the student? Are they just now acquiring the math skill? Do we need to make it fluent or work on generalization? Or the strategies that we might use are going to be different based on that?

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And so to give example of the color coding, green means go. So for example using a task analysis when you're just learning to acquire something particular, if we put that task analysis into a student friendly form, that has, you know, they can check off steps as it's completed so that they're sort of self-managing it perfect for acquisition.

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And we might fade that. So yellow is like with caution might be able to fade. Red is no it's not appropriate. So for example, over learning not appropriate when you're acquiring something. You haven't learned it yet so you can't over learn it. Similarly massed trials or the sort of blocked practice that's not appropriate for maintenance. If you're having to do that, then the students not ready for maintenance.

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So here's just a quick example of like what this could look like I'll put together. so going back to sort of the concert example, you can see here that the instruction, the stimuli is like actual screenshots from websites. The teacher found out like what concerts the different students in the class might be interested in, so that different interests were represented because we can't tailor everything to every individual student

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that's not sustainable or realistic in a school setting. And then you can see here that we have this word problem. It's written with considerate text. There's no irrelevant information because those could be barriers. Doesn't mean we might not add that later, but it wouldn't start. You see here that there are what I call equation templates are basically just visual supports to support students to fill in the equation.

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And then we have a picture task analysis with considerate text and visual supports paired with each step for the students to go through. So they're not only learning the procedures we need to teach conceptual understanding of in this case, simple equations. But also students with autism are going to need most likely some procedural supports as well.

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So as we proactively support independence, we know that where problem solving can be a natural opportunity to develop social emotional learning skills as well as self-determination. So within the context of math, we can build confidence and perseverance in goal directed behavior, which is what further makes math meaningful.

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I'll give an example of what this could look like as far as, supporting self-monitoring. So in this case.

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Sorry for accidentally muting myself. I'm not sure how that happened. So we want to proactively support independence and we can put supports in place. So in this slide you can see several examples. One, very basic, but just so that students know what is expected, particularly if math is not a preferred task. I saw one of the questions that were submitted ahead of time that talked about like math, PTSD, that, that students might have.

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So I would say everybody wants to know when they're going to be done. Everybody wants to know what to expect. And so one thing that we can do is make it clear how much of this math task, whether it's the number of problems that need to be solved or the amount of time we're going to spend. And then we can also ask students things like, what type of problems did you solve today?

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Making sure that they can articulate what it was. The learning goal was what was your goal? This screenshot shows an example of where the students were setting goals for how many steps of problem solving they could do independently correct. And then say, well, you know, you were able to get 12 steps. What do you think is should be your goal for tomorrow?

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This it's a very small opportunity to work on realistic goal setting and perseverance and self-reflection that could only add two three minutes to an instructional session. I have two final examples. and so in this you'll see, two things. One, you can see that the math goals don't only include steps, correct, but also right answer and the time.

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So in this case the student was working on fluency. But notice that the fluency goal didn't start until, they were already getting the correct answer and a lot of the steps correct right. So once we are an acquisition and I know you know how to solve and get the right answer, now let's work on speeding that up.

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and setting the next goal. Having students self graph is an excellent strategy because it makes it very concrete and clear. There's not some moving target of like again, I want to know when they're going to be done. But that they're able to see and take ownership of their progress. And that also presents an opportunity to self-advocate.

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So I'm going to open it up to questions. But I want to flag these two resources that a lot of them materials from the presentation are sort of further expanding in. And so these are two practitioner friendly publications. One that focuses specifically on using the four stages of learning within math. So it gets like that color coded table had of specific strategies aligned with our evidence based practices aligned with situations.

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And then one article that is specifically talking about how to teach word problem solving to students with autism and intellectual disability. So I'm gonna open it up for questions. I want to point out that this URL will take you to a Google Drive folder that has the Big Ideas handout, which is also, included here, as well as copies of those two articles.

00:54:17:06 - 00:54:37:15

Awesome. Thank you so much Jenny. And this concludes the presentation portion. And then it begins the Q&A session of today's webinar. We will be sensitive of everyone's time, but we can hopefully go a few minutes over and try to answer a few questions. And as a reminder, you can continue to submit your questions through the questions pane in your control panel.

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And we may not be able to get through all those questions, but we will try our best to get back to you by email if we cannot. So we're going to start with the first question which is, “For students who require ABA programing to learn like direct, explicit, broken down materials repeated in a structured, systematic way, what approaches to math instruction do you recommend? ”

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Yeah. So I think the short answer would be direct explicit instruction where things are broken down. So I think that both of the articles that I have put into this folder will give concrete examples of how to do that. For example, using a task analysis where we're going to break down the task and then how are we going to teach it?

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So using explicit instruction where we're modeling with that student actively involved, where we're sort of gradually releasing responsibility and then making sure that when they are expected to do something independently, that they've been taught those skills and that the skills are being reinforced. Wonderful. Thank you. The next question is, “I have taught my son how did you addition and subtraction using a calculator and also added to his IEP, but the school is not very keen on adding that as a skill.

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So how can we advocate for it?” Sure. so I would, you know, any time there might be a disagreement in instructional strategy or target goals, I want to know why. Right. So the question would be why don't they find that to be a necessary goal? Is it because they think that they've already mastered it? Is it, again, it would depend on the student's age.

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But parents are a member, of the IEP team. And so, I would encourage you to talk with them about what their purpose is. Why they do or do not find that to be a priority, and then also communicate why you feel like it is a priority for that student. Certainly we want to build conceptual understanding, but that and procedural fluency.

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But sometimes doing those at the same time is it's just too much. We're asking too much, and overloading cognitive capacity. So I often promote use teaching calculator use and using that, when we might be just learning a new, problem solving strategy. But then if we're working on procedural skills, maybe we do that with in a context that's not as cognitively demanding, so that we're not working on two hard things at the same time.

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Great. Thank you. And I think we have time for one more question. “Is inquiry based learning appropriate for older students with autism to encourage interest and real world connections?” Yeah, I would say inquiry instruction is appropriate for all students at all ages, with autism, just as it is for those without. The caveat is that often, behaviorism, direct instruction,

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explicit instruction is put as the opposite of or like incompatible with constructivist, inquiry based, problem based and various different words and approaches. And that's not true. And we often assign some sort of like moral judgment behind instructional theories or approaches. And there's just more nuance than that. And the answer is it depends. I would say that whether it's math or science that students need to have something to inquire about, they need to have the vocabulary and the habits of mind to be able to really engage and get the most from inquiry.

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And so that might mean that some things need to be explicitly taught that we might and that could be from the vocabulary and language, how to use particular measurement tools. going through some, teaching multiple strategies so that the students can then choose which strategy works for them. But I would also push back on the notion that inquiry is what's needed in order for students to, for learning to be personally relevant in order for them to be invested.

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Students should be invested and interested and should be personally relevant regardless of the instructional approach that we're using. And if students aren't engaged when explicit instruction is happening, then it's with instructions not being done well. That wraps up our webinar today. Thank you again, Jenny. And thank you everyone for attending today and joining us. If you found today's event helpful, we encourage you to register for OAR’s next webinar, Building Connection and Community in Middle and High School Settings on May 2nd from 11 a.m. to 12 p.m. Eastern Time.

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Once you close out of today's event, you will receive an exit survey, and we would appreciate if you would complete that and provide your feedback. Everyone will receive a follow up email with their certificate of attendance. And on behalf of the organization for Autism Research, thank you for joining us and have a great rest of your day.