



EC Podcast #4 Seth King and Chris Lemons, “Math Interventions for Students with Autism Spectrum Disorder: A Best-Evidence Synthesis,” *Exceptional Children*, 82, pp. 443–462.

Lorraine: Welcome to this Exceptional Children podcast. I'm Lorraine Sobson, Publications Manager for the Council for Exceptional Children. Today I'm speaking with Seth King, an Assistant Professor at Tennessee Technological University's Department of Curriculum and Instruction, and Chris Lemons, an Assistant Professor of Special Education at Peabody College at Vanderbilt University. Seth and Chris, along with Kimberly Davidson, recently published an article in *Exceptional Children* entitled “Math Interventions for Students with Autism Spectrum Disorder: A Best-Evidence Synthesis.” Welcome, Seth and Chris! Thanks for joining me today.

Seth: Thank you for having me.

Chris: Thank you very much; glad to be here.

Lorraine : One of the most interesting things about this article to me is it's focused both on effective math interventions for students with ASD and also on identifying evidence-based practices. I'm really looking forward to delving into these both areas with you today. Seth, I'd like you to set the stage. Can you summarize the achievement levels of students with disabilities in mathematics versus their typically developing peers? Then, within this group, can you focus on students with intellectual disability and those with autism spectrum disorder?

Seth: Certainly, and I'd also like to address the effect that higher standards have had on these populations as well. Students with disabilities generally underperform their typically developing peers with about 80% scoring below proficiency on assessments like the National Assessment of Educational Progress, what we will call NAEP from now on. The performance of students with autism spectrum disorder is consistent with this on average, but you have large portions of these students who perform well on mathematics relative to their cognitive ability.

There are also many children with high-functioning ASD, however, who underperform in mathematics relative to their level of cognitive functioning. What you have to realize, and I think many people who work with children with ASD will also understand, is that this is a variable diagnosis. The limited performance that you are seeing across all levels of ability of children with ASD is important, because what we find is that the [state-level] standards ... continue to ask a lot in terms of applied mathematics. This actually tends to exceed some of the standards that are on NAEP.

Lorraine : In selecting studies for your synthesis, you relied on the What Works Clearinghouse Guidelines for evaluating experimental research. Can you summarize these guidelines and tell me how they informed your methodology?

Seth: The What Works Clearinghouse Guidelines are going to be different depending on whatever design it is you're evaluating. Our article mostly incorporated the pilot guidelines related to single case design, which is an experimental method that usually involves between one to three students and it's highly accessible. I would recommend that to any listener who's thinking of doing an experimental study with any of their students.

We ended up focusing on single case designs because we didn't find many group designs concerning this topic. The group designs we did find were generally not consistent with the WWC guidelines. What WWC tends to target are aspects of articles related to internal validity. We have to think of authors as trying to make the argument that their intervention results in [some sort of] benefit for their participants.

What the WWC does is they evaluation the strength of the claims for a given study. Once you've applied these standards, you often end up excluding a large number of articles from a review. You have articles that make a claim that a practice worked but there's a reason to believe that there's something else may have been responsible for the results. In our case, we were still left with enough articles following the exclusion process to merit the review, which in some ways [speaks] to the strength of this area of study.

I should note that the WWC standards often do not emphasize components that are of interest to teachers. Those would be things like where did this study take place? Who is involved? Could I as a teacher actually use this practice? These are things that the WWC really doesn't evaluate in their review process.

Lorraine : You've mentioned finding and then also assessing studies to include in the synthesis. Can you go[into] a little bit more detail [about] the process of how you identified studies and then selected which ones you were going to include?

Seth: I'm glad you asked this question because it's really kind of boring, and what I mean by that is it sounds really boring but it's actually really important. Science and talking about what works is never really about one study. Reviews are the way in which a field can get an idea of where we're at as a discipline, and the way in which studies are identified can accidentally overlook a number of studies which leads to a skewed picture of the field. While no review is perfect, when you disclose the research process you at least know how the picture might be skewed.

We started with a search of multiple electronic databases. I want to mention that searching for studies with children with autism spectrum disorders can be difficult because there are a lot of other diagnoses that may be the focus of an article. For example, if you're looking for math instruction for children with intellectual

disabilities..., they will often feature students with autism spectrum disorder but they won't identify that fact in the abstract or the title.

We looked for the use of that term—autism spectrum disorders—anywhere in the article. That search generated thousands of results. What we did is we looked through those results and selected articles that were relevant to our research questions. We then performed something called an “ancestral search”: We looked at what studies the authors of articles we had already had identified were reading, and we tried to see if any those should have been included in our study as well.

Finally, we performed a hand search, which involves looking through the table of contents of a variety of journals which often publish the sort of research we are interested in. Once we're done with all of that, we double-checked our process along the way, which involved pretty much having someone else go over everything we'd done to that point to see if there was agreement. It was a long process, but I'm generally pleased with it.

Lorraine : Of the studies you ultimately included, can you summarize the demographics of the participants? What kind of skills were being targeted?

Seth: Really, there are a two stories here. Most of the studies pertain to a narrow range of students, and many of the studies did not report some of the information of interest regarding the participants. Now, just forgive me, I'm going to use a lot of numbers here. We had 28 total participants. Because these were single case designs, 70% of them were male, which is generally consistent with autism where most of [the] people that you're identifying are males. Most of these students were in elementary school, roughly 46%, or high school, 28%.

Most of the studies involved children with intellectual disability and ASD, and 60% of participants were identified as also having an intellectual disability. I want to point out here, though, that information regarding cognitive ability was not provided in 32% of the studies. School placement wasn't reported for 35% of participants. Of the studies where the school placement was identified, 39% of the participants received the majority of their services in special education.

What we have here is we're not really certain whether students had ID or intellectual disability in many of the cases. When it was reported, we find that they overwhelmingly do have intellectual disabilities, which again is a narrow range of students with autism spectrum disorder. When we're talking about targeted skills, we also find that it's primarily a narrow range of skills. Functional skills—which involve money, telling time, or computation—were targeted in about 78% of the studies. That probably reflects the emphasis on young students or children with intellectual disability.

Fewer studies focused on the applied mathematics problems that are increasingly emphasized in things like the Common Core or other state standards.

Lorraine : Those are the skills that they were targeting. What were some common features of the types of interventions that the studies focused on?

Seth: Many of the studies evaluated intervention packages rather than individual treatments, which I think is fairly consistent with actual practice. I don't think that, or at least in my experience, I didn't try one thing to see if it worked. If I wanted to change a behavior or have an effect, I would use as much as I thought would work with the hopes of making an immediate and meaningful change. What happens when you use these packages [is] it becomes difficult to determine which intervention was the most effective. What we found is that many of the packages had some common features.

The most common was something like consequences, like praise or a reward, and systematic prompting. These two things were used in most of the studies and these things were associated with positive outcomes. I also want to note that one-to-one instruction was also used in about 71% of the cases..., which really may not be feasible for a lot of educators but which also may have contributed to the success of the study. Whatever you're doing, if you're able to do it on a one-to-one basis with the student, you might find that that's successful.

Lorraine : Although you found positive outcomes associated with certain math interventions, you point out in the article that none of the math interventions in the studies can be considered evidence-based for students with ASD. Could you explain why?

Seth: This is a really important issue and I'm glad you've given me the opportunity to address it. One positive finding—even in a study [that meets] WWC [guidelines for] a high-quality study, that one finding is not going to be enough to confirm that a practice is effective. We see a lot of studies where something works, but that's not sufficient. In addition to the guidelines related to study quality, the WWC has guidelines related to the extent of the evidence. In other words, how much evidence is required before we can say that research supports the practice?

For single case designs, the WWC standard is 20 replications, which means 20 versions of that study either across students or groups of students, across five different studies by three independent research teams. That's a pretty high barrier. Some evidence, I want to note, suggest that confidence in the treatment from a practical perspective really doesn't improve after about 12 successful cases.

If you are a teacher trying to use the literature to find something, maybe you don't actually need 20 replications; maybe 12 would do. I want to point that out. The overall point is I think practitioners might be able to make decisions based on less evidence than what is recommended, but you still need to consider the extent to which a practice has been evaluated before you decided to use it.

Ultimately, if you can only find one study to just suggest using one practice versus a practice that has a multiple studies suggest and it's effective, then you're going to want to use the practice with more research supporting it.

Lorraine : How did the lack of information about implementation fidelity and the lack of social validity affect your conclusions?

Seth: The absolutes of ... fidelity [and] social validity, combined with the limited number of studies in this area, made [our] paper more about the literature base itself and less about what this literature could tell a practitioner. This reflects my experience at conferences, where I have teachers come up and they're looking for answers. Essentially I am put into a position of having to tell them that [we don't have] a lot of answers...; I have to tell them that only five of the 14 articles included information about whether or not teachers thought this stuff works, or whether teachers thought that they could use some of these interventions.

Again, 10 reported whether or not the teachers in the study were able to use these interventions appropriately. What we had to conclude based on that is that in an applied field we probably need to do a better job of including information related to common concerns of practitioners. Do I have the time to do this? Did this really produce a meaningful change? You can have a change on a measure in a study, but that doesn't necessarily mean that practitioners or parents are going to think that that's an important change.

Lorraine : You just mentioned, in regards to research, the question that always comes up: What can the literature tell the practitioner? What guidance does this research that you reviewed provide for practitioners who work with students with ASD? What guidance do they still need?

Seth: What I like about single case design—which, again, was featured in most of these studies—is that it emphasizes the individualized nature of what we do in special education. As I said, there isn't one intervention that's going to work 100% of the time with all of the students that we work with, and that's the nature of special education. Single case studies involve an intervention that can be changed to meet the need of that student that you're working with. What these studies point to, again, is [that] you should use generally effective strategies, and you need to be able to adapt to those strategies using ongoing routine data collection in order to make instructional decisions. That's consistent with a lot of the work that Chris has been doing.

Chris: I agree with Seth that, for many students with ASD, individualized instruction guided by data is going to be really important. One of the things I would like to share at this point are a few resources that maybe helpful for teachers out there who are trying to determine how to improve math outcomes for their students with ASD. First of all, there's a book called *Designing Effective Mathematics Instruction: A Direct Instruction Approach* by Marcy Stein, Diane Kinder, Jerry Silbert, and Doug Carnine.

This is an excellent starting point to think about delivering direct instruction in math skills to students with ASD, and includes a broad set of lessons to teach a broad range of math skills and concepts. There's also the Early Numeracy Curriculum that's available from the Attainment Company. This program was developed by Bree Jimenez, Diane

Browder, and Alicia Saunders. This is a curriculum that has been evaluated in experimental work for students with significant cognitive impairments, including many students with ASD. It progresses from early math skills ... to using sets for addition.

I also really agree with Seth's point that having teachers use applied single case logic in their classrooms to evaluate the responses of students is a very valuable approach, particularly in light of this review, which shows we don't have a lot of studies that have evaluated effective math interventions for students with ASD. One of my favorite texts on this topic is called *Evaluating Educational Interventions: Single-Case Design for Measuring Response to Intervention*, by Chris Riley Tillman and Matt Burns. This is a textbook that provides teachers [with] guidance on using applied single case designs to evaluate the progress of their students. I use this text in my masters' classes here at Vanderbilt, and my students really find this book to be user-friendly and very practical.

Lorraine : That's very practical, Chris, thanks. Seth, in addition to the recommendations for practitioners, what recommendations would you have for further research in this particular area?

Seth: There are some easy takeaways here, and that is we need more high-quality research in this area, we need more research involving the broader spectrum of students with ASD, and we need a greater emphasis on higher order math skills. This is going to be similar to an earlier point, [the] emphasis on individualization. It speaks a lot of what Chris is doing. Chris, do you have any more to add to that?

Chris: Yes, Seth. One of our biggest needs for future research is to really ensure that special educators are clinical experts who can adapt and individualize interventions for students with disabilities. Recently in our field, we've really had a very strong focus on *where* students are educated. Unfortunately, this has decreased our focus in many ways on student outcomes. What are students with disabilities actually learning to do? One approach to ensuring that special educators can meet the needs of their students—including students with ASD, the students who have the most severe and persistent learning needs—is an approach called data-based individualization, or DBI.

Two national centers, both funded by the Office of Special Education Programs, or OSEP, are involved in this work. First, there's the National Center on Intensive Intervention; the website is www.intensiveintervention.org/. This is a technical assistance center that has developed numerous high-quality materials that teachers can access to learn more about DBI. I really encourage your listeners to go to the website and to explore the implementation support section of the website. There's a full training series on learning about DBI, about what it is, about the evidence behind it, and about how to implement it to improve outcomes for students with disabilities.

The second center is called the National Center for Leadership in Intensive Intervention. The website is ncli.org. This is a doctoral training program that I am a co-director of. In this project we are training a group of doctoral-level researchers to conduct more research on intensive intervention. Our first cohort of scholars just completed their first

year of doctoral study. On the website we are going to be showcasing their research and their reviews of the literature.

Those resources will be available later in the year, and I encourage people to return to that website. In sum, though, I think that the most important thing of where we're going next in terms of special ed research is ensuring that we have developed effective tools the teachers can use really readily to meet the needs of their students.

Lorraine : I love your description of special educators as “clinical experts.” You actually also opened the door to let me plug *TEACHING Exceptional Children*, our practitioner’s journal, because in 2014, we had a whole issue on data-based individualization. So I encourage people to look up that too; that issue was great. Thank you both so much for talking with me today.

Seth: It was my pleasure, thank you.

Chris: Thank you very much; we really appreciate being given this opportunity.

Lorraine: Seth and Chris's article, “Math Interventions for Students with Autism Spectrum Disorder: A Best-Evidence Synthesis,” is published in volume 82 of *Exceptional Children*. *Exceptional Children* is a publication of the Council for Exceptional Children. To learn more about CEC, visit cec.sped.org.