Connections between Speech Sound Production and Literacy Skills

Recorded July 11, 2019

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SpeechPathology.com Course #8955

- [Amy] And at this time, it is a pleasure to introduce Dr. Kelly Farquharson, who is presenting connections between speech sound productions and literacy skills. Kelly is an SLP and associate professor and director of the Children Literacy and Speech Sound Lab at Florida State University. Her research interests include school aged children with phonological and language disorders, the effect of those disorders on the acquisition of literacy skills and the cognitive environmental and academic factors that contribute to the phonological and language disorders. Prior to pursuing a research degree, she was a school based SLP in Pennsylvania. So welcome Kelly. Thank you so much for joining us today.

- [Kelly] Thanks for inviting me. Just doing a quick audio check to make sure you can hear me okay. Awesome, great. Well, thank you again to the folks at speechpathology.com for inviting me, thank you to all of you who are here live. 238 friends with us today, which is great and hopefully there will be more of you taking advantage of listening to this recording later. Either way, I'd like to welcome you to this presentation, connections between speech sound production and literacy skills. My name's Kelly Farquharson and thank you for the introduction, Amy. Today we'll be talking about, in a very brief amount of time, number one area of research interest for me, which is how speech sound production relates to literacy for the kids who are on our caseloads.

I do have experience as a school based SLP and that really informs a lot of my research now at Florida state. So I'll be talking a little bit more about that as we go on. We will have time for questions at the end today and given the amount of time that we have together, I would prefer to hold all questions until the end and I also really encourage you and invite you to email me later if you have questions that we didn't get to or if you wanna follow up or have specific case based questions that you wanna

think through with me, I'm happy to do that. So I do quickly have to disclose that I'm being compensated by speechpathology.com for today's presentation and for my faculty position at Florida State, I do receive a salary. I have no non financial disclosures. There's this some contact information for me, which is also going to be on the last slide of this presentation as well, my email and then I'm pretty active on social media through different outlets and so I encourage you to follow along and if you're active on any of these social media outlets as well, we post a lot of current research, any research possible opportunities for SLPs to participate in and those kinds of things.

So I'd love to hear from you there. And then most of the research that we publish is also freely available on our website, which is listed here at the class lab, children's literacy and speech sound lab. So today we have a few learning outcomes that we'll make sure that we get to for all of you. The first is to describe the phonological relations between speech sound production, decoding and spelling. We're gonna talk about the SLPs role in literacy and we're going to discuss the importance of early identification and intervention for kids with speech sound disorders. So I like to think about this question of how speech and reading are related using this kind of observational framework that I have from my time as a school based SLP. So it seems to me or it seemed to me at the time and this is continuing to be the case as I research this topic, it seems to be the case that there are children who have speech sound disorders who experience different levels of access to literacy skills.

And so just to orient you here a little bit to what I'm gonna talk about, we've got this group of kids up here under this term remediate and we've got kids who do remediate, meaning yes, their speech sound production gets better and then we've got kids who don't remediate, meaning that they continue to experience difficulties with speech sound production really past the normal age of acquisition. So our current research collectively is showing that children should be able to produce all speech sounds

accurately by the age of six, although that's been clinically argued a bit. So even if we extend that to eight, we're thinking about the kids who don't remediate even past that normal point of acquisition. Over here we've got the idea of a child having literacy problems and so here we're having kids who, yes, do have difficulties with literacy and here we have kids who do not experience difficulties with literacy. So we're gonna fill in each of these squares. So our first group are kind of our gold star kids, these are kids who remediate their speech sound production issues and have no literacy problems.

So of course we hope that this is the case for all of the kids on our caseload, regardless of the setting we're working in, but we know that that's not necessarily true. So we know that there are kids who experience difficulties, for reasons that we may not quite understand. Then we've got our kids who don't remediate, so they continue to experience difficulties with speech sound production and they have difficulties with decoding, maybe even spelling or maybe just spelling. We think of these kids as having a true phonological deficit. There's something happening here in the phonological system that's getting in the way of their success with access to phonemes So the way that they need to access phonemes for speech production as well as the way they need to access phonemes for decoding and spelling.

Our next group of kids are these ones who don't remediate. So they have difficulties with speech sound production, but they really don't have any literacy issues and so we don't really know why they don't get better with speech, but it's not necessarily something that we see bleed over into decoding and spelling. For these kids, we don't know a lot about this population and this is a population I'm really interested in, but that they've not been widely studied in part because we think that it's maybe just a motor deficit. And so we assume that these kids don't need our help anymore because, well, they're doing fine in the classroom, we don't really need to provide services, but there might be more to the story there including some issues with the social perception of their speech. And then our last group is this group here that they

do remediate, but they also have issues with literacies. So this is a really interesting population and I think of these kids as having maybe a more of a linguistic deficit. So they're able to remediate how they produce the speech sound, but then they might experience difficulties with decoding, that may or may not be related to the fact that they ever had a speech sound disorder, that we really don't know. But it could be the case that there's some leftover kind of fragments of this phonological deficit that's related to why they experience difficulties with literacy.

So I think this is all still really observational. This is what I saw as a clinician, what I continue to see in working with other clinicians and what I continue to see here in my lab with kids who come in to participate in studies, is there's varying levels of access to literacy and so that continues to be an area of interest for me for that reason. So, let's really kind of dig into this idea of what reading really is. So, I'm just gonna give you a quick synopsis to consider and I borrowed this story from my PhD mentor, Tiffany Hogan. So here we've got a grandfather and a grandson and the grandfather was born and raised in Germany during a time that education wasn't necessarily highly valued and so he made it through school through about sixth grade. And at that time his family moved to the United States and he learned English later in life. He's got this grandson who's a third grader who is monolingual English speaking only ever, lived in the United States and the grandfather comes across an old text that his mother used to read to him when he was a young boy.

And so he asks the grandson to read the texts to him. So of course, if it's a text that the grandfather remembered from being a young boy, it's written in German. And so the grandson says, well, I don't know German, so I can't read that to you. And the grandfather says, just try, just sound it out. Just look at the words on the page and sound them out. And so the grandson says, well, okay, I'll give it a try. And so the grandson looks at the words on the page and does his best to try and sound out those words and the grandfather is listening to the story and remembering the days gone by,

remembering this story that he hasn't heard since he was a young boy living in Germany and feeling very nostalgic because he's remembering kind of days gone by. And so I'll just ask you to reflect personally, you can kind of type into the Q & A box if you want. I'll ask you to reflect here. Who's actually doing the reading? Is it the grandfather or is it the grandson? Okay, so Cindy says both. We've got some votes for grandfather, another vote for both. Votes in different ways, some votes for grandson. Okay, so I'm gonna stick with Elena's answer here, which is neither.

So in my opinion and what the research tells us is that neither of these people are reading, because in order to and thank you for participating, in order to truly be engaged in the process of reading, you need to be doing what both people were responsible for. So you need to be able to look at the words on the page and decode them, but it doesn't really matter if you can do that if you can't understand the story. So we have to kind of think of this process of decoding and comprehension as both necessary for successful reading. So that is conceptualized under the simple view of reading, which is a theoretical framework that's used a lot in my research and in the research that I follow and that I participate in. So we think of this idea of reading as comprised of word recognition. So that's what the grandson was doing. Looking at the words on the page and doing his best to sound them out and then listening comprehension, which is what the grandfather was doing, listening to a story and understanding it, remembering, tying it back to background knowledge and previous experiences.

So this is truly what's required for reading. And we can have kids who experience difficulties in word recognition only and we can have kids who experienced difficulties with listening comprehension only. But we have to really understand that reading requires both of these skills and so if a child is doing just one of them, they're not reading. So this is another way that the simple view of reading is conceptualized and the best part about this is that it really highlights that the simple view of reading is not

so simple. So this graphic is published in the handbook of early literacy. It's called the reading rope, so if you haven't seen it before and you google the reading rope, it will come up for you. It was created by Hollis Scarborough and her colleagues and is widely used in reading research to really help conceptualize what we mean by the simple view of reading and what we mean by the skills that are required to be a good reader.

So just to kind of orient you here, in the same way that on the last slide we talked about word recognition and listening comprehension, here we've got the word recognition piece, which kind of falls into this rope here and then we've got language or listening comprehension up here, which is this part of the rope. But what you'll notice then is under each one of these main components of the simple view of reading, we've got additional skills that fall under. So language comprehension is a big skill and it's made up of a bunch of little skills and any one of the skills can be impaired and that's going to impact how a child's comprehension works or doesn't as the case may be. And then we've got word recognition and the same is true here. We've got a few skills that are necessary that really comprise the idea of word recognition that are all necessary in order to be successful.

So over here we've got this skilled fluent execution of reading, which in the United States we often expect kids to be at by about third grade, sometimes a little earlier and sometimes a little later depending on the state, depending on the curriculum, but by and large, we expect kids by third and fourth grade to be able to fluidly weave together all of these skills and access reading on their own. So how does this apply to speech sound production? Well, first let's think about who we're talking about here. We're first talking about kids with speech sound disorders. And so for our purposes and the way that the research and the literature is really moving to conceptualize this population of kids, these are kids who have both or either articulation and phonological disorders. So speech sound disorders comprise both articulation and phonological disorders. I've

personally started to shy away from distinguishing between articulation and phonological disorders. I could probably fill another entire hour about that topic, so I'm gonna leave it to the quote that's on the next slide and we can talk a little bit more about it if there's time. But we're also thinking about kids who have dyslexia. We'll spend some time talking about this population today too. And those are kids who have both or either issues with word reading and phonemic decoding. So what we mean there is word reading is referring to the process of reading real words and the ambient language.

So we'll stick with English for today's purposes, being able to read real words in English, whereas phonemic decoding is referring to a child's ability to read non words. And so non words are an important part of the assessment process when we're looking at a child's phonological ability because it really shows us what they know about letter, sound patterns and it takes out of the running, their familiarity with the word. So when we test a child's word reading, we're often looking at how they read the words, but we're also unsure if they know it because they're sounding it out and they have a good representation. Or if they know it cause they've seen it a lot. So if we use non words, we kind of take that out of the running and we're really just looking at what they know about letter, sound correspondence.

And so we'll circle back to that and talk a little bit more about it in a minute. So this is the quote I was referring to and this is from a paper in 2006, which is now fairly dated, shockingly. But we've also updated some of this information and talked about it in a paper that came out last year with Katie Cabbage as the lead author in LSHSS, language, speech and hearing services in the schools and in that article, which is in your reference list, we talked a lot about the overlap between speech sound production and literacy skills. But my thinking about this distinction has kind of changed since reading this paper by Bruce Pennington, which really helps me think about how we were making the distinction between articulation and phonological disorder. And what

really struck me here is that we're really making a premature commitment to what's happening with these kids when we say it's just our tick or that it's an articulation issue. We don't actually know if that's true unless we really test their phonological knowledge. So if we're only listening to their speech sound production, regardless of which sounds are in error or regardless of how many sounds are in error, if we don't test their phonological knowledge in any way, we can't say that it's an articulation disorder unless we test their phonological knowledge.

So these terms, we're kind of making a premature assumption that we know that the underlying process, the underlying deficit, is either a motor programming or cognitive representations, but we weren't actually testing either. So as a field, we're really pushing for speech sound disorders to be used as the primary term here. So then when we're thinking about these kids who have speech sound disorders, we know this is a very popular population for SLPs. This as a school survey that came out in 2018 indicates that 90% of SLPs who work in the schools work with speech sound disorders. This is one of the top three populations that continue to be part of case loads for SLPs. So I know I don't need to overly define this population, but I do just wanna make sure we're all on the same page. We're talking about kids who have a difficulty with acquisition of appropriate speech sounds, again, those sounds based on a recent paper by Sharon McLeod and Kate Crowe that reviewed all of the normative data that we have available in English told us that speech sounds should be acquired by the age of six.

Speech sound disorders again, as I mentioned, are the primary population treated by SLPs, especially in schools. We know that children who have difficulties, oh, it looks like I may be missing a box here. So sorry about that, but there should be an additional box here that talks about the educational impact of speech sound disorders and that these children have difficulties with reading and spelling. That's been well documented and the unfortunate part is that that's true even once the speech sound disorder has

been remediated. So we know that there are kids who've received therapy, who their speech sound disorder has gotten better, but they still experience difficulties with literacy. And then some really interesting followup studies of kids who had speech sound disorders that then were asked or interviewed later when they were adults, were asked about the kind of special education services that they received as children and 50 to 70% of kids with early speech sound disorders when later interviewed as adults, reported that they needed some level of special education services through the 12th grade.

So this is a population of kids who are certainly at risk for literacy deficits and that can lead to some lifelong issues. So we know that more than half of children who have speech sound disorders experience difficulties with reading and that's primarily because if you conceptualize the simple view of reading, that word recognition component, those phonological skills that are necessary to be successful and that component of reading don't often develop as strongly in children who have speech sound disorders and so this can lead to difficulties with phonological awareness and we really know a whole lot now about how important phonological awareness is for reading success. So we'll talk a little bit more about phonological awareness too.

So I do wanna quickly touch on prevalence, first to say that prevalence studies are really hard and in the United States in particular, it's hard to obtain these kinds of data. So these are estimates. I think they're fairly accurate, but it's really hard unless you're measuring every single child in a country or in a region, it's really difficult to be incredibly accurate with these numbers. But we know that kids between the ages of five and seven, about 13% of that age range are children who have speech sound disorders. And we see that for kids who persist with speech sound disorders past that age of normal acquisition. So kids between the ages of nine and 11, about 10% of those kids still have difficulties with speech sound production, which is a good... That's a pretty big number and we're not really considering this a low incidence even in that

age range. There's some more, I think possibly more accurate numbers coming out of the UK based on the way that they're able to measure health outcomes in their population. So Sue Ralston and her group have talked about 18 year olds, I'm sorry, eight year olds who have unresolved speech sound disorders and they report about 18% of that population, which is very likely to be a more accurate representation given the way that they're able to measure there. And then this is a pretty old study that looked at college freshman and how many speech sound errors are seen in that population. 1.4%, pretty low, but still definitely more than we should see in college freshman.

And so this issue here is important because we're talking about kids who have speech sound disorders in isolation because those are kids who are often, kind of swept under the rug or assumed to be okay because it's just speech or it's just our tick. And that can be really problematic because those are children who may be they're not as at risk as children who have a speech sound disorder plus a language impairment, those are children who certainly have difficulty with academic success, with educational performance, that's absolutely gonna be the case for kids who have speech sound disorders and language impairments. But that's not to say that kids who have speech sound disorders only then aren't at risk. These are kids who are certainly at risk and that's primarily the case because these are kids who have likely have undiagnosed dyslexia.

And so we'll talk a little bit more about dyslexia as we progress here, but it's really important for us to understand the connections between speech sound disorders and literacy, especially speech sound disorders and literacy disorders because treating and assessing dyslexia is part of the SLP scope of practice. And so we need to really be mindful of what are early warning signs are for dyslexia and one huge early warning sign for dyslexia is a speech sound disorder. So let's talk a little bit more about dyslexia and define this. So we know that dyslexia is a language based problem, it's a

phonological processing disorder that's neuro-biological in origin. That means it's present from birth. So it's not the case that a child gets dyslexia or develops dyslexia, it is the case that a child is born with dyslexia, so they have it and it is treatable, but it is not curable. So we are not... Our goal is not to get rid of dyslexia, our goal is to early identify and provide support for kids who have dyslexia because it is something that's experienced for life. There's a wide range of severity levels with dyslexia so it can really range anywhere from an annoyance to a severe limitation. That language comes from individuals with dyslexia.

So it's not me calling it an annoyance, it's something that an individual with mild dyslexia has used to describe it. And it is the most common learning disability. So that might be surprising because we're not in the habit of using this term, but it is the most common learning disability. Importantly, this is one that's responsive to expert informed instruction. So we can get in there early, find these kids, provide appropriate services and help them achieve appropriate reading skills. Sometimes maybe even on grade level if they get services early enough. So the way that we see this manifest is, we see difficulties with word reading, phonemic decoding and spelling.

So again, word reading is the reading of real words in the ambient language, whereas phonemic decoding is reading non words, so that really just removing the familiarity aspect and looking at letter sound correspondence and how that relationship plays out when reading actual words. That could be legally represented in the language but don't actually have semantic meaning. And dyslexia is typically a surprising diagnosis for parents because it exists in the presence of normal intelligence. And so one of my favorite stories about this that I'm just gonna quickly tell you, is a parent of a child with dyslexia and that the child now is 25, but the parent shared with me that when her daughter was young, they had read one of her favorite books, in a Frog and Toad Are Friends and they had read it so many times that she basically knew it by heart and the mom thought she was reading it. And so, then when it came that this child ended up

with a diagnosis of dyslexia, the mom kind of said, but she can read this entire book by herself, I've seen her do it. And so the diagnostician gave the child that book, printed it out as a word document, so all of the words from Frog and Toad Are Friends in a word document version, not in the actual paper back with pictures and asked the daughter to read the word document version and she was unable to do that. And the mom was just floored because she had no idea that the daughter was relying on so much memory and structure and cognitive strengths and pictures and sequencing, all of those really robust cognitive skills that we see as strengths for children with dyslexia, the mom had no idea.

So this diagnosis can often be surprising for that reason, but we do see this as something that persists throughout the life span. So these are adults often who maybe if they've compensated for their dyslexia, they continue to be slower readers or poor spellers or maybe both and they might have difficulty with novel or complex phonological forms. And so they might have a really hard time learning a second language and often what we see in teenagers is one of the accommodations that we really recommend for IEPs of kids, who have dyslexia and are receiving services in the schools, particularly in high school, is that they aren't required to take a foreign language or that they can take it as a pass fail because this is gonna tap into one of the biggest areas of weakness that continues through adulthood with individuals who have dyslexia.

So we're still unfortunately too at a state with dyslexia that not only do we have to define it, we have to kind of still myth burst a bit and we'll have to talk about what dyslexia isn't. So it's not characterized or diagnosed by seeing letters backwards, that's not a part of dyslexia. I still see so many jokes and memes on social media and on the Internet about seeing letters backwards or confusing letters and it's really unfortunate cause it really perpetuates this negative and false understanding of what dyslexia is and that impacts our kids in the long run. Dyslexia is not indicative of gifted

status. So as we mentioned, these can be individuals who have normal cognitive processing, normal nonverbal IQ scores and that may vary. So there may be some variability there, but it's not necessarily... It's not a one to one relationship with being gifted. An individual with dyslexia can certainly be gifted, but at the same level of frequency that we'd see in the average population. We don't have to wait until third grade to diagnose dyslexia. So, without kind of spending a lot of time on some of the previous research, we can really identify in kindergarten kids who are at risk, looking at their phonological awareness skills and looking at whether or not they have a speech sound disorder.

So those are our two huge red flags in kindergarten, is weak phonological awareness skills and poor speech sound production. So those are two things we'll circle back to a little bit too. Dyslexia is not a visual problem. So while it is the case that we do rely on visual acuity to read words on a page, if a person has dyslexia, their issue is not related to their ability to see the words on the page, they don't see the words backwards, the words aren't fuzzy. So in that case then, colored lenses, prism lenses, eye tracking exercises, different fonts are not gonna help a person with dyslexia. So all of those things are myths and are unfortunately not true. So let's talk a little bit about this idea of phonological awareness then.

So if this is something that we can identify or use to identify kids at risk in kindergarten, what really is this skill? And I know this was a buzzword for a really long time, so it's probably the case that you know a lot about phonological awareness, but again, I think it's helpful for us to be on the same page as we are talking about this. So I'll bring this back to the reading rope by Hollis Scarborough and remind you that we have word recognition here, that's what the grandson was doing, that's reading the words on the page, we've got language comprehension up here, what the grandfather was doing, understanding the story as it moves through. And so we see that phonological awareness is one of the skills that's listed here that's part of the reading rope. This is a

skill that's a requirement for being able to ever get to this part of reading. But what I'll just help you remember is that as important as it is and it is important, it's only one of the many skills that are necessary to be a good reader. So working on phonological awareness alone is not recommended because there are so many other skills that are necessary to be successful here. So we need to think about it, but we need to think about it in the context of all the skills that are necessary to be a good reader. So here we're talking about your ability to understand or be sensitive to the sound structure of a word.

We measure this through rhyming, blending and deletion tasks, most commonly and research supports a causal link between phonological awareness and early reading, to the extent that a child who has good phonological awareness in kindergarten is very likely to be almost guaranteed to be a good reader in second, third grade, whereas a child who has poor phonological awareness in kindergarten is very likely to be a poor reader by second grade. So this is really important for us to know because we can help identify these kids really early on. One of the things that's my biggest recommendation that I'll circle back to at the end, but related to phonological awareness is that our early speech screeners should include phonological awareness. So when we're screening our kindergarteners, either before they come to school or in that first few months that they've started kindergarten and we get referrals for their speech down production, we should be looking at their phonological awareness too.

So that should be part of early speech screenings because of the predictive value related to reading and because of the connections we see with speech sound production and literacy. And so, excuse me, in this... On this slide here, I have kind of a continuum of skills that are considered phonological awareness skills that kind of range from easier skills to harder skills. Keep in mind that that's all relative, so these are considered easier according to linguistic complexity. There may be a lot of kids that you meet that the skills that we've put on the easier side of this continuum are actually

not easier. So just keep that in mind too. So we've got skills like rhyming and sentence segmentation. These are skills that are on the easier side of the phonological awareness spectrum. And then we've got syllable segmentation and blending, identification of initial and final phonemes and manipulation of individual phonemes that are on the harder side of things. Now again, it's quite possible that you work with a kid who can do these things and not these things. So these aren't necessarily a hierarchy of treatment approaches or treatment targets, this is simply saying that when you think about linguistic complexity, so in the context of language, these types of skills are gonna be more difficult because they're really requiring knowledge of individual phonemes.

So for that reason, these two blue boxes are phonemic awareness. So there's a lot of confusion and misuse of some of these terms. So phonological awareness and phonemic awareness are not synonyms, phonemic awareness is part of phonological awareness and it is the part that is asking children or individuals to manipulate individual phonemes. So at the rhyming level, we're really thinking about whole words. So cat, mat, rat fat. So we're at the whole word level. Sentence segmentation, we're at the whole word level. Syllable segmentation, we're at the syllable level. And in these two skills, we're asking people to manipulate language at the individual phoneme level. So identification of initial phonemes, what sound do you hear at the beginning of cat? And we want them to say C. Manipulation of individual phonemes, say cat without C.

So we want them to delete that phoneme completely and then tell us at, as an example of a deletion task. So these are harder, these are a lot harder. And so this is considered phonemic awareness, which is part of phonological awareness. One other term that I'd like to draw your attention to is phonics. So I consider phonological awareness activities that you could do with your eyes shut and this is my nephew, Everett. So you can do phonological awareness tasks with your eyes shut. Say cat without C, tell me two words that rhyme with cat, right? And doesn't have to be all cat related, that just

happens to be where I stick. And so you can do those activities with your eyes shut. A different term of phonics is referring to the same kind of activities, but now we're actually referring to the letters or the letter patterns that correspond to those phonemes. And so when you're talking about phonics, there's letters involved. So your eyes need to be open because you're thinking about and manipulating the orthographic patterns that correspond to those phonological patterns. And we'll talk a little bit about that orthography and phonology connection in a minute, but that's a big distinction. Phonological awareness, we're not talking about letters or looking at letters, in phonics we are.

So I'm gonna ask you guys to test your phonological awareness skills in a quick activity. And so in this activity, what you're gonna do is, each one of these real words, I'm gonna ask you to ignore the spelling, ignore the orthography of the words and just think about the sounds that you're hearing. So we'll do the first one together and what you'll do is you'll reverse the order of the phonemes in the word. So the first word is teach and if you segment that into its phonemes, you get T-E-ACH and then if you reverse those phonemes, you get ACH-E-T, okay? So you get the word cheat, okay? So let's do the of these together. So we'll clear this and ask for more, right? So cheat is up on the screen.

So we're gonna do the next one together. Sigh becomes eyes. So I see some responses here of eyes, but if it were eyes, then the word would be zigh, right? So it has to be eyes because the word is sigh, okay? How about cuts? Okay, stuck, yeah, cuts becomes stuck. Okay, we can clear and do speak. Yup, speak, becomes keeps. Okay, we can clear and do jab. Yeah, you guys are good at this. So Jab becomes badge, J-A-B-ADGE, right? So it's not reversing the letters, it's reversing the sound. So I see some folks spelling the words backwards, but we're actually thinking about the sounds in the words that doesn't always work to just reverse the letters. So it's badge and then we can clear and do scene. Knees, so I see some responses that say knees,

if it was knees then the word would be zeen instead of scene, right? So we really have to listen to even the voicing distinctions there. Okay, the next one we can clear and do might, time. Yep, good. Okay, we'll clear and do tax, scat, yeah. So there's a lot of different answers coming in here for tax. So if we segment that T-A-X and then reverse it, X-A-T, okay? And then the last one we'll clear and do caught, talk, nice job. Okay, so thanks for participating in that and thanks to Kathleen for moderating that. I love this activity, this is not one that I recommend you do with the kids on your caseload necessarily, but I think it's a really helpful activity to really make you think about the sounds.

When I'm using the constant example of cat and words that rhyme with cat, we kind of lose the complexity and how difficult it can be for kids who have a hard time with speech sound production or with phonological knowledge. And so this is a nice activity to really help you remember that you have to think sometimes about the voicing distinctions we hear in words, about the order of phonemes that we hear and so I think it's a nice activity for that reason. So thanks for playing along. So the reason that we know this is so important for kids, thinking about this connection between phonological awareness and speech sound production, has to do with how this relates over time to children's abilities. So I'm gonna go through quickly preschool, school age and then adolescence.

So the first one here, preschool, we know that preschoolers with speech sound disorders are at an increased risk for deficits with phonological awareness and a lot of the work that Jonathan Preston has done has shown us that children who have speech sound errors that are atypical. So atypical would be something like backing, so something that you wouldn't see in typical development that a child might do or distortion. So something like a lateral list that's not a sound that exists in the English language. Those types of errors are even more predictive of weak phonological skills because children are using error or exhibiting errors that either aren't normal in

development ever or include errors, include phonemes that don't exist in English. And so that's really problematic when phonemes that aren't in the language are being substituted. And this is true for kids even when language is normal and so some work out of that. UK group has also suggested that we consider the proportion of speech sound errors, speech sounds that are in error by the age of five because that's predictive of how many sounds will probably still be in error by the age of eight. And so it's important for us to be thinking about the severity of speech sound production very early in kindergarten because that's likely to predict whether or not they're going to still have issues by the age of eight.

So in our school age kids, we know that kids who have persistent speech sound disorder. So this was a study, I'll quickly tell you about in a little bit, of second through fifth graders who have markedly weaker phonological awareness skills compared to their same age peers and a lot of work looking at kids who have residual speech sound disorders, ages eight and a half to 10 exhibit cortical and sub-cortical differences during phonological processing tasks. So this was an MFRI study that was really fascinating and looked at how children, how their brains respond to phonological processing tasks and so their brains actually respond differently. There's cortical and sub-cortical differences and activation and neural responses in this population of kids, so I have the word residual in quotes because my fear in using that kind of terminology is that, well, it's a residual, it's leftover, it's not that big of a deal, but we're seeing cortical differences, neural responses in the brain that are different, that are slower, that are poorer, than typically developing peers.

So I think we need to be really careful with how we label these kids. If we're calling them residual or just arctic, that makes it seem like it's not that big of a deal and it is. And then this is a followup study to the one that was on the previous slide about preschool kids. And in this one, they found that kids who had atypical speech sound errors in preschool were that bill or that type of error. So the atypical error was not only

predictive of their concurrent phonological awareness, but of their longitudinal phonological awareness. So through school age, if they had atypical errors in preschool, they had poor phonological awareness in school age. So a good rule of thumb that's recommended from that group of researchers is that if more than 10% of the child's speech is affected by atypical errors, it's very likely that they're gonna have deficits in phonological awareness, including reading and spelling.

And then finally, we've got our adolescents here, so 10 to 14 year old kids, again with that residual speech sound error, weaker phonological processing compared to same age peers. And then we've also seen this continue even once a speech sound disorder has been remediated. So kids who have been dismissed from speech, still exhibit difficulties with word reading, phonological working memory, even once their speech sound disorder has been remediated. So that's really problematic because we could be in there earlier in helping them establish some of those phonological skills through our treatment to hopefully help curtail some of these issues we're seeing with later phonological deficits. So how do we use this information? Well, this should be something that we're using for early identification to find these kids as early as possible to provide services as soon as we find them and identify them. And in the long run, we can reduce the risk of reading disorders.

So as I mentioned, we're not going to eliminate dyslexia. That's not a possibility, but we can reduce the impact of dyslexia on kids' educational performance. So some of these early indicators then that we need to keep in mind are difficulties with oral language and speech sound development. These are primary signs of risks for reading disorders. So we're really on the front lines as clinicians to make sure that we're identifying these kids is at risk for reading impairments. Some additional risks, early signs of risk for dyslexia, family history is huge of reading or language impairment there. Children who early on preschool, kindergarten having a hard time learning the letter names and letter sounds. Children who consistently use unusual or non

developmental speech sound errors and then children who have a hard time with multisyllabic words. So that's really a lot of the kids that we work with, right? So the kids who have unusual errors, non developmental errors or difficulty with multisyllabic words, those are some big red flags for us. Things that are not red flags for dyslexia are reversing letters. This is a typical part of development through about second grade. That's not the case that kids with dyslexia won't ever reverse a letter. Of course that's a possibility because any kid can reverse a letter. It just doesn't, it's not really a part of the sequella of dyslexia.

And then calm and speech errors on long words, so saying aminol instead of animal or pasghetti instead of Spaghetti. Those are common errors. Of course, if that kind of metathesis is happening on any multisyllabic words, then we might be concerned. But those two particular words tend to be problematic for kids and so are those types of common errors that we frequently see aren't red flags for dyslexia. So we really wanna be making sure that we're testing phonological awareness in this population of kids, our early screeners should include that information. And this is gonna help us get at children's phonological representations. So phonological representations are the building blocks for spoken and written language. This is how phonological information is stored in memory. And if you'll just allow me this example, this is how I like to think about how phonological representations might be weak or strong.

So this is a depiction of the B phoneme that might be what a week phonological representation might look like. Again, these are all... We're thinking here about how it's stored in the lexicon or in the memory. So this is my own depiction, but you can see like it's not really obvious at first glance that this is the phoneme B. The edges are kind of blurry and it's kind of wobbly and we'll compare that to then what a strong phonological representation might look like. It's definitely a B, so every time we hear it or tap back into it, we're accessing the same phoneme. And so we know that those representations are underdeveloped in kids who have speech sound disorders and part

of the reason that it could be the case that children with speech sound disorders have weak phonological representations is due to their working memory resources. And so this is something I'll also quickly talk about and tell you the results of the study. It could also be the reason why some children with speech sound disorders experience difficulties with literacy while others don't. And so it's a possibility that if we think back to that very first slide when I talked about the observational subgroups that I've noticed in research and in my clinical practice, it's a possibility that the reason why we see kids fall into those quadrants and maybe even more subgroups is because of these phonological representations and the strength with which they're developed or their overall specification.

So how could this affect reading? Well that's gonna impact how you learn the sounds that map onto the letters in your language. And so this could impact how children learn any words, but we think a lot about how kids know sight words. And so I just wanted to give a quick shout out of what sight words really are. What we're thinking here is about a circumscribed list of words where the sight of the word itself activates its pronunciation and meaning in your memory. And so these words aren't really different than any word you would read. So for you as an adult who potentially reads a lot or has at least has a masters degree and has read a lot, your sight word vocabulary is enormous.

So you're not limited to the sight word list that's on the second grade classroom wall of sight words, the words we know, those are second grade sight words because those are words that are frequently seen in second grade textbooks and in second grade literature. And so it's not the case that they're special in any way. It's not the case that you can't decode them and it's not the case that you need to learn them in a certain way, it's just that they're more frequent, you'll see them a lot more. And so you should be able to recognize them quicker because you see them a lot more. For me, my sight word vocabulary is gonna be totally different than yours, is gonna be totally different

than hers, is gonna be totally different than his. So everybody's gonna have their own individual sight word vocabulary based on the words that you see, based on the words that you expose yourself to. So Farquharson is a sight word for me. Arguably, it's probably not for any of you because it's not, oh, my last name is not a word that you see frequently. So in order to build that relationship, you need orthographic mapping. And so in order to establish orthographic mapping, you need orthographic representations. And this is how our knowledge of letters and letter patterns is stored in memory.

So similar to the way that we have phonological representations, we also have orthographic representations. And so this is my depiction of a weak orthographic representation. The letter B stretched out and wobbly, the edges aren't clear, it's kind of dotted and blurry. So we're not exactly sure what this is maybe at first glance as opposed to a strong orthographic representations is definitely a letter B. And so then if you can imagine that mapping process that goes from letters to sounds that happens on or really early on in reading development and through developing phonological process, that mapping process can be strengthened. And so if you can envision then kids who have weak phonological representations who are trying to map those weak memory traces onto weak orthographic representations, that's gonna take a long time.

It's really gonna be protracted by the fact that their representations aren't very strong as opposed to kids who have strong representations. These are kids who are gonna be able to quickly map those letters and sounds. So this is why for one of our risks of reading disability are kids who have a hard time learning letters and sounds. This is one of the reasons why that could be the case because the way that their memory is actually processing these representations is inhibiting their ability to remember it. So you can maybe even reflect on kids that you've worked with that you say, we just talked about that, I just showed you that yesterday and today they don't remember and this could be why. So the self teaching hypothesis, I'm just gonna mention very quickly

here, is a theory that I really like to conceptualize these connections between phonology and orthography. So if you can envision these gears kind of turning, so the phonology wheel turns, which turns the orthography wheel. So you hear the way that a word is pronounced and then you see the way that the word is spelled and over time that builds your literacy skills and you're able to read on your own because you've heard the word, you've seen the word and now you can put that altogether yourself.

And so I'm gonna leave it there for now even though I could probably add a lot more to that particular theory. So some examples of this that I think are really important to think about the way that our phonological representations map on to orthographic representation. So we've got sounds that map onto letters that might not necessarily correspond with what we're used to. So an example of that might be the words pony and Bologna. So allow me the anglicized butchering of the word Baloney. But here we've got words that sound the same, so our phonological representations might kick in and say, hey, those words sound the same. And then we see the orthographic representations and we need to learn over time that these two words might sound the same, but they're not spelled the same way. So the letter patterns are gonna differ and so this relationship is also inverse.

So the way that we learn sounds map onto letters, we also have to learn sometimes that letters map on to sounds in different ways. And so what we might see here are words like cough through rough and though. So we see this O-U-G-H pattern, the orthography here and we think, okay, I got this, O-U-G-H, off, I get it. And then we hear through, right? It's not throw off or then we hear rough, it's not... Every time we hear though, it's not the tho-off, right? And so these are some examples of this need to understand how phonology and orthography work together to build literacy in developing readers. So you can imagine then if phonological representations are weak as a result of speech sound disorders, this is gonna carry over to difficulties with reading. And so, I've been really interested in how this relates to kids who have speech

sound disorders. We have seen through the literature that they... This is a population of kids who do experience difficulty translating phonology to orthography. We see longterm difficulties with this issue with kids, kind of throughout their schooling. And so I wanna quickly talk about working memory before we wrap up our time together today. So one of the research studies that I was a part of kind of asked this question of, okay, so if we know we have deficits in phonological representations, that's gonna lead to deficits in acquiring phonological awareness and that's gonna lead to deficits in literacy. But what is leading those deficits in phonological representations and could it be working memory?

And so a very quick overview of Baddeley's working memory model is that it's a three component memory model that conceptualizes what working memory is. So working memory is a short term capacity space in which we hold information for a brief amount of time before we either forget it or we use it enough that it establishes a pretty strong memory trace for us and it gets sent to longterm memory. So one of my favorite examples of this is when I used to have to remember someone's phone number so I could dial it and I don't have to do that anymore with technology, but I would kind of repeat it over and over in my head until I dialed it and then I could either forget it or it would maybe be stored in longterm memory and you might still remember your next door neighbor's phone number. So this is a three component model. I am gonna quickly talk about each one. This is the central executive, this is the visual spatial and this is phonological loop.

So each one of these within working memory, the central executive is kind of the main player responsible for allocating attentional resources, either to visual spatial or to the phonological loop. The visual spatial, this is responsible for storing visually presented information such as pictures or words. And then the phonological loop, it's responsible for storing auditorially presented information such as speech sounds. We know that this particular aspect of memory is very involved in language processing and

development and has a positive relationship to speech and language acquisition. So in this study, our research question was, so we've got these kids with persistent speech sound disorders, do they differ on their working memory skills compared to typically developing peers if we test them on all three components of that working memory model? And so, to cut to the chase for our sake of time, I'm just going to say that yes, we did find that. We found that kids who had speech sound disorders, second through fifth graders had very weak phonological loop skills.

So their ability to process phonological information in their working memory was substantially weaker, significantly weaker than their typically developing peers. But with respect to their ability to perform central executive tasks, it was the same as typically developing peers and with visual spatial tasks, the same as their typically developing peers. So there really seems to be this isolated issue with how these phonological representations are stored in this population of kids and then how that connects to their ability to understand how phonology is used for literacy. So we've got five minutes for some conclusions and then we'll have another five minutes for some questions that hopefully you'll have some time to stick around for them.

So what we're seeing here is that kids who have, so P-SSD here is persistent speech sound disorders, but the reality is this is the case for a lot of kids with speech sound disorders, that they appear to have deficits that are specific to the phonological loop of working memory. We see that this is a population of kids that struggle with complex word structures. So we see they have a hard time as language gets harder. So as they go from single to multi-syllable words or they're required to think about or manipulate longer a list of words, this is when they really exhibit difficulties and so we see that they do have or they're very likely to have based on these samples, limited phonological representations as well as limited working memory. And so then what does this mean for our assessment and treatment implications? So a few things. My recommendation, I have already talked about our need to have early speech screeners include

phonological awareness, but I really think our speech sound evaluations need to include a test of phonological awareness. I say this knowing that there are so many things that we're asked to do as clinicians and this is not specific to setting even. So, even if you're a private practitioner and governing your caseload yourself, there's still a limit to your time that might be governed by a third party payer. And so there's definitely some things that we need to be aware of here. I think the important thing to take away is that as SLPs, it is our responsibility to be involved in this process. We can be involved in assessment, we can be involved in consulting, we can be involved in the actual delivery of word reading instruction.

So we can be involved every step of the way. But at the level of assessment, we should be testing phonological awareness in this population of children. We might even consider adding a non-word repetition task. So this is something that a lot of research is looking into that I offer with kind of a hesitancy in a way because we don't have strong connections yet to what this looks like clinically, but I have seen in my studies that non-word repetition, so a child ability to repeat back non words, seems to be pretty predictive of their overall phonological knowledge and so kinda stay tuned on that one, but just kind of have that in the back of your mind.

My favorite test for phonological awareness including non-word repetition is the CTOPP comprehensive test of phonological processing. That's not the only one, there's also a good non-word repetition sub test in the TILLS, which is the test of integrated language and literacy skills. So additionally, in assessment, I think I would be remiss to not mention the fact that you should be relying on the other people on your team in whatever setting you're working in. So, I think a lot about the schools, so I'll think about that out loud here. But, you should be thinking about partnering with the classroom teacher to get information from them, particularly if the classroom teacher is the one who made the referral to you. So if they made the referral to you, the onus is on them to help you collect some data. So this is not all on your shoulders as the SLP. The

teacher should have loads of data on how the child has done on weekly spelling tests, how the child's doing on reading tests in the classroom, whether or not the child is meeting their benchmarks for phonological awareness. So use the data that's been collected to the extent that you can. Again, with the screeners screening early and often and not screening just for speech sound disorders. So making sure you're including something about phonological awareness because if you're concluding based on a screener that a child is just our tick, you're completely missing this possibility that could be a huge red flag for you that this is a child with dyslexia.

So with respect to treatment implications, so I mentioned that SLPs are involved in assessment of literacy skills, SLPs are involved in consultation with teachers and also in direct service provision of word reading, treatment, but also we have some things we could maybe tweak in our practices of speech sound treatment, so including phonological awareness in our speech sound treatment, using minimal pairs as an approach to speech sound treatment and referencing orthography. I talked a little bit about this already. Collaborating with reading specialists with special educators. Pushing into the classroom using vocabulary from the curriculum.

And so then just as clinicians really having an understanding that kids who have speech sound disorders are likely to have poor phonological representations and as SLPs, we're really on the front lines there, that this is our job to help identify these kids and it's a possibility that they continue with literacy deficits even once they've been dismissed from your caseload. That doesn't mean they should continue on your case load, but that means that you should be communicating to other people on your team. So just be mindful of those warning signs and open to collaboration and consultation. So you've got two handouts here. One is my slides and the second is a pdf of references that should have everything I've cited here, but also a lot of other studies that have kind of fueled this work and so it's fairly extensive resource list. I hope it's helpful for you. Some additional resources, the Florida Center for Reading Research

here at Florida state, a few other websites you can check out. Decoding Dyslexia as a grassroots effort, that's parent based. And then there's a Facebook group called Clinical Research for SLPs and full disclosure. I'm an administrator over there, but we host weekly topics in that Facebook group led by experts and two that you can look up are week nine and week 16 within that group to get some more information on these topics. I'd also welcome your feedback today and also your feedback as we progress through this conversation, which I hope it continues to be a conversation either using social media or sending me an email. So Amy, I'll turn it over to you to hear some questions.

- [Amy] Sure, okay. So the first question, a couple of people have actually asked, do you have a suggestion of a good phonological awareness screening?

- I like just using a sub test from the CTOPP actually. I think the Woodcock reading mastery tests, so, W-R-M-T Woodcock reading mastery tests, they have a great phonological awareness sub test that gives you a standard score, that could easily be used as a screener.

- [Amy] Okay, great, next question is, is there an age of when you expect kids to be able to rhyme and segment, et cetera?

- I think that depends on the curriculum, when that's actually required by the end of kindergarten, beginning of first grade, for sure, developmentally, but that kind of depends on what the reading instruction includes. So kids aren't going to learn how to segment and delete without explicit instruction most of the time. I mean, some kids kind of get it. Earlier, I have a niece and a nephew, nephew really kind of gets rhyming and got it right away without ever really being asked about rhyming and so some kids kind of get it. So developmentally, five or six years old, but it really is gonna depend on what the curriculum is asking the kids to do.

- [Amy] Okay, thanks. And there are a couple of questions about diagnosing dyslexia. So let me just, let's see. Can you please clarify, can SLPs diagnose and treat dyslexia? And somebody is saying, who's responsibility is it to diagnose, label a child as dyslexic?

- So it's within the SLP scope of practice. So yes and yes. With respect to responsibility, I can't speak to that cause I don't know what the rules are in your district or in your work setting. It could be the case that it's the school psychologist responsibility, it could be the case that it's the reading specialist responsibility. I've seen a variety of different team based approaches. Some schools unfortunately require an outside evaluation, which is completely unnecessary because the school psychologist is capable of doing that testing as is the SLP. So I can't speak to responsibility because I don't know who governs that in your school or in your state, but it's within the SLP scope that's for sure.

- Okay, great. And then along that same line, can dyslexia be diagnosed with an MID diagnosis, if they cannot be, but they also have literacy deficits, is it appropriate to take a structured literacy approach?

- That's a great question. So to clarify your acronym that you've used there, are you referring to intellectual disability? Okay, thanks. So just so that we're all on the same page with the terminology that's used with quite variability across state lines, so that's a really good question. I've seen children with varying levels of cognitive ability receive a dyslexia diagnosis. I think it's a possibility that we see the same symptoms of dyslexia manifest regardless of cognitive ability. Whether or not it's going to respond the same way that a child with strong cognitive skills and dyslexia is gonna be totally child-specific. Is it appropriate? I think a blanket answer is hard at any stage. A blanket answer at this point, I'd say yes, you'd have to check and see how the child responds.

So I think it's appropriate. I don't think it's something that you should shy away from. I don't see any clinical or theoretical reason why a child wouldn't be considered for a structured reading program. But I think you'd also wanna just take into consideration what their cognitive skills are and if they're not responding over a period of time, then you might consider changing things or going at a slower pace or considering a different type of program. But some of that is really child-specific. So it's a great question and it's pretty complex. But I think it's also really child-specific.

- [Amy] Okay, thank you. And can children without a history of SSDs still have dyslexia? What are your thoughts on that?

- Oh, yes, yes, absolutely. So, sorry, that's a really good point of clarification is that a child can have dyslexia without ever having issues with speech sound production. So the purpose of today's topic is really to talk about the connection between speech production and literacy, but absolutely dyslexia can and does exist in the absence of speech sound disorders. So those kids are even trickier to identify because our kids with speech sound disorders, the benefit that they have going for them is that their speech sound disorder is a red flag saying, hello, everybody can hear this, right? Pick me up, I need some help. Kids who are at risk for dyslexia that don't have speech sound disorders sometimes they fall through the cracks because they don't have that over issue with speech sound production and so those are kids that we often miss. But yes, sorry, that's a great point of clarification.

- [Amy] Thank you. And then can you explain atypical errors? Are phonological processes considered atypical or would it be less common substitution? Say the child who says S for T or both?

- So there are phonological processes that are typical and there are phonological processes that are atypical. So first, the field is moving towards, moving away from

using the term phonological processes because of how similar it sounds to phonological process thing and so I use phonological patterns, means the same thing. There are some that are typical like stopping, gliding, fronting, cluster reduction, those all happen and as a part of typical development. The issue is when they persist past that point, that's when we start thinking about them as problematic and possibly indicative of a disorder. There are also phonological patterns that are atypicals. So, backing, initial consonant deletion, those kinds of patterns are atypical. They don't happen in normal development and so they are likely indicative of a disorder pretty early on. Same goes for specific substitutions. So, there are typical substitutions. So T for S is a typical substitution, S for T, not so typical. So I think that's kind of how you can maybe think about it. Some of the common errors that you've seen F for TH, W for R, W for L, frontal lisp. Those are typical errors that by typical meaning they happen in normal development. Some kids outgrow them, the kids we see don't and so that's when it becomes problematic. So I hope that helps.

- [Amy] So we're gonna take one last question. I do see that there is still some in the Q & A, but we do need to wrap it up and those of you who do need to log out, please feel free to do so at this time. You will be given credit for the entire hour. And Kelly, I hope it's okay to say since you do have your contact information on this last slide, if you do have any questions that were not addressed today, are they free to email you? Okay, okay, perfect.

- Yes please, definitely.

- [Amy] Alright, one last question then. So this person is saying, I've encountered many students, who would quote unquote read a sentence, but they were just saying words that shared the first sound letter of each of the words on the page. Do you think this is due to over-training of sight words when the students haven't mastered phonological awareness and decoding first?

- That's a great question. I've seen that too. I will say that it's a common compensatory strategy of kids who have reading impairments, not necessarily specific to dyslexia, but just kind of broad, more broadly thinking about reading impairments for them to guess the first word. So for them to see a word that starts with D and say dinosaur instead of dragon or vice versa, to kind of guess at it, that's a common compensatory strategy because they're just really trying to guess. Is it overtrading due to sight words? It's a possibility. I think it probably depends on what the curriculum was comprised of along the way. So were they taught a more phonics-based approach, which is the recommended approach, it's definitely something that reading war story is kind of over that we know phonics is necessary. I will say it's a possibility that those kids were taught at a more whole word level and so, which is why that doesn't work cause it's hard to guess if you don't have those skills. Maybe it's over-training. If that were a kid on my caseload, I would start by testing their phonological awareness. I'd also do some testing of that phonemic decoding that we mentioned, which is the reading of non words. So I mentioned the Woodcock reading mastery tests, the WRMT that has a sub test called word attack. That sub test is non words and so that's a nice one to look at because if a kid is guessing, they're not gonna be able to guess at these words cause they're non words, they've never seen them before. So you can really get at whether or not they're guessing or whether they do have some letter sound correspondence skills, but they're just habitually doing this because of maybe the over-training that you thought about. It's a really good question.

- [Amy] Okay, excellent. Thank you so much for sharing your expertise and for joining us today.

- Thank you guys.

- [Amy] It was really a pleasure. I know I have learned a lot and this is just one of the areas that I love. So thank you so much for joining us and thanks to all of our absolutely and thanks to all of our participants...

- Thanks for inviting me.

- [Amy] For joining us today and asking some really great followup questions. We do appreciate your time and look forward to seeing everyone again soon. Have a great rest of the day. Thanks everyone.