Supporting individuals who need AAC in learning language & literacy:
State of the science, emerging technologies, & future research directions
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[Dr. Janice Light]
Well, good morning, everybody, and huge thanks. Jordyn and Bob. Very powerful words and a challenge to us, obviously, as a field. What Christine and I hope to do, in the next little while, is to talk a little bit about the state of the science, where we are so far in terms of understanding how to support individuals who need AAC in learning language and literacy, and then to talk about the future, because clearly, we still have a long way to go.

And some of the emerging technologies and also, future research directions. And we're here presenting, this morning on behalf of David McNaughton, obviously our colleague, as well as Dana Nieder and some of you may know, Dana, who is the mom of Maya, now, it's hard to believe, adolescent young adult, who uses AAC, and some of you may know her from her blog, "Uncommon Sense."

And she's been an active participant in this paper, as has Jamie Preece. And again, some of you may know him as an AAC user who came late to the table in terms of having access to opportunities to learn language and literacy skills. Neither of them were able to be with us today, and we're really sorry about that.

We desperately missed them, but they have certainly contributed to our work and we're grateful for that.

So, communication really is the essence of human life. And all of us know that. And as Jordyn and Bob really emphasized effective communication, being able to participate, really depends on language and literacy skills. Especially if we're going to be able to communicate anything we want to anybody in any kind of situation. So really, the importance of language and literacy cannot be overestimated.

And I just wanted to share with you this quote from Dana Nieder. And she's talking about the challenges, ahead of her and trying to set some priorities. So she said, "Like many children with global challenges, Maya has always been a child with a large number of goals. And I realized early on that as a human with limited energy and resources, it just wouldn't be possible for me to approach all areas of development with universal enthusiasm and passion. And I decided to focus on communication and literacy. These seem to me to be the cornerstones of everything else. Communication is a right. And I was pretty determined to find her a system that would serve her well. And literacy? It opens the doors to basically all learning."

So, learning language and literacy isn't easy. They're complex processes that begin at birth and require years and years of learning. And there are two things that are essential for sure. If you're

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going to learn language and literacy, you need opportunities to interact with other people and opportunities to learn. And you also have to have a means to participate within those interactions.

And that seems like a simple statement, except as Cathy-Cathy Binger's research-has recently told us, 1 in 89 - did I get it right? 1 in 89 School age kids cannot rely on speech alone to be heard and understood. And these kids cannot learn language and literacy if they don't have access to a way to participate, if they don't have access to tools, if they don't have access to AAC and they cannot learn unless they have opportunities to interact with others and opportunities for effective instruction.

So we have what is a rapidly developing body of research now that demonstrates the positive impact of AAC. So huge thanks to MaryAnn Romski and Rose Sevcik for their RCT and future research that is really demonstrated this benefit to, Connie Kasari and her colleagues, their smart study that, again demonstrated strongly the benefits of AAC to many, many, single case research designs conducted by many of you in this room.

And to an increasing number of meta analyzes, as Bob talked about and systematic reviews that pull that research together and truly demonstrate the power of AAC. And just to alert you to a new one coming out that, Lauramarie Pope just finished, that demonstrates the power of NDBI interventions for individuals on the autism spectrum. When AAC is incorporated into those interventions, and how much more powerful they are when AAC is involved than when it is not.

When we have access to AAC, we know that it increases communication, improves comprehension for those individuals who benefit from visual supports, increases the frequency of expressive communication, and increases the range of communicative functions. It also serves to enhance language development, increased vocabulary, increase the length or complexity of messages, and even improve morphosyntax or the grammar and structural aspects of language.

It reduces frustration inevitably, if you don't have a way to communicate, there's tremendous frustration and overlay to that traumatic experience, and it reduces all of that. And of course, what we know is that this happens with no risk to speech development and speech production. Okay. And it's been demonstrated over and over again in, in the research that's been done.

So, we know that the process of learning language and literacy skills begins at birth. But most kids do not get access to AAC until they're much older, and that's on us. It results in a delay in their language and literacy learning. So, on top of challenges that they already confront, we've now held them back for potentially years upon years upon years.

Unnecessary frustration, unnecessary isolation. As Grant talked about yesterday, and cascading negative effects that lasts throughout life and impact every aspect of their lives. Why does it happen? I won't reiterate everything from yesterday, but a lack of competencies in AAC amongst our service providers. A continued belief that there are prerequisites to AAC that you have to prove you know language before you can get access to AAC, instead of an understanding that AAC is the way that you learn language.

Okay, continuing to view AAC as a last resort despite evidence and this comes out of Connie Kasari's study that outcomes are best (and MaryAnn and Rose's) outcomes are best when kids start with AAC.

But that doesn't happen. Listen to Dana, Maya's mom, and she says, "The professional support for AAC use has been dismal throughout Maya's school career. We were lucky one year,"

One year out of her entire school experience!

"With a school based SLP who got it. But aside from that, we've had to fly solo." (Dana Nieder)

So. But for Dana and her husband and Maya advocating for themselves, no support.

We really need a paradigm shift in this field. We need to stop thinking about AAC as something just for people who aren't talking. We need to understand the tremendous power of AAC in terms of enhancing communication and language, and the potential for literacy. Imagine a world where every child from birth who was at risk had access to AAC.

And was able to jump start their language and literacy development from the very beginning. Instead of waiting 5, 10 years. What a difference for those individuals in terms of long-term outcomes! Some of them may end up relying on speech as a primary mode of communication, but they would have had a jump start in terms of learning language and literacy skills.

And they will also be good technology users who are good at using other modes of communication. And we are all multimodal communicators, as you've seen today. And some of them will be lifelong AAC users, but they will have had a chance to learn language starting at the same time as other kids from infancy. But it is never too late, and I sometimes see that we write off individuals who haven't had a chance when they're adolescents and young adults.

And the research definitely shows work by Christine Holyfield, and others that shows that older children, adolescents and adults can still learn language and literacy skills provided they have access to effective AAC and to effective instruction. Okay, so I do say effective AAC. I'm going to challenge us as a field to get out of our rut a little bit.

We have a group of AAC systems out there that are not research based. They've been developed by neurotypical adults, in fact, developed based on no necessarily research or understanding of how people process information and how they interact with it, but instead just based on way back, we had people with cerebral palsy who needed a way to communicate.

Many of them had lap trays, and we've done some pictures on them and laid them out in rows and columns. And our current AAC systems still look like that, and they work well for some people. Don't get me wrong, you have seen people who do very well with those systems, but as others have said, they are hard to learn and use tremendous demands.

Understanding the picture symbols, being able to navigate it, being able to make sense of what's being said and the messages that need to be produced. And I think Grant, in one of our planning

meetings, you said it best where we don't get recognized as AAC users for the tremendous work that we have to do to communicate.

And everything we have to coordinate. But you know what? It doesn't have to be like that. AAC systems are not immutable technology. We can do anything we want with that. What we need to do, and this is a challenge to us as researchers and developers and manufacturers, is to understand how people who use AAC process information and interact with information and let that drive our technologies, not just habit.

The easiest thing to change is the system. It can be anything.

So, we need to maximize the appeal. Make them easy to learn and use, but incredibly powerful. And they should, in the early days, reflect what we know about how kids learn language. MaryAnn and Rose, I know you've been saying this, to this field forever. Above everything else.

These kids are language learners, and we need to remember what we know about how people learn language. And that's what should be driving communication systems. Okay. Okay. So, there are a ton. I hope someday we will have those of you that are smarter than me and that have more creative juice than I do, I hope we will come up with a million better ways of doing this, but we know that what we're doing currently with systems is hard for many kids, especially infants and toddlers.

And it's not that they can't learn. Of course they can. But it is that the demands of learning are so great that their language development is being held back, and we don't want that to happen. We want them to be able to learn at the rates that they're able to. Okay. And some of the reasons are because we take the language out of context, we lay it out, we represent it in these picture symbols.

And all of that imposes a lot of metalinguistic demands. And if you're not, I hope you become familiar with the work that Natasha Trudeau and Anne Sutton and colleagues have done, that show that the way we deal with language in AAC systems in a AAC picture simple systems, is so complex that it's not until kids without disabilities are five and six years old, already starting to learn to read.

Okay, that they can understand three symbol, three concept messages, or express three concept messages. And these are kids who have thousands of words of vocabulary and use them generativity to tell stories and communicate complex messages. That's the system that's difficult. And we can change it. There's nothing magical about what we've done. Okay, so one tiny idea, and it's just one idea is that we instead take what we know about language development, that in fact, learning language in the early stages is embedded in the meaningful contexts of daily interaction.

Let kids, if they can, snap photos of their lives, the situations that are important to them. Take video about situations that are important, and then control their own vocabulary by letting us know what things are of interest to them. And very interestingly, we know from some of the work Krista Wilkinson has done in her lab that in fact, we are fundamentally wired visually to

deal with things on a daily basis, and all of our vision is immediately driven towards, in this case, Lily and her mom.

And the telephone because they're playing phone Okay, so we are driving it to guess what? These are also the early emerging language concepts, right? And we can do hotspots to communicate these concepts. Mom and Lily and talking and hi, whatever concepts we want. And Lily can control and indicate some of her vocabulary. So, it's not just having access, and I want to go back just for one second.

I hope we come up with even better ideas. So don't I'm not tied to anything we've done. Just trying to say we need to think outside the box. Whoever take credit, whoever said that yesterday. So, I think outside the box really important. And we need to think about new ways of learning language. We have been stuck in this model of spoken language for a long time.

But you know what? We now have captioning glasses where kids conceivably from birth could be receiving all of their language input in text. And now we've righted the symmetry, right? Kids learn language through written language, right? And produced through written language. We don't know. But we need to break out and start to explore new directions. Okay, so it's not just the systems, it's also the opportunities to learn language.

And too often we end up our research shows that we're great at teaching people how to make requests. Honestly, as one mom said to me, "You know what? There's more to life than cookies, right?" Kids are never going to learn language that way. These are dead end interactions. I ask you for something, I get it, I'm done. We learn language in social interactions.

And this is not more difficult than requesting those social interactions where we go back and forth with another person. Those also emerge early on, and then we learn to put together the social side and the object side or the activity side. And pretty soon we have joined attention and people sharing activities and learning. And those are the interactions that are the foundation of language learning.

So, we need to do things differently in this field to support true language development.

Okay. Our goal I think, Bob, you talked about this. We need to build a large a rich and varied vocabulary. Vocabulary is very highly correlated with later outcomes, academic outcomes, employment outcomes, etc. and it's terrifying to me to hear this field talking about, oh, let's focus on a tiny core vocabulary. No, we need to expand vocabulary. I know why we do it, because it's difficult in our current systems to deal with all of those concepts.

But the solution is not to limit what kids who use it need AAC can say. The solution is to do a better job with our AAC system so that it's not so hard to learn and get to that language. And I think Jamie said it beautifully when he said, "You know what? Words are more than just talking to us."

They're definitely talking to us. But they're thinking tools as well. And when we externally cap vocabulary, we externally cap cognitive development.

So access to rich and varied vocabulary room to grow. You cannot learn new concepts if you don't have access to them. We need to teach kids to ask questions. That's an incredible way to control your learning and to empower kids to control their AAC system so that they're actually able to take pictures of the things that are of interest to them, take videos of the things that are of interest, and show what is of interest to them, because those are the things that they will want to talk about.

And then most importantly, teach literacy skills early on, because that's the only way that they'll actually have that true generative capacity to say anything to anyone. Okay, so we've heard from Bob, and I won't spend a lot of time on this, but how many individuals are excluded from the opportunity to learn literacy skills? And it's been estimated that of, AAC users, Beth Foley's work that more than 90% enter adulthood without literacy skills.

So again, we have abundant evidence that people who use AAC can acquire literacy skills and huge recognition. And thanks to David Yoder for founding, founding the Carolina Literacy Center and Karen Erickson continuing the work and others, in her group. And to many of you in the field, Martine Smith, Jess Caron at Penn State and Nicole Romano who are really looking at implementation science because as Bob said yesterday, "It's great we know all this stuff, but nobody is doing it!"

And so, thanks to NIDCD for funding that work and to really move what we know from the research into the classroom, we can see gains with effective instruction in emergent literacy, phonological awareness, letter sound correspondences, decoding, encoding, sight word recognition, reading comprehension, writing, etc., etc. and this is again just from Dana on the importance of literacy.

She said, "Yesterday, Maya was very jazzed about a class trip to Legoland. There was a period of frenzied typing, but I noticed when, after a pause, she started again. L E G O Wait, what? Maya spelled her name for a long time, but prior to yesterday, I never seen her spontaneously type another word. Ever."

But why did she? Because she had access to the alphabet and the chance to do that. And then Dana goes on and talks about what that meant. A window had opened because rather than Maya being tied to what we decided she was going to communicate and the vocabulary we gave her, she could say anything or not. Yeah, but was on the road to being able to say anything she wanted.

And Dana says, "I spend a lot of time thinking about what she thinks and what she knows and what she understands and what she can do. And now, somehow, I was starting to get a glimpse." So, we need more R&D. So many individuals who aren't literate, get or are preliterate or, haven't had a chance are left with using picture-based systems and they tend to get trapped in those and never get out of that because those systems don't automatically support the transition to literacy.

So we've been doing some work, at Penn State, trying to, under the RERC, trying to leverage what we know about visual cognitive processing, specifically the fact that motion attracts our

visual attention, using that to attract the attention of people who use AAC to the written word so that they're not caught in the clutter of the display, but rather are focused on the orthography.

And then to map that with the speech output, either add a letter sound level or add a full word level, to support the re coding into spoken language. And we're currently involved in a wide range of studies under Christine's leadership to look at the impact. We've done kids as young as three and as old as 55, that's actually young.

But I know you're right Bob? and 88% have increased their literacy skills simply with access to what we call the T2L or transition to literacy feature. And I will say that we do not intend this to be a replacement to instruction. Every child should have literacy instruction, but we do intend for this to be a supplement and a support, especially when unfortunately, professionals or service providers don't know how to provide good literacy instruction because the system models that for.

And I should say, many thanks to all of the AAC manufacturers: Attainment, PRC Saltillo, Tobii Dynavox, TherapyWorks, all of whom have incorporated that feature now into their technology. So every child can have access to that visual scene displays or grid displays. So again, back to, Dana, Maya's Mom said, "AAC use really changed when the pandemic started. Using her her picture-based device over zoom was awkward and unnecessary because she quickly found that it was far easier to use the chat feature." As many others know, I use regularly, right? A favorite of Jordyn's and type responses. "She never really transitioned back to using her AAC system as she had before. So, in thinking about how technology has or hasn't met her needs, I'm somewhat at a loss."

"I feel like we're kind of fumbling again to find a system that'll work for young adult Maya, who's no longer child Maya." And I think what Dana's emphasizing here is that kids change over time. Needs and skills change over time. And it's not just quantitative shifts that we can do more, but it's qualitative shifts so that in fact, kids think differently about things and can use language differently.

So, we really need a new generation of AAC systems that will meet each individual at their stage of learning and grow and evolve with them. And on that note, I'm going to turn it over to Christine, who's going to take us into the future with, the next steps.

[Dr. Christine Holyfield]
As Janice mentioned, there's an urgent need for research to better support individuals who use AAC who are learning language and literacy. Future research should investigate techniques to ensure children have early access to AAC services. Such research could investigate the effects of changes to policies to provide early access to AAC to all children receiving early intervention. This research could also evaluate the effects of interventions to improve pre-service and in-service training for service providers and should also focus on reducing racial disparities in access to AAC and AAC services.

Future research should also investigate how best to support people who use AAC in learning, language and literacy. This research should explore other models of language learning, not just

spoken models. So, as Janice mentioned earlier, future research could explore the possibility of people who use AAC receiving text input-input to supplement all of the spoken input that they hear.

Future AAC technologies must undergo rigorous theoretical and empirical scrutiny, with investigations considering the context and outcomes important to people who use AAC. Additionally, future technologies should be adaptable to the people who use them, not the other way around. As such, development should be driven by the needs and skills of people who use AAC and their communication partners. Technology is emerging to create new opportunities for building AAC that is more powerful, easier to learn and use, more responsive to users, and that empowers AAC users to control their vocabulary and their learning.

In the following slides will highlight just a few of countless opportunities for future research and development. To leverage emerging and quickly developing technologies to better support individuals who are learning language and literacy.

Recent advances in technology allow for AAC technology to be context aware or more connected to the context outside of the device. During interactions and language and literacy learning. Many contextual factors outside the AAC device play an important role. There's the people around and

There is the physical environment and the activity that people are interacting around, and there's things like location and time of day, just to name a handful.

Future technology could draw on and integrate information outside of the context of the AAC device to better contextualize interactions and provide richer language and literacy learning opportunities. Recent research from Cai and colleagues evaluated AAC that integrates questions from communication partners when expanding on abbreviated responses from people who use AAC. This capability reflects priorities from AAC users and allowed the AAC technology to more accurately expand their abbreviated messages, supporting communication efficiency and reducing effort.

Recent research and development has also focused on context aware AAC to support individuals who are learning language and literacy. For instance, [Fontana] de Vargas and colleagues used computer vision to integrate the immediate physical environment through photos taken with the AAC device, which resulted in related communication options. Such an approach has the potential to support literacy and language learning and communication efficiency.

But more than that, this approach creates an opportunity for AAC users who are learning language with the possibility of self-directing the vocabulary that they use. Though limited research and development today indicates that contexts where AAC could result in increased technological support for individuals learning language and literacy.

Also, future AAC technology could learn from and alongside the AAC user through recent advances in artificial intelligence. For instance, future technology could be learning from the individual who uses AAC every time they use their device. Their input into the technology could

provide input about communication preferences, development of language, cultural and personal communication style and interest. In addition, future AAC technology could learn alongside the individual who uses AAC as they are learning language.

Recent research outside of the field of AAC includes monitoring language input from young that young children are receiving and using that to teach artificial intelligence, language.

Future technology could also support the integration of unaided communication, such as gestures, facial expressions, and intonation into interactions supporting that multimodal communication that we've been hearing so much about. Research and reach. Researchers and developers are applying gesture detection and computer vision to recognize American Sign Language, which could allow people who communicate through American Sign Language and people who do not to interact more effectively.

These technologies could also be leveraged to integrate unaided communication from people who use AAC into interactions, enriching them for both the user and the communication partner. For instance, technology could look for unaided communication signals indicating a person's communicative intent or affect while communicating using high tech AAC and integrate that information into the interaction. Differentiating the intent of a single word message could promote better responses from a communication partner.

If AAC technology could detect intent or affect. This could also inform the intonation of corresponding speech output or suggestions for communication. In these ways and more, there's potential for future technology to integrate nonlinguistic communication with linguistic communication to enrich interactions and language learning opportunities.

Jamie said, "I didn't learn to read or write in school and thought I never would. I thought I was not clever enough to use a device. So, when I realized that the age of 36 that I was going to be able to do it, I was overjoyed. It has totally changed my life, and I do so many things I never thought I would."

This quote from Jamie underscores the power and the responsibility communication partners have. The professionals in Jamie's life could not effectively teach them or support his access to communication. Jamie was always clever, and he always had the right to communicate effectively with others, to learn language, and to learn literacy. Yet a lack of knowledge and skills on the part of the professionals in his life left him feeling that he was the reason that he could not effectively communicate and that he never would.

In addition to better supporting users, future AAC technologies must better support communication partners. Much work outside of AAC technology is urgently required to better support communication partners, for instance by addressing insidious, low expectations school policies and a lack of pre and in-service professional training. Still, through emerging technologies, there are more opportunities than ever for future AAC to support communication partners and we'll provide just a few examples.

Through work like that completed by Laubscher and colleagues Frick Semmler and colleagues, Binger and colleagues evaluating vocabulary, selection and language development, large language models could be fine-tuned to better support communication partners in selecting vocabulary to support language learning and communication across functions. Through work like that from Venker and colleagues, future technology could also support communication partners in deciding how and when spoken input is augmented.

Large language models could also be fine-tuned by the published works of self-expression from AAC users like Latif McLeod to better support a path towards self-expression for advocacy and for art.

There are many other ways communication partners could leverage large language models to support communication, language and literacy, such as through generative AI. Classroom materials could be adapted to support nonspeech responses very quickly and to use more accessible language and text. For instance, communication partners could feed a book being read in a class to generative AI and prompt it to rewrite the book in the child's current reading level to support their participation in the classroom and literacy learning.

Generative AI could also be used to offer visual supports that are both culturally and personally meaningful to the person who uses AAC existing classroom visuals can be quickly remade to better reflect the children in the class through this approach. For one example, a Marshallese child who used AAC could for the first time see a child who looked like him represented in a classroom activity.

And as a bonus, these image images were also easily imported into his AAC device, as representation for future research and development could explore many ways to make literacy and language more accessible to people who use AAC by creating supports and communication options responsive to them and their needs.

Future AAC technologies should also supplement communication partner knowledge by building in automated language input. For instance, two communication strategies that are often very, that research shows are very supportive of language learning are expansions or the repetition of words and short phrases with the addition of language detail and augmented input, or supplementing speech with visual support to scaffold comprehension.

Recent research by Valenti and colleagues shows that large language models could be used to expand short phrases, and while in their research they used that technology to expand the messages from the communication partner, it also could be used to enrich input to the individual who uses AAC. Recent research by myself and colleagues suggests that automate automated augmented input and communication options in response to partner speech could support communication and engagement from autistic children who are learning language.

For instance, in the photo in this slide where the child receive color photo communication options based on the color question being asked by the person reading the book, much more work is needed to understand all the ways that future AAC technologies could support

communication partners and supplement the input they provide that is so critical to language and literacy learning.

To conclude, people who cannot rely on speech to be heard and understood have the right to the power of communication, language and literacy. However, like every right, this right requires deliberate work to be upheld, and this right can only be realized if people have access to effective AAC and have meaningful opportunities to interact and learn.

Thank you.