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TECHNOLOGY ASSISTED LANGUAGE INTERVENTION IN CHILDREN WHO ARE DEAF/HARD OF HEARING

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>> DR. SUSAN WILEY: I think we should get started. Sorry. We're going to get started because we want to respect the next speakers' time as well.

We're really appreciative to talk to you today about our Technology Assisted Language Intervention for Young Children who are Deaf or Hard of Hearing. We've had the good fortune of having funding through the March of Dimes, NIH, and NIDILRR. We have no conflict of interest.

What we hope you learn today is to understand some of the impact of augmentative and alternative communication language learning for children who are deaf and hard of hearing to kind of understand what types of kids that might be best for and to think about strategies within their early childhood domain to support AAC readiness in children who are deaf and hard of hearing.

Our motivation for the study was we recognize while children who are deaf and hard of hearing reach low average language skills that seemed like an underperformance. And really they should be achieving to their cognitive capability. We have a belief that this gap does not have to persist. We should be shooting for higher. And recognize that maybe a different approach was needed to make an intervention be more effective to help kids meet their potential.

So the theory behind this intervention was to apply kind of the framework of augmentative communication approaches as a teaching tool, not as a speech‑generating device but as a speeching tool for language learning in children who are deaf and hard of hearing who also have language under performance.

So our study objectives were to understand if high‑tech AAC within the context of speech language therapy is an effective teaching tool to enhance development among children who are deaf or hard of hearing and compare that to the usual treatment or treatment as they are typically getting.

So this prompted us to start a randomized controlled trial to figure out the efficacy of this intervention. What we've done is taken kids and evaluated them to determine if they are appropriate for our study. They get randomized. You flip a coin and one goes into our intervention group and the other stays in their usual treatment. If they are in usual treatment, they can cross over into the intervention after the period of time for the study.

Really, basically this high-tech AAC uses TouchChat on an iPad within a series of speech language therapy sessions in both situations, they are based on the specific gaps and family priority. So that's really not different than standard of care.

>> ROSE SHELDON: My name is Rosie Sheldon. I'm one of the team members helping guide this project through its different steps.

First of all, I wanted to show you all what TouchChat word power looks like. Some of you may be familiar with it and some probably not. Basically it's a language‑based program that has different buttons showing all the different words that we can use in the English language. The pages range from 20 buttons on a page. This one has 42 buttons on a page to 108 buttons per page depending on where the child comes in from a vocabulary standpoint.

As you can see or maybe not quite see from there, some of the buttons have a small emblem, a little arrow in the corner. That just indicates that's going navigate to a page that correlates to that first button. For instance, when you touch the picture for eat, it takes you to the food page. When I touch the picture for play, it takes me to my toy page. Similarly, we have our pronouns on the left. And it's predictive in how it navigates. So when you touch a pronoun, it takes you to action words or verbs next.

So basically the intervention, what we did is we incorporated these AAC strategies into speech language therapy to use it as a teaching tool for more complex verbal language skills. One of the perks is that it provides a static visual representation of those concepts and it supports different grammatical words like conjunctions or articles. In addition, it also has morphological word endings. So like a past tense ed or plural s you can also add those features in the system. It provides a consistent model for verbalizations and allows the child to get a sense of feedback and a self‑monitor what kind of language they're producing. And all of the children were taught to use their words and to imitate the messages they construct on the device. It's all well and good if you can make a message with the iPad but really the ultimate goal is being able to use that skill verbally.

And finally, one of the most important things we know about any intervention is the active family involvement and participation. So we were able to use it as an aid language stimulation tool through our sessions to help families generalize the skill across settings.

>> Some of our basic inclusion criteria, we had kids who were 3 to 10 years old, all with bilateral permanent hearing loss. The current focus for our group was the 3 to 5‑year‑olds as we know we can make a bigger impact during that time of language development. All of our kids had IQs greater than or equal to 60, non‑verbal IQs in each of them were determined at the screening visit to have a language under performance which was determined at that screen visit before randomization occurred before we flipped that coin.

We assess the language skills in several different ways. One is we collected language samples. We looked at spontaneous interactions in conversations based on the child's developmental and age level. So for a lot of our younger kids, we did play‑based language samples where we were just trying to elicit spontaneous conversation. We were looking at several different things: the mean length of utterance, morphemes. If I said the word cat, it's one morpheme. The moment I add that plural s, cats, it's two morphemes. There are two units of meaningful language in that word.

We're also looking at the number of different words spoken in 50 utterances from the sample as well as the mean term length. So the length of the conversational term the child was taking.

Sometimes kids say sentence back‑to‑back with another sentence with another sentence. And it's important to look at what kind of communication partner they're becoming in that role.

We also did standardized assessments, so the CELF or CELF‑P, as well as looked at a Pragmatics Profile that was social language skills completed by the parents. We looked at receptive vocabulary with the Peabody. And we were able to gather information on the frequency of use through the TouchChat software. That's something we haven't been able to analyze yet. We have data but at some point we'd love to see what kind of outcomes we have based on usage.

Other assessments we did, we looked at neuro‑behavioral outcomes so our kids' cognitive performance on several different measures. We used either the Leiter or the BRIEF. And also looked at functional outcomes like the Vineland or the CBC. We collected demographic questionnaires and also performed health record reviews.

So we talked about our kids being randomized into two groups. The first group that was randomized was the TALI intervention, which is the technology intervention group. And you can see that on the timeline up top.

For that group they received weekly speech therapy with the use of a device, six weeks of weekly therapy, a six‑week break, six weeks of weekly therapy, and another six‑week break, which is when the post intervention assessment happened.

Language samples were collected every six weeks. And then we also did a final evaluation, another 24 weeks after that final visit to look at sustainability of those outcomes.

For our treatment as usual kits, we tracked their progress across first 24 weeks with a pre- and post‑assessment, also with a language sample taken in the middle. And then like Susan said, at the very end, the families were able to switch over to the intervention if they were interested.

All right. I'll let you jump in at this point.

>> So whenever you include or exclude kids, it's helpful to know who didn't get in the study. So this chart really talks about the differences between those who were deemed eligible and ineligible. And really ineligible meant your language was commensurate with your capabilities.

Really, I think the main kind of differences in terms of those who were deemed eligible were in their age, so they were younger in a non‑white race and in a lower household income.

When we look at the overall group of participants, and this is all comers so that goes up to 12. There really aren't a lot of differences. And that's the whole idea between randomization. So there are a few things that kind of skew in one direction at this point, but we expect over time as we get more kids it won't look as different. So those who are in the TALI had a little more likelihood of having private health insurance, a lower likelihood of having a mom who was a college graduate, and a little bit more likely to have a lower income.

>> We also want to go over some of the outcomes we had of the study. So as I explained earlier, we had the mean length of utterance in morphemes. So the number of morphemes the child is using per phrase. And you can see that our blue dots show the intervention group and our red triangles show the treatment as usual group. These are all adjusted means. And they show the progress over those 24 weeks.

You can see the TALI group, the technology group, had a nice increase across time. And I want to just float here that this is all the kids who are 3 to 5 years old. Now, your acquisition of morphemes, your acquisition of longer sentences as you go, varies based on if you're a 3‑year‑old, 4‑year‑old, or a 5‑year‑old. So we just want to give an idea of what that whole group looked like over time.

And then you see on the right the graph, the same dots represent the same groups. So blue is TALI, red is the treatment as usual. And you can see the number of different words used in 50 utterances from those samples.

In addition, we looked at the mean term length so that conversational turn. How long was that child's conversational turn? On the left you have the 3 to 5‑year‑olds and on right our whole cohort.

It is noteworthy we had statistically significant increases for our TALI group, for the 3 to 5‑year‑olds across time. And this is really just looking at how that child participates as a conversational partner.

So, we also looked at the standardized assessments. Our primary goal in using standardized assessments was to look at eligibility and look at the child's ‑‑ where they came in, the progress that was made. And we actually did not power this as a primary outcome. This is a secondary outcome for us. So we were pretty surprised that the mark moved as much as it did. And we did have statistically significant increases in the standardized language scores for these kids.

So you can see on the left side, you're looking at receptive language scores and we had an increase from roughly 86 to about 102 for our intervention group for standard scores for receptive language. Like I said, we did not expect this outcome and it might be something we delve a little deeper into in the future because we did not power it based on that.

And then similarly with expressive language you see quite a jump there. And the gray is the treatment as usual groups.

All right. So this graph, I know it looks a little confusing at first but just to explain what it's looking at, these are the kids who were in treatment as usual to start and then they flipped to participate in the intervention after. So this is kind of a nice glimpse into being able to track a child's progress, their personal progress, and compare their personal progress with the intervention after the fact.

So, if you look here, this is our 0 mark. And we're looking at the change of mean length of utterance. You can see for children 1, 2 and 3, there really wasn't much change in the mean length of utterance when they participated in the treatment as usual group.

The green bars show the participation in the intervention group and what the change of mean length of utterance was during that participation.

All right, you can see the range above and below the bars of where the child started during the intervention or where the child ended during their intervention.

Does that make sense? I know it's a lot to look at.

>> So we were pretty floored by this. I know ‑‑ like we were really excited. And I think when you find such striking changes in outcomes, first off people go, “I don't believe it.” And we heard that a lot. What we saw change in people's perspectives and therapists who received a child after this intervention back or schools back into their program and saw how markedly different their progress was.

But what I think is also important to think about is, well, who is this right for? Are there aspects of things that make this more impactful for some children than others? So I think what was really interesting is that when we looked at each kid's individual trajectory or data, those within the technology group did not lose skills and everybody gained skills. That kind of goes against that worry that people have that's a myth that technology will decrease kids from talking.

And we do recognize age and IQ impacts the growth. So we're also looking at growth over time, at least in our primary outcomes of, like, mean length of utterance and so forth. But those standard scores take that into consideration.

What we also thought was important is when we looked at these models, what didn't show up as important was age of identification of hearing loss and degree of hearing loss. And perhaps that's because we already took the under performers. I'm not entirely sure but that did not really play a factor in who did or did not make progress with this.

And then the factors of maternal education level public insurance status. Those are factors that are often talked about in language, just in terms of just language development and the general population also did not really play out as driving the results.

>> So we're still relatively early in this research. We started with a pilot study. Now we're on a randomized trial which we're midway through. We're hoping to have multiple sites at one point. We know we're still early. But we're starting to look for themes and reasons why this might be work for some of our kids.

One aspect we look at is that auditory messages are fleeting and they're temporary and they're really hard to go back and review and talk about and capture that moment in time. So, this intervention allows us to get a visual snapshot to help the child see what's happening, monitor what's happening, get another try at what's happening. So it makes it more permanent and accessible to some of our kids with hearing loss. It also highlights low emphasis language features. So those morphological word endings, past tense ed, plural s's, articles, conjunctions, those are all not emphasized in English verbal language so it allows us highlight those.

In addition, especially for our young kids, it allows us to work on developmental language skills at the appropriate developmental time. So it gives us just kind of a step up in the ability to work on those skills at an earlier time that we might not be able to without visual supports.

In addition, using the device, it also gives a very consistent verbal model. It sounds the same. The visual supports look the same every single time. And it also allows some of our kids to independently initiate and self‑monitor, which we know from a lot of our kids they are very motivated by very different things. And this is just a tool that we're adding to our toolbox to allow them to buy in to control their environment, and to socially engage with peers and family. And like I said, we are early and there are limitations.

We know we have next steps in the process. So one thing we'd like to do is to reproduce this type of study in a multi‑site trial. We're currently working on getting funding for that for next steps. We want to know how it looks in a natural setting and in other settings like schools. We want to know what kind of supports we need to provide those professionals, and how do we get it there.

And then all right, we need to understand who benefits most from this treatment. So do we get more progress if we get an earlier age start? Do we get more progress if we have more frequently or sessions? What exactly does the intervention look like to get the biggest bang for our buck? And then we also want to look at sustainability of results. Over time what does that look like?

Finally, I know a lot of us are involved with early intervention in this crowd so I want to make sure we're going over a few things that are going to set us up for kids to be able to use an intervention like this. A lot of these things you're going to have heard before. They're very similar but with small tweaks just to kind of gear kids in that direction to be successful with a tool like this.

One, non‑verbally connect. So getting on that child's level, using what's motivating for the child and showing interest in that activity.

Two, focusing. So using actions and words repetitively and consistently to facilitate new learning and to use visuals while doing that if possible.

We also want to set up that conversation‑like interaction. I take a turn. You take a turn. Or you have time to take a turn. I think that's one of the hardest things is that time that, is that expectant waiting where we allow children a chance to respond.

And then also building. So adding an action, a sound, or a word to what the child is already doing. It looks very similar for our little, little guys as it would using the iPad with TouchChat in our intervention, adding one piece.

Finally, we want to honor and model all types of communication. Use picture supports when possible to start just getting kids used to seeing the picture, supporting those concepts. We want to encourage and differentially reinforce verbal attempts. So while I accept all types of communication, I might give you a little more of what you want if you use that verbal mode to get it.

So, for instance, if a kid opens up to me and gives me a picture of M&Ms, absolutely, you ask me for an M&M, I'm going to give you one. If you come up and say M&M, I might give you the whole bag.

Also, we want to read books together. Keep looking at those pictures and encourage talking about them.

And finally, just to model language as a shared learning experience while using visuals. So we talked about bath time, about play time, car time, any of those opportunities to model language just in that back and forth interaction.

And I think that's it. We do want to give a big thanks to all the people who have been involved in our research. We have a Deaf/Hard of Hearing Research Advisory Board which has been incredibly helpful with moving our research forward. And it takes a village. So we have all of these people that have been very vital in moving our research forward and we wants to give thanks to them.

So I wanted to open the floor for questions. I do have an iPad with TouchChat on it in case anyone's interested. Some of you may have seen it and some of you may not have. We can do that at the end.

Any questions?

Yes?

>> Hi. Thank you. I just was wondering. Have you seen a difference in the outcomes based on the age at which intervention with this technology began so our children who are starting this technology at 5, 6, 7 performing any worse than children who are starting out at 3?

>> So the biggest thing that we want to do is continue to track outcomes because we haven't necessarily gotten to that point yet where we're able to say such and such skill compared to such and such skill looked different depending on when you started it.

I will say from an informal perspective, the kind of progress you make is different. And we try to follow the developmental timeline as much as possible. So if we can catch you when you're 3, when you've got just little things you're doing and we can tweak those, sometimes we have more success than when we get to 5 and we're missing all of these pieces that we could have learned along the way.

>> Sitting still is an issue, though.

>> Yeah. Little guys are hard. When there's a lot of buttons. It's really fun, but.

>> I was wondering if you could just describe like a quick activity that you might do and how you use the TouchChat. And then were you just using the TouchChat in speech‑and language intervention session? Did it go home?

>> That's a great question. I didn't clarify. Each of the families that were in the intervention received an iPad with TouchChat on it. It was theirs to go home with. If they wanted to send it to school, they could send to school. It was not just in sessions

That's also a great question about the type of activity. And typically what I say ‑‑ what is your field, can I ask?

>> [Inaudible; off mic]

>> Ok. So basically my strategy was to take an activity that I would have done otherwise and to implement the use of the device to support language within it. For instance, we play a lot of I spy in our activities, sessions. So you might play I spy with, I spy something yellow or I spy something red. And then for the more advanced kids we might use two concepts, I see something that is red and round. And we would model use of the device as the partner. So I would take my turn modeling on the device and encourage the child to do the same.

>> And the parent is there the whole time, too, learning as you go. So they can follow through at home and do some activities at home.

>> Correct.

>> I have two questions. First one is really quick. Did you involve kids who also had other disabilities?

>> That's a great question. So, we first did the pilot study and were very inclusive and involved kids with a wide ranging number of abilities hearing wise and developmentally. So we had a bunch of kids with a bunch of different things going on.

For the randomized trial we've had to narrow it a little bit just because we're looking at the intervention itself the compared to not intervention. But, yes, we still have kids with a wide range of abilities and a lot of our kids have different syndromes or developmental things that are going on as well.

>> So cognitively we went down to 60 because if we were going to 3, you got to be able to sit ‑‑ you got to be able to participate in a little more structured therapy. And I think there are a lot of kids with unidentified language disorders, speech apraxia, things like that, who ended up benefiting.

>> The other question is basically where did you come up with this idea? Has this technique been used with kids with other disabilities or anything like that?

>> So AAC is traditionally seen as like ‑‑ I ‑‑ for some kills that don't have verbal skills it is their primary communication system. For other kids that have some verbal skills it fills in the gaps of what they are not able to do verbally. So AAC as a strategy has been studied for a while, especially recently. And it just hasn't been used with kids with hearing loss. So we have a specialty in our clinic for AAC evaluations to get kids devices who have things like cerebral palsy or autism or Down Syndrome where they need a communication system. So it kind of came from that team expertise in that area in and say, hey, why can't we use this with kids with hearing loss? It doesn't hurt to try.

>> Am I allowed to you put on the spot? This is my one conflict of interest.

>> That's ok. It is on the spot. So my little guy was in the pilot study. And one thing ‑‑ I'm going to cry. He has apraxia, and ‑‑ a processing delay. So even now we have this very green iPad at home that he's likely at home right now playing with. And it's funny because he'll still get it ‑‑ we don't use it like we did when we were with Rose, just because he's bigger now. He's 7, almost 8. But he'll get it out and ‑‑ I won't even know he's on it he'll be typing it talks back to you. He'll say, "Mom, did you hear that?" “Good job.”

But one thing it also helped him to do was to learn how to spell. Because he would see the picture and then along the way as we kept using it, it actually helped him learn to spell things.

I'm trying to think of what I can add. It was a great tool.

>> [Inaudible; off mic]

>> He liked to play with it.

>> He was little, too.

>> 3?

>> Yeah.

>> It does. This takes him ‑‑ he lovers dinosaurs. And Rose was so good to always pull the dinosaurs out that encouraged him to pay attention. But I allowed him ‑‑ we're in Kentucky. So it's like an hour and a half drive to Cincinnati for us. Even in the car I would just allow him to play with it. The more he played with it, the more he learned and could quickly go. He knew if he hit, you know ‑‑ what it was? Play, it went to the toys. He could navigate it. And ‑‑ so I would do like Rose; I would sit down with him and I would talk to him using the iPad first and then I would do it verbally. And sometimes he would watch me and I would be trying to create a sentence. And he would help me find things on there. So I would allow him to just have time to play with it. And even now, like, when he does play with it, I really like to watch him put like that ending s on it. So we still use it.

He at the time was an undiagnosed apraxia. He's since been diagnosed with that. That just really helped. Because he would be so frustrated. He would have things he would want to tell me. And even as his mom, sometimes I couldn't understand and I think that's where I get emotional when I first start talking about it because he's mine. And we would pull that iPad out and he would find it. And then he would be so proud of himself. And then we would work on that. And then I would know that that's something we would work on.

>> Thank you.

We lock it down during the intervention so they can't put any other apps on it at the end we unlock it so you can do more things with it and add the TouchChat back on.

It's 12:44. One more question.

>> Did you look at [Indiscernible] as an option versus the TouchChat?

>> That's a great question. For those who aren't familiar, [Indiscernible] is just another AAC app that you can get on the iPad. It was structured a little bit differently. And we felt like we wanted very readily available access to word endings. At the time we started it, I believe it's also the same function now where you can hold down the button on [Indiscernible] and the word endings become available when you select that button for long enough. We wanted to have consistent and immediate access to those functions in the same exact place every single time. So that was one thing and the whole down function wasn't available at the time we started this pilot either. We felt like the predictive navigation in TouchChat was also really helpful. So the kids were required to push fewer buttons to get to the page they want to go to in TouchChat. That was one reason we went that way. But it's not to say it couldn't be done with something like that. It's just the one that where he chose because of those reasons.

>> I do usually do a disclaimer that you should not really just go home and tell everybody to buy a TouchChat. I always feel the need to say that. Because really it is the structured intervention and training that makes this work.

So I'm encouraged by what we're seeing and hopefully we'll get more papers out and more dissemination.

>> And trainings and videos and all of that.

>> To give you time to get to the next section or whatever.

Thanks.

>> Thank you.

[Applause]