>> Alright, we are going to go ahead and get started. I'm going to introduce my guest, Allison Seddy.

>> Good afternoon, everybody. You for joining me towards the end of our conference here, and I hope everyone has been having a great time and isn't to exhausted. If anybody in the back would like to have a chair, there are plenty of chairs up front, feel free to come up and take a seat if you would like. I'm going to be talking today about factors that impact language outcomes in children who have unilateral hearing loss. In this project was funded for the centers of disease control under a cooperative agreement. Again, my name is Allison Seddy, and at the University of Colorado and I met at a sea which stands for the outcomes of development and [ INDISCERNIBLE ] I will talk to you briefly about what that is because that is where our data set came from but mainly this is the outcome of outcomes we've been finding for children who have hearing differences in just one ear. Also assisting me with this project is Doctor Christine Yoshinagotano who is not with us at the conference today because she's out of the country some are interesting. I can't member with her but she does travel a lot right now she's in an interesting location. So the topics I'm going to be going over today our first, just to compare the language outcomes of children who do have a hearing difference in one ear, relative to those who have hearing differences in both of their ears of varying levels. So that will be sort of our first piece. I'm going to characterize some of the characteristics of the children who have hearing differences in one ear, I think just in and of itself that interesting, the population demographically, in terms of what year is impacted et cetera. And the primary focus of today's presentation is to talk about facts that are associated with better outcomes. With better language outcomes in children who are unilateral, and on the flipside of that, what are factors that might put some children at more risk for more significant language delay? As I mentioned, the data for this particular talk comes from a project that the CDC supports called Odyssey. And it is an out, and developmental data center partnering with early intervention programs across the United States. I see some people in the room who are participating in a project, so thank you for coming and thank you also for your work that you've done that is contributing to the data that we have. Right now we have 17 programs that are partnering with us, and the overall goal of this project is to look at factors that impact outcomes, too help us determine what are things that might help children do better, what are things that put children at more risk et cetera across United States, across programs, not just limited to one geographic area or one particular program. So the objectives of Odyssey are for programs that are partnering with us to have accurate and standardized data on outcomes of their children who are deaf and hard of hearing. For programs that are partnering with us we created a database for that program which we then send back annual reports that let programs know how are the kids doing, what are their strengths, challenges? And then how did they look compared to other children in the United States? Because again we have 17 programs we are partnering with, so we can put side-by-side, to give them program averages and the highs and lows next to that of other programs. Again, overall to increase our collective understanding, of what are factors that impact children that not just have differences in one ear but that are unilaterally impact. Here are states that are currently purchase mating with us. You can take a little brief look there. Here are states that are currently participating with us. You can take a little brief look there. We have four components at the programs are doing and sharing with us. We have a demographic form, we collect audio logic information on the children to get their hearing levels, and then we used to standardized norm referenced assessments. One is called the developmental assessment for young children or the Daisy, the other is the McArthur Bates communicative Torrey inventory. I will talk about what those are because the outcomes we are going to look at have come from those instruments. The first questionnaire going to talk about today is is there a difference between the language scores for children who have hearing differences in one ear? So unilateral group. Children have differences into ears? That is further divided into those whose hearing levels are in the mild to moderate range, and then a second group of those who are in the moderately severe too profound range.

About two thirds of those children have differences in ears bilateral and about a third are unilateral. The MacArthur has similar numbers in terms of a little over 600 children total with about one third of them being unilateral, two thirds being bilateral, and that bilateral group being more or less, not exactly evenly but closed evenly split between those with more significant hearing levels and those with more mild to moderate degrees.

One of the criteria for being in this particular analysis is that the children had no disabilities that would impact their speech or language development, and the other criteria was that we would take their most recent assessment, so through this project, children are assessed typically every six months, so if we had assessments on a given child, we had -- we took the recent one, when they were the oldest. So the children in the study ranged from two to 36 months of age with the mean being about two years, half and half boys and girls and briefly I will tell you about the Daisy. As a general development assessment. But often people call a five domain assessment meaning it's not just look at communication but also at motor skills, self-help or adaptive behavioral skills, social and also cognitive. Today we are going to focus on the results of both the receptive and the expressive language subtest of that instrument. We have modified it slightly so that the family's and interventionists are sure to get credit whether an item is done in sign language or if it is done in spoken language.

Then the MacArthur is our second instrument. It is primarily an assessment of expressive vocabulary and it is primarily an impairment report -- the interventionists is going to work with the pair as they complete the form but the form is designed to be given to a family to fill out and primarily be indicating that words their child can either say or sign Eric so again this is going to include both sign vocabulary and spoken vocabulary. So what we started with was looking at differences between our three groups.? Did a one way, we had unilateral group and to bilateral groups, one that was mild-to-moderate others with levels that were moderately severe too profound. And what we found, first starting with the Daisy, we found that there was no significant difference between those that were unilateral and those who were bilateral whose levels were mild-to-moderate. The outcomes for those two groups which pretty much exactly the same, no significant differences but however there were significant differences between the two bilateral groups. Mild-to-moderate levels, those with moderately severe too profound levels, and then also a difference in the unilateral group. In the moderately severe too profound group. I MacArthur the picture was a little bit different, it was more of a stairstep word children who were unilateral have the highest scores. Next highest was the mild-to-moderate group, bilateral and the next highest was the moderately severe too profound. We can take a look at that graphically and I will just orient you to the side because all of the slides up too much can be set up in the same way in terms of the graph so on the left axis we have the percentile score on the test, receptive language, or the MacArthur vocabulary. I have a little note at the bottom just to keep in mind at the 50th percentile is really what we are shooting for. The 50th percentile would be right in the middle of the pack, that is the median, or right in the middle. 50 would be right at average where they should be, so nicely, we see that on the Daisy expressive language which is the first set of bars, those children who were in the unilateral group or in the mild-to-moderate group, they were on average hitting that average. That average for the test. And you can see they look almost identical and similarly for the other Daisy is in the middle, the two bars, the dark green would be the unilateral, dark blue would be the mild-to-moderate bilateral. You can see a pretty big difference when you look at the bilateral moderately severe too profound compare to those other two. MacArthur as I said more of that stairstep pattern where the unilateral group is scoring the highest and next would be mild-to-moderate and after that moderate severe too profound. You know, of course it brings to mind why is it different from one test compared to another test? Also they test very different things. So the Daisy is a very general language test. Ask questions like says at least five words, can tell you what they are doing, talks in the past tense whereas the MacArthur is a very specific vocabulary test is about diversity of vocabulary. Parents are literally checking off all of the words they have heard their child say or seen their child science was a very specific test and a great test at identifying gaps that we often see. He might look at this and thank gosh, I'm kind of surprised, children with unilateral loss, mild-to-moderate, looking like they are doing so we'll, I thought there would be more issues. And too some extent I think it is a function of the test. It's a very general testimony look at the MacArthur, we don't see quite as good of scores. Again we are shooting for the 50th percentile and I will come back to this later but take notes about that third set of bars where children on the MacArthur are closer to 30th percentile on average we want them to be closer to the 50th on average. That is what we are shooting for. So what are the factors associated with better outcomes? Particularly what's now focused just on those with unilateral hearing differences. One thing you can see here is something you might think would be a predictor if you look at the audiogram. All three of these children, audiograms or present hearing difference in just one ear but those are very different hearing differences in one ear. Maybe that's one of the factors that might impact, and that's one thing that we looked at so you will hear about that in a minute. So for this particular analysis, we are just looking at those unilaterally impacted, and now because we are doing a regression, we are looking at lots of predictors that might predict outcomes, the number is even further slightly reduced because we don't know those variables in every single child. We have a demographic form, but sometimes when it is -- it's not always 100 percent completed for various reasons. A family might not want to answer a question or might not know an answer et cetera. But we had about 200 children who had a unilateral hearing difference on the Daisy in about 200 on the MacArthur as well.

Just a little bit about these kids, they range in age from one through 36 months, within the meaning of little under two years of age. 50/50 boys and girls, 50/50 left or right here impacted. A little bit more on the right than the left. I'm not sure why. Could be just by chance. English is the main language in the home for 86 percent. For most children because these children to have a hearing difference in one ear, generally English is the spoken language at home instead of ASL but in some cases it might be ASL but the family reads and writes in English 80 percent. Colorado, Arizona, Texas have a high Hispanic population, and the race is white [ INDISCERNIBLE ] in terms of the hearing level in the year that is affected, you can see that on this histogram where we have the highest percentage of profound hearing difference in their affected ear. Definitely have good representation and all of the various categories or levels in an amplification use. I think this is always of interest two people. What happens in terms of these people getting hearing aid, Baja, cochlear implant? Are they wearing nothing? That is what is represented here and you can see about one quarter of them are not using any type of amplification. They may have gone at one point but don't use it or they may have never gotten it, so that includes both of those, and we have a quarter getting a hearing aid. Majority of the kids are getting Baja's or some variation of bone conduction system and we are just starting to see kids getting the cochlear implant in the impacted ear, only 2 percent in this sample, and that's been kids that have only recently been tested because it's kind of a new thing with young children to be doing that.

And what about meeting the EHDI guidelines? How are we doing there with these children? Again, these are all children who have reduced hearing in one side. Compared too only look at the numbers for children who have bilateral hearing differences, we don't see as many meeting 136, and it's not because of identification. 76 percent being identified by three months is pretty much the same as children that have hearing difference in both years, but where we see the lower percentages in the time to intervention, so often times it is looking like children who have hearing difference in just one ear are getting to intervention a bit later than children who have hearing differences in both years so being able to meet both of the guidelines, one, three and X, we only have about one half of children with unilateral loss of a NetWare if we include children with unilateral differences in both years, -- whereas if we include children with unilateral differences in both years. My guess is probably in your own programs, children who have a hearing difference in one ear might get a little less in terms of frequency of sessions and that's definitely what we found across the states, so if we look at our children who have hearing difference in both years, that is the lower part there, they are getting an average of about five sessions a month, not necessarily from the same provider, not the people going into the home more than once a week, but often children with hearing difference in both years and multiple services, part C, multiple therapists come to the house, they also might have a specialty person from the school or private program or therapy and they are getting that as well. Children with hearing difference in one year, and again these children didn't have any disabilities to impact, it's definitely a different picture if we would have included children who had multiple disabilities, they probably would be getting more intervention, but those who's really their own issue known to people at the current time is hearing difference in one ear often get just once a month. At 62 percent of the family get once or twice but many get just once a month and on average they were getting about three sessions per month. So when we look at the predictors of language outcomes, we used a regression approach. We looked at a lot of variables might impact so lots of things that people might think about or are often asking about, what about my ear versus left air, is there anything there what about the level of hearing any affected ear? Does not create any difference? What about characteristics of the family? We thought about -- we used a forward backwards approach to select those variables and to exclude those variables that were not significant the outcomes were not what they were or create a better outcomes for some children and not for others these we're variables that were not associated with language outcomes. Even though intuitively we thought they would be. In the older literature they have stated this is related but in more recent literature, the right ear left ear thing. I grew up thinking that it would be more impactful if the hearing loss was in the right ear, and our more recent studies have not found that it doesn't really seem to matter for language outcomes which of the two years are impacted. No difference in language outcomes for children who had unilateral differences on the right compared to the left and also the difference depending on the degree or the level of the hearing difference in the affected ear. Also no difference if that year had auditory neuropathy, no difference between family homes where English versus Spanish was the language of the home, no difference whether the parents themselves had any sort of hearing difference or not, and interestingly, no difference in whether they used amplification or not. I just went to see with the amplification piece, doesn't mean there's not other benefits. I'm not suggesting that home, maybe we don't need to do it. Doesn't appear to be impacting short-term language outcomes, we are only following 23 so my impact longer term outcomes but it could have other impacts anything from localized sound, there are some studies to show that it reduces listening fatigue so that children at the end of the day aren't as tired as they might be when they are struggling with hearing difference on one side which makes it difficult to year in background noise and makes you have to use a lot of effort to understand what people are saying. That could be all kinds of benefits but it doesn't seem to be benefiting short-term language outcomes. Let's start with a daisy. The predictors are slightly different between the two judgments but not dramatically. In children who are bilateral, boy versus girl. Sort of as the folklore would suggest and actually I think language data would suggest test, two girls tend to develop their language more quickly, at least in the earlier years. The two converge and the boys catch up but that was the case here with children with unilateral differences so girls language, was a little bit better. The age which I got to intervention. This is important if we look back at the meeting EHDI guidelines inside. People don't seem to have those big of a rush to get judgment intervention when they only have a difference in one year and maybe that's not so great because the age they did get into intervention did impact in a positive way. The earlier the better, their language scores were. So I don't think we should be complacent or we can wait a little longer with this group, it's not important. Because it actually is an important contributor to language outcomes. the mother's level of education or the caregiver, people have shown us and just typical language acquisition of any group of children whose parents whose education is higher, their children tend to learn language quickly and get higher scores and this is something to think of clinically as you are working with families and learning about them and thinking about frequency of service and that sort of thing. That might be a variable to consider is the family's level of education. Interestingly, from a statistical standpoint, these variables that were significant only contributed, only explained 11 percent of the variance in the language scores and that really is not enough for progression. It is significant from a statistical standpoint but it means like 89 percent of the variation in the scores were not explaining by these three factors and we are not explaining it by any of the factors on the site before because none of those are significant, so what is it? I found this again and again as I looked at data from children who have a hearing difference in one ear. It's very hard to figure out what's going to predict a child who is going to learn language quickly and well compared to a child with unilateral hearing difference that isn't. It is not easy to figure out what's going on, what's different about those two groups of kids. We really weren't able to solve that problem either in terms of explaining a lot of the variance in the scores. So let's look at those graphically, 50 percent we could see educational levels, those who would have a bachelors or higher on average are right where they should be at the 50th percentile. Those children whose mothers were in between not completing high school up to an Associates degree were not doing quite as well. Children who were in intervention by six months of age. Again, right where they should be, hitting the 50th percentile. This is on the Daisy. Those who are older than six months when I got into intervention, again, not quite as good. Girls right where they should be, boys not quite as good. The differences are pretty similar across those variables in terms of it being percentile points among each of them. And MacArthur the differences were a little bit different. One thing that chronological age. As the children were getting older, they were doing better and learning more language. Their language was improving but not at the rate that it should be. Not as quickly at was improving if you look at typical language acquisition curves. So between eight and 22 months, they had a higher percentile by quite a bit and then the children who were 23 through 36 months, so right around that two year old level is where we start seeing the division between the children with a hearing difference in one ear compared to where they should be for the chronologica age. 136 guidelines, those meeting it had better outcomes and once again we see the mother's level of education showing up here. For the MacArthur we were able to explain more of the variance in the scores, 27 percent. Here is the differences graphically. Those who had a bachelors degree or higher, getting a percentile, about 35 or 36 compared to those who had not completed high school. For those below the 30th percentile. MacArthur is a more rigorous test, more likely to identify gaps in language that are they are so none of the groups are hitting 50th percentile even if they are on the better side of a predictive variable, but the ones in the better side are approaching it so children who are meeting EHDI guidelines are at the 40th percentile. Honestly it's pretty good on the MacArthur. Those not meeting it were about 25th, so big difference there between meeting 136 and notch. And little ones impacted in one ear. Maybe intuitively wouldn't think it makes that much of a difference even in that population and it does. In looking at age group, that is the most dramatic, so the younger kids, when the demands are low, you don't expect on the vocabulary from a child who is 12 or 18 months old, but once a child is sitting about 24 months old that is exponential growth in vocabulary and we are not seeing that kind of rapid

acceleration of vocabulary in the children with unilateral hearing difference. So a really big difference and that is so important when it comes to intervention. If a family has opted out, that we revisit it when the child is about two years old, make sure an assessment is done if the family is willing, think about starting some services. Because ideally you would start before so you don't see that gap but if the family for whatever reason decided that they weren't interested, you would definitely want to revisit it when a child is about two.

So some summary conclusions here, this is important when your picking assessments to use your cell that the language scores on a general language just like the Daisy, this is not specific to the Daisy, you will see this across a variety of general language tests. They tend to be better. In the case of children who are unilateral, they were pretty much approaching where they should be on the general language test if the children didn't have any of the risk factors, so if they were on the better side of the predictive factors they were hitting that 50th percentile, but the MacArthur is more sensitive to the gaps and in particular, gaps in diversity which is where we often see problems with the child who is any language delay is the number of different words they can express. 31 percent of the children were delayed, scoring at or below 10 percentile at 31 percent. In a typical population you would expect 10 percent would fall below the 10 percentile, so higher percentage than expected or having delays with a hearing different on one side.

Children in the unilateral group are very similar to those in the mild-to-moderate bilateral group on the general language test, but they did have higher scores on that more specific MacArthur vocabulary test than those who had mild-to-moderate bilateral. Some of the factors that are going to place children at risk. This is really a way to think about it clinically, who might need more service, who may need extra assistance. Boys tend to be a little slower with language development. MacArthur has separate norms. MacArthur recognized that phenomena, so they have separate norms for boys and girls. Same exact number of words if you are a boy, you will get a higher language age if you're a girl because the expectation is that girls are going to tend to grow their vocabulary more quickly when they are little so boys is a bit of a risk factor. Later ages of intervention is a risk factor and that something we can impact. Obviously we can't impact boys versus girls. Not meeting the EHDI guidelines. We can [ INDISCERNIBLE ] lower levels of maternal education and again nothing we can personally change but something we can address in terms of frequency of service, the type of service that we are giving, and older children, this is critical, again, because of if everything is going great, if they are reassessed at two and half years of age and everything is revisited in terms of how often they get service et cetera. You're going to start thinking about preschool placement at that point as well so it's good to know where they are at your typically I wouldn't wait until then were typically a child with unilateral hearing difference should be evaluated at two years of age and hopefully they were before as well. And again, a transition to preschool, because maybe the gap for that particular child started at age two, but as they are approaching their third birthday and demands are getting more and more with language and vocabulary size, there might be a cap at that point but you want to identify it before they going to preschool.

With this so if you were to give a Daisy or a Patel or a miser or sky or any of the more general language questions, child who has a hearing difference on one side, you may not be to concerned, but you want to make sure that you also do something more specific, more rigorous. I think MacArthur is a great instrument for that. I'm sure there's others as well but that's really important at this population to identifying potential gaps. I just want to say a big thank you, partly to those in the room who have contributed to this project and also to all of the families who are here with us today -- who are such University of Colorado and Odyssey as well. If you have questions, feel free to come forward but we are right at 330, so I will let you go. Thank you so much.

[ APPLAUSE ]