*Transcript*

**LETITIA NAIGLES, PHD, UNIVERSITY OF CONNECTICUT**

**HELEN:** So our last, but certainly not least.
Speaker today, is Letty Naigles. Letty's a professor at the University of Connecticut, and she has spent her life solidly in the field of language acquisition. As we heard earlier, she, uh, created both the looking while listening paradigm, and has done an enormous amount of exciting work on syntactic bootstrapping, lexical development, and many other topics she has extended her research from, uh, re, uh, studies of typically developing English speaking, or I should say American speaking children, to, uh, children learning quite a number of other languages. So she's really extended her work in that direction. And now for the last several years, she too, has been brought into the family of researchers who study language in autism. Again bringing her, um, methodologies that she's created and theoretical and other empirical insights into thinking about what kinds of problems children with autism may encounter in acquiring language. So thank you Letty. (Applause)

**LETITIA NAIGLES:** Okay. Um… let's… see if we can get this set up. (Pause) There we go. Oh… Okay… Let's… let's… uh… here we go. Let's go to the beginning. (Pause) Okay, yes, there we go. (Pause) He needs to check something. Um, while he's checking, let me just, uh, again, also thank Helen very, very much for inviting me to speak, um, at this symposium. I want to thank all of you for hangin' in there. (Laughs) Um… through; are we good?

**MAN:** Uh, this should be… (Pause)

**LETITIA NAIGLES:** Okay, I don't want, I don't want you to close it, (Oh no I won't) because, 'cause I just got all the animation, um, uh, to work. (Some people laugh) Um… (Pause)

MAN: Um, it's, yeah, I mean if… you don't want them, we're, we're not gonna have quotes. Just stick these (inaudible words),

**LETITIA NAIGLES:** So I mean, I don't, I guess…

**MAN:** I'm sorry, it's just, I've just been (inaudible words) . . .

**LETITIA NAIGLES:** Oh . . .

**MAN:** But I'll try and see if I can get (inaudible words).

**LETITIA NAIGLES:** Okay, thank you. Um… okay. Again, thank you all so much for staying here. Um… it's, it's a delight to talk to, um, many of you who, who I have, um, uh, worked with, I have learned from, um, and I hope that I can also, uh, teach you a few things that I've come up with. Um, okay, so my disclosure statements, I hadn't done this before, so I kind of over, I disclosed everything I possibly could. So this is all, (She and some of the audience laugh) this is all about me. Um… so… I have books, and I, I also got speaker fees here. Um, and, um, and I'm on other grants, uh, but I don't get paid for that. And anyway, um, what I'm used to disclosing is, um, is, the acknowledgements to… the children and families for their steadfast dedication to this project, Um, to Debbie Fine, my, um, my co-investigator on all of these, uh, studies, and to all of my wonderful students and research assistants, um… who have helped me, uh, my funding people, um, my great undergraduates, and, um, all of those people. So this is really a cast of thousands who have helped with this research.

So yeah, my title was all about semantic difficulties. And so I wanna start off with what is semantic knowledge. You know, let's start with a, a, um… a base know--- understanding, common ground of what this is. And so, one possibility is that it has to do with reference. So, when I say blue jay, it refers to that thing, that beautiful bird out there. Um, and, so one question is though, is this sufficient? Is it sufficient for… uh, semantic knowledge to make a link between the word and its referent? And, um, probably not, okay. Philosophers have talked about this for, uh, for many, many decades, if not centuries. Um, so for example, words with the same referent can have dissimilar meanings. So there are clearly more, more to meanings than just referents. And so, um, the counteract there is something called sense, where there's lots more about when you know what, the meaning of blue jay, that's lot—there's lots more that you know. So you know it's a vertebrate, it's a bird, it's a corvid, so you know all this taxonomic stuff. You know that it eats nuts and it squawks loudly, it, these are its activities. You know that it's fairly typical of the category of birds. And so it contrasts with peacocks, for example, which are somewhat atypical. You also know things like that blue jay runs with PJ. So you make all of these links to other lexical entries. And, and, uh, psycholinguists have developed a number—a number of tasks that tap into this referent sense distinction. So for reference, there's naming and word recognition tasks. So I show the picture and you say yes, that is a blue jay. Um, for sense, there are, um, studies like, uh, category typicality effects, um, where if I ask you if a blue jay is a bird, you might say yes, in 500 milliseconds, but I ask you if a P, if a peacock is a bird, it might take you a little bit longer to say yes. Um, and then there are also priming effects. So labels prime other labels of similar meaning. Um, so if I ask you is a blue jay a bird, and you would say yes, and then I ask you is a corvette a car, those are completely different categories, and you might say yes at approximately the same rate. Whereas if I ask you is a blue jay a bird, and then I ask you is a robin a bird, you will be quicker to say a robin is a bird, because a robin is another one of those birds, and I have primed, uh, the semantic network of birds.

Okay, so that's sort of a whirlwind, uh, uh, uh, run through. I'll talk about one more task in a little bit. But let's see how the sense reference distinction might work in individuals with ASD.

There's a number of studies that suggest that referential knowledge may be intact. So many children with AD acquire a sizable lexicon as you have seen in other, other studies. Um, vocabulary scores from standardized tests are often at chronological or mental age levels, and for example, early vocabulary via parent report, can show similar representation of multiple domains such as toys and body parts and foods, and things like that. Whereas, in contrast, sense or meaning, in a very broad sense has been shown to be impaired. So in word fluency tasks, adults with ASD produce more atypical labels than typical labels. In typic at—typicality tasks, asking like is this is a bird, individuals with ASD are not consistently fast or more accurate with a blue jay picture tan with a peacock picture. Um, and with priming tasks, adults with ASD are not consistently faster in making lexical decisions about semantically related words, and, and, um, Susan Ellis Weismer has some really close, uh, similar studies with kids.

Um, now I wanna sort of shine the spotlight on another kind of semantic sense task that I call Categorical Induction, which has to do—well I don't call it that; it, that's what it's called. Um, (Several people laugh) I didn't make up this name. Um… and it has to do with extending properties, um, uh, to new instances of the same category. So for example, um, I can show you this bird, and I can say see this bird, it lays eggs, it builds nests, it vocalizes. And then I show you a new instance, and I call it also a bird. And then I ask you about its properties, and you are likely to say yes, it also probably lays eggs, builds nests, and vocalizes. Whereas, is, uh, if I show you another new instance, which kinda looks like the first one, but I don't call it a bird, it is not assumed to have these properties. So the label, is sort of the indicator of the category, and then the properties all come along. Typically develing—developing preschoolers, and even 2 year olds, consistently extend properties based on category membership. Susan Gellman has done a whole host of lovely studies on this. However, school age children and adolescents, high functioning adolescents, and even some adolescents with optimal outcome, are less consistent. And I must say you know, this is some work that, that, um, students, uh, of my—of mine have done, and I must say, when, when we first came up with this finding, it sort of blew me away. Um, and it also kind of revealed to me why some kids with ASD may find the world very scary. Because if the prop—if, if you can't rely on the word, to assume that the same properties hold when you encounter a new instance, that's a very unpredictable world.

Okay. So, um, so what the study, what this talk is really about though, is what are the origins of the semantic difficulties in ASD. Because most previous results of semantic difficulties come from grade schoolers, adolescents and adults, and come from high functioning individuals with autism. And so I really have 2 major questions here. One is, can these semantic difficulties be observed early in development? Can we see what these precursors or origins are, and can we trace these semantic difficulties across development and see why they're happening and how they're happening? And so this is now where I will talk about the longitudinal study of early language that we've been doing at UCON for the past 15 years or so. In the, in this overview, what we do is we have visited children with ASD and typical controls at home every 4 months for 4 to 6 visits. Um, at each visit we assess language comprehension, via preferential looking. I'll get into that in a minute. We collect 30 minute parent/child interactions, and we administer a host of standardized tests. Um, 2 years after the last visit, we go back and visit them again, and we do a bunch of outcome assessments. So what do these kids look like at visit one? The first thing to notice, well we have over 30 kids in each group. Um… the first thing to notice though is they're not the same age at visit one. In fact, they're never the same age for a particular visit. Um, the kids with ASD are about a year older. And this was by design because we wanted them to be matched on language at visit one. We wanted them to start our study at approximately the same level of language. And so you can see their Mullin raw scores, are really you know pretty equivalent. Their CBI word production is also equivalent. But, whoops, but you notice that their Vineland standard scores, and in fact, um, you know, the, the typical kids are right where they should be, and the, the kids with ASD are, are, quite, uh, lower. And I should say, all of the, um, all of these kids, we redid, uh, we, they had been diagnosed, um, by service providers, but we went back and collected, um, ADOSes from all of them and sort of confirmed their diagnosis.

Okay. So, preliminaries are, you know, I’ve talked about this referent sense dichotomy in kids with ASD ion general. Do we see this dichotomy in this dataset? So do we see for example that referential knowledge seems to be intact early, and do we see that semantic or sense knowledge seems to be impaired at grade school? And so the first thing I’m gonna tell you about is yes, we do seem to see that. So, typical kids and kids with ASD in the longitudinal study, show similarities in noun reference. So for typical kids nouns comprise the, uh, biggest category of vocabulary items. This is the percent of words that are nouns across our 6 visits. Um… and… um, if we add the kids with ASD, they look pretty much the same, okay. So for these kids with ASD, they’re producing nouns as, as about 40% of their, of their lexicons, just like the typical kids are.

So, okay, what about, uh, categorical induction at the outcome visit? So these are now, this is now what we call visit seven. The, the typical kids are now 5 years of age, the kids with ASD are 6 years of age. You’ll notice they’re not matched on language anymore. Our typical kids are maybe even super kids with very high, um, tackle scores, and doss scores. Um, our kids with ASD are not doing terribly, they’re kind of just within the normal range, but they’re, they are statistically reliably different. So, um, what did we give them; we gave them a classic categorical induction task. So we show a picture of a white rabbit and we say see this rab—this is a white rabbit, it eats grass. What is it; a white rabbit; what does it do; it eats grass. Okay, we’re all on the same page. Then we show a brown rabbit, and we say here’s a brown rabbit; does it eat grass? They should say yes, right? And then we also show a white squirrel, and ask does it say, east grass, and they should sort of say no, not necessarily. So what do we find? We find that the 6 year olds with ASD have difficulties with categorical induction. So, this is the percent of extension. Golly you cannot see the Y axis on that, can you? This is the percent of, of instances where, where the kids are extending. The left bar is the typical kids, they are above chance, um, the right bar is the kids with ASD, they are at chance. Um, and the typical kids are extending much more consistently than the kids with ASD, and this holds even when you co-vary their language scores, okay.

Um, but I wanna point out, even with the lower, you know, so these are 6 year old kids with ASD whose language level is around 4, but this is a task that 2 year old typical kids can get. So, them being at chance is, is… to give you pause. So, um, do we see the referent sense dichotomy in this dataset? Yes, we do see that early referential knowledge seems to be intact, and yes, we do see that semantic sense knowledge seems to be impaired at grade school. And so, what is connecting these two things? Um, is there a candidate early indicator of the school age plus and beyond semantic difficulties?

And what I’m gonna spend most of, of the talk talking about, is the candidate indica—uh, early indicator which, um, which is called the shape bias. Okay. Um, and the way this works, you, you show the kid a solid exemplar, you know like that triangle, and then there are 3 possible choices. There’s a shape choice that’s of a different material and color, that’s on the left, a material choice that’s, um… of the same material but a different shape, and a color choice that’s of the same color but a different material and shape. And there are two conditions here. A no name condition, and a name condition. In the no name condition, you just point to the exemplar, and you say here is this one; point to another one. So, they don’t you know, there’s no, no label involved. And then in the name directive, you say here is a dax, pint to another, dax, okay. And this is been used, um… you know for the past 30 ye—uh, years or so, um, and demo—and what you see with kids with typical development, is they will make consistently more shape choices in the name condition than in the no name condition. Um, and they will do this you know starting very early.

Um, okay, I wanna take you through—so, so here is my candidate, uh, semantic, uh, property that you can see very, in very early kids. It can show up in typical kids before they're 2.l Um… let me take you on a somewhat whirlwind tour through two different ways to explain the shape bias, both of which talk about semantics. There's the attentional account, which suggests that the shape bias, so that's now what SB stands for Forever afterwards in this talk, SB stands for shape bias. The shape bias emerges when typical kids have between 50 and 100 count nouns. It involves noticing that these words that they have in their lexicons, distinguish objects by shape, okay. Um, and a, and thus inducing that shape is an important property for object labels. So sort of noticing that chairs differ from tables by shape, and pencils differ from cups by shape. Um… and what, uh, uh, many researcher, and a lot of this comes out of, uh, really cool studies that Linda Smith and her students have done, is that ki—having, getting the shape bias then facilitates subsequent rapid and extensive word learning. Okay, so that's the attentional account, that you're paying attention to shape.

There's also the conceptual account, which suggests that the shape bias can be observed in typical kids at 12 to 15 months of age. Um, it involves realizing that shape is a reliable cue to object kind, to category. So it's not so much about noticing the difference between lexical items, but noticing that shape cues you into the whole category. Um, and it illustrates how word learning and conceptual knowledge are linked bi-directionally from the earliest stages of development. And so Sandy Waxman and Lorie Markson, and, uh, Amy Booth are people who have done a lot of this kind of research.

So my first question in, when I've, uh, started looking at this was, do kids with ASD have a shape bias. I thought it would be so easy. Um, … but first we needed a new method, okay. Um… because the kids at visit one were very young. The typical kids were only 20 months of age, the kids with ASD were 33 months of age. You know the social challenges of kids with ASD, so we had to remove the need to understand the purpose of the tasks. We didn't want them to have to think about that. Um, they also have attentional challenges, so we had to remove the need to pay attention for long periods of time. And so what we did was to adapt method used for very young typical children, and the method that I chose was intermodal preferential looking.

So let me show you a little bit what that looks like, okay. Um… so, this is how—we set it up in home. We go to the kids' homes with all of our stuff in backpacks. Um… and we set it up in their living room. Um… and so what we do is we're showing side by side videos that, um, and playing one linguistic stimulus that matches only one of the visual presentations, okay. And this is actually stimuli from the shape bias task. I'll go over that in a sec. It's important to point out that the stimulus videos include both control trials, when the child hears a nondirective audio, and so you get some sense of stimulus salience, and test trials when the child hears a directive audio and you're trying to see what kind of language they understand. The child is seated on a small chair, or on a parent's lap. This little guy is on his parent's lap. Notice that mom has earphones on, so she doesn't know what the child is hearing. Um, the child's eyes are recorded while they’re watching the video. You may be able to pick a, pick out a camera there. And then the eye movements are coded offline by coders who are blind, or maybe deaf, to the matching site. So let me show you with the typical child, um, what this looks like. ‘Kay, is it working? Oh good, it’s working. (Pause) so he’s movin’ around, but he’s riveted on the video. Except, you know. And you can see his eyes. Mom is a little bored. Um, (Some people laugh) you can see his eyes going back and forth. Okay. So could we use this with a child with ASD? So… um, this is what I’m gonna be doing here is showing you a little clip from the parent/child play session, so you can see… that he’s, he’s not really good at sitting still for long periods of time. And then I’ll show you what he looks like when he’s watching, um, uh, a video. Okay.

So he’s lying down now. So Jana, there you go. Uh, and then he just gets up, (Laugh) and says I’m done. Let’s go into the kitchen, I’m all done with this. Um… so, but now you see he’s sitting down, he’s munching on his cheerios, and he’s watching. And this gave us such hope that they were watching, we could see that they could maybe understand something. Okay. So, let me take you through what the similar worth of the task. Um, in the no name trials, so we showed these are novel objects. This is actually a banana boat, if you’re into making, um, banana splits. Ocean State Job lot is really good for getting novel objects. Um… so we say here’s this one. And then we show a same shape object, and a same color object side by side, and we say which one looks the same. Okay, so this is the no name trial, there’s no labels here. Um, in the name trials, we show the same thing; here’s a, but now we say here’s a dax. We show the same shape object, and the same color objects, and se say look at the dax. And if they have a shape bias, they should look longer at the same shape object here, than they did in the, um, in the non-name trials, okay. Um, and I should just say that they get all the no name trials for all their items in a block, and then there’s a screen saver, and then they get all the name trials in a block, in a different order, the stimuli are in different order, um… um, after that. So… the same procedure was repeated for 4 additional triads of items. We did present this both in preferential looking format, and 3D you know hold up the objects and point format. Um, we presented it at 4 visits for the typical group, and at 6 visits for the, uh, group of kids with ASD.

So what did we find? Typical children show a shape bias, okay. So what you see here is percent looking to the shape match. The red bars are the no name trials; they’re around 50%, the blue bars are the name trials, they’re reliably higher at every visit, okay. So starting at visit one at 20 months of age, our typical kids are showing a shape bias. In the pointing task, we actually don’t get the shape bias, um, until visit 3 when they’re 28 months. So the eyes are cluing us into what they know a little bit earlier than the points. Even if you’re typical. What about the kids with ASD? Well… they don’t show a shape bias. Um, there’s no difference in their point looking to the, their, their percent looking to the shape match during the name trials, versus the no name trials across all 6 visits. And during the pointing task, the kids with ASD as a group, never chose the shape map significantly more during the name trials than during the no name trials.

Okay one more thing. Uh, I, I wanna just give you a moment by moment, uh, looking group comparison okay. So this is the typical kids. This is like a… um… eye, an eye tracking. I want you to focus on that last block, and on the blue line. The blue line is they‘re looking to shape, and you can see the looking to shape is consistently high in the TD kids. Whereas, in the kids with ASD, it’s alternating with the green line which is looking to color. So the kids with ASD do not seem to have a shape bias. And I have spent some time trying to figure out why not.

So, possibility one, is perhaps the preferential looking paradigm isn't suited for children with ASD. How can we test this? Well let's look at another video, because we actually gave the kids 3 videos at every visit. Um… and, the one I wanna share with you is one where we tested the noun bias, because it was well attested in typical children, and also indicated in the speech of kids with ASD. So we wondered, you know, they should have a noun bias, can we see it with preferential looking. So I can play you this video. I'm gonna voice it. Um… so we say "Look Piffin. Wow Piffin!" Piffin is the novel word. "Hey Piffin. See Piffin." So there's an object and an action going on. "Oh look now! See, they're not the same! So the Piffin is doing something else, and something else is— "Where's Piffin? Look at Piffin." Okay. So, if you have a noun bias, you should keep looking at the possum. Um, whereas if you have a verb bias, you should look at the armadillo 'cause he's the one who keeps doing the nose thing. And what we find is that both to the typical kids, and the kids with ASD. Showed a noun bias, okay. So they looked reliably more at the same puppet during the test trial, that's the dark blue, compared to the control trial. So they showed a significant preference for the object when asked for the label.

So, interim conclusions, one. Children with ASD show a noun bias at the beginning of word learning for them. This was at visit one. It's a similar preference as TD children. It supports that determining reference is relatively easy. I mean these kids are delayed, but they can do this. And ex—and it explains one way that children with ASD may learn words. But it doesn't explain why they don't show a shape bias.

Why don't they show a shape bias? Well, possibility two. Do they not notice the similar shape? Does shape not jump out at them? So we calculated what proportion of children look at the shape match, more than 50% of the time during the non-name trial. Okay? And during the non-name trials, actually more kids with ASD look a lot of the time at the shape than the typical kids. Okay? So when, when we're just saying which one looks the same, a lot of them are looking a lot at the shape. Whereas, when we finally say where's the dax, now, we see all the typical kids looking at the shape, and the kids with ASD are looking at the shape more or less the same amount.

So interim conclusions two; children with ASD do notice the similarity between the target and shape match. But they're just as likely to look more, that is more than 50% of the time, at shape during the no name trial, as during the name trial. So the lack of shape bias during the name trial is not because they don't notice the shape similarity. They do. It's just that hearing it with a label doesn't do anything for them.

Why no shape bias? Well, another possibility, with typical children, more complex items, which we sort of operationalize as having more corners, elicit a smaller shape bias than simpler items. And children with ASD are known to pay more attention to local features like those corners, than to global features like overall shape. So, a third possibility is that children with ASD will show a shape bias to simpler items, but maybe not to complex items, and so we need to look at, uh, items. So here are our items. Um… sort of ordered from less complex to more complex, as in fewer corners to more corners. Um, so you might think of the ones at the top as, uh, more likely to elicit a shape bias, and the ones at the bottom as less likely to elicit a shape bias. And so we looked at, um, the perpor-- the percent of kids who looked more to shape during the name trial, by item. And this is just the ASD group. This is again percent of children on the… Y axis. And what you can see is that it doesn’t kinda matter. So, the items that are more shapey, don’t necessarily elicit more shape matches than the items that are less shapey, in fact, Pilk, which was very complex, um, did elicit you know kinda more of a shape bias, than, than, uh, Pim which was less complex.

Interim conclusions three. Some items do seem to elicit greater shape bias responses than others. But the less shapey items are not easily categorized as visi—visually more complex. So we have item effects, but they don’t seem to match onto being sort of maybe local, global contrasts that you might expect with kids with ASD.

So I still have this question; why no shape bias? (Some people laugh) Possibility four. Maybe some children with ASD manifest a shape bias, whereas, others do not. All I presented so far is the group data. So we calculated subgroups of shape bias performance. Um, the always kids demonstrated a shape bias at all visits. The consistent kids demonstrated a shape bias at 60 to 90% of visits. The inconsistent kids demonstrated a shape bias at 40 to 55% of visits, and the early kids demonstrated a shape bias at either 90 or up to like a third of the visits.

And so this is the typical kids. Um, and the, and so it goes from always consistent, uh, inconsistent, and rarely, from bottom to top. And so what you can see is that 80% of the typical kids were always or consistent kids. In contrast, only 40% of the kids with ASD were always or consistent kids. Hence why we don’t have a group effect. But we do have some children who show a shape bias, right? So what’s different about them? Um, maybe this will help us figure it out. So, one question, and this comes directly from the attentional account, is maybe it’s vocabulary content. Because remember, um… Perry and Samuelson had said that you need a sufficient number of shape words in your lexicon to endure the shape bias. And so in work that I’ve been doing with Sarah Cover, um, we’ve been analyzing the CDI’s from our kids to see that kind of shape, uh, words do they know. So this might be a little hard to read, but all the shape words, the proportion of shape words are at the top, and proportion of material words are at the bottom. So the black circles are TD kids who are producing shape words, and the, and the, uh, the clear ones are the material words. This is of the proportion of total vocabulary. And what you can see for the typical kids, is that practically all of them are producing way more shape words than material words. What about the kids with ASD? Well they kinda look about the same. You know, they’re all producing way more shape words than material words. And in fact, within each subgroup of shape bias performance, the always, the consistent, the inconsistent, and the rarely, children with ASD produced more shape side words than color or material words. They’re producing lots of shape words. Is it maybe vocabulary size? We did find that children with higher vocabulary scores, showed stronger concurrent shape bias performance, although we only found that at 2 of the 6 visits. So, um, it’s not clear how consistent that is. We found that children with higher vocabulary scores at visit one, show stronger shape bias performance at visit 2 and visit 6, controlling for shape bias performance at visit one. And we find that children with stronger shape bias performance at visit 4, have higher vocabulary scores at visit 6, controlling for vocabulary at visit 4. So we do replicate Smith and Samuelson that the shape bias and vocabulary are mutually facilitated. More vocabulary stronger shape bias, stronger shape bias more vocabulary. But is vocabulary size sufficient?

Remember the prediction was that children with more than 100 count nouns in their vocabularies would induce the shape bias, it would happen automatically. I've talked to Linda Smith about this and she said it just happens. Well it doesn't happen with my kids with ASD. (Laughs) Because 70% of these children pass this threshold by visit 4. But only 40 to 50% of children are not always the same child— not always the same 40 to 50% ever showed a shape bias.

So interim conclusions number 4. Vocabulary size and content are possibly necessary to induce a shape bias in children with ASD. but are nonetheless insufficient by themselves.

Let's summarize so far, okay. Children with ASD have persistent difficulty with the shape bias between 2 and 4 years of age. And this unstable or inconsistent shape bias is not attributable to the preferential looking method, to children not noticing shape similarities, to the complexity of the object stimuli, to the children's non shapey vocabulary content, and to their not leaching of threshold of 100 count nouns. So one thing we can say is the difficulties with semantic sense do emerge early. Because you know, this is early and they don't have a shape bias. Let me remind you maybe why the shape bias is so important and why I've perseverated on it for so long. Um, so one reason is that children with ASD remember with stronger shape biases, subsequently develop larger vocabularies. So it can be a strategy for learning new words. And of course this has been replicated numerous times in the Td literature as well.

Reason number 2 might be that the shape bias might connect with subsequent measures of semantic sense in grade school. Such as maybe categorical induction. Let's go back to categorical induction okay. Remember those findings from our dataset with this sample at ages 5 to 6 where the typical kids were above chance, and the kids with ASD were at chance. Is categorical induction at the age of 5 or 6 related to the shape bias at the age of 1, 2, or 3? Well, with the typical kids, it really is, okay. So… we get this with this lovely linear effect, we have the degree of shape bias at visit 4, on the X axis, and degree of extension, at, um, so visit 4 is, uh, just over 3, and category extension is at 5. And the kids who have a stronger shape bias at visit 4 are the ones who are really extending for categories when they're 5 and ½.

Where the kids with ASD, there's nothing there. Um, I mean it's negative correlation, but it's not significant. They're, they're scattered. You know, they're really scattered. Um, so interim conclusions number 5, as predicted, typical children demonstrate good categorization at age 5, and these categorization skills are related to their strength of shape bias more than 2 years earlier. Children with ASD have difficulty with categorical induction at age 6, and their earlier unstable shape bias performance does not connect to their later inconsistent categorization skills. It's like this connection is broken.

So, sometimes I've, uh, you know, these are descriptions I have used to talk about this phenomenon. So I've said things like children with ASD don't notice how their words refer to concepts that are similar in shape. And I've said that children with ASD don't integrate their word meanings in ways that they need to in order to induce the shape bias. But I'm not really happy with these kinds of descriptions. I sort of wanna know what the mechanism is, okay. I mean these are just descriptions, they don't tell me what's going on. So why is there no shape bias? (Some people laugh) Come on; we gotta find this out.

Possibility number 5. I started drawing from the conceptual side of shape bias, theorizing, because these researchers have suggested that children extend object kinds by shape based on the object creator's intention, so that they'll show a stronger shape bias for objects that were intentionally created versus accidentally created. Well, we know that children with ASD have well attested difficulties with understanding the atten—intentions of others. Are there difficulties with the shape bias related to this? So we coded the children's degree of engagement and joint attention as an index of intentionality. We coded this from the parent/child play sessions at visit's 1 to 3, and then created a composite. We coded for the number and duration of response to joint attention episodes, initiation of joint attem—joint attention episodes, and passive attention episodes generally using the Roose et al, um, metric. Let me just, uh, uh, you know what response to joint attention is, you know what initiation of joint attention is. Passive attention occurs when the child is focused on an object and mom swoops in and starts talking about that object, but the child does not indicate in any way we can tell that he or she is paying attention, is acknowledging. There's no flicker of eye up to mom, there's no smile, there's nothing that we can tell that the child, uh, cares or knows that mom is talking about the object that he is looking at.

So what do we find? Well, early joint attention does not predict shape bias in the typical group, okay. Let's leave that aside. But, it does in the group of kids with ASD. Across the entire ASD group, all 30 odd children, kids who engaged in more, in longer initiation of, you know, who initiated joint attention and had longer episodes, were the ones with the stronger shape bias, at visit 4. Um, and the kids who engaged in longer episodes of passive attention, um, had, uh, had, uh, worse performance on the shape bias at visit 4. Now there is complexity here, okay. We wanted to control for their Mullin scores and their receptive language scores at visit one, just to show that this isn't just an effect of, of earl language. And so the significant relationships are really only for the 15 low verbal kids with ASD. This is by a median split, okay. Um, but the beta is actually quite nice, okay. And you can see here, so this is the degree of shape bias at visit 4 on the Y axis, and the average IJA, uh, duration, in seconds on the X axis. 'Course there's a lot a kids who are there not engaging in IJA at all. Um, but the ones who are, and who are engaging in longer and longer, are the ones who are showing more of a shape bias. So children who initiate and then maintain joint attention for longer periods subsequently demonstrate a stronger shape bias. 'Kay. Why might IJA have this effect? Okay, this is just really new stuff. Um, the clue that we're following now is we coded for parental follow in utterances during all of these different episodes, and these are the ones that had significant effects on the shape bias at visit 4. Follow-ins during IJA, significantly, I mean it's practically the same slide, right? Um, significantly predict shape bias at visit 4. Uh, in the positive direction, follow-ins du—follow-ins during passive attention negatively predict shape bias at visit 4.

So, I think we're getting somewhere. How do follow in utterances differ during IJA versus PA? Well the first thing to notice is that they're, they're, they're longer. I mean there's more. The IJA duration is of longer duration than the PA. So the IJA is on the left and the PA is on the right. But it's not just length, okay, it's what they're talking about. So let's walk through this IJA episode. The onset is the child just gives a book to his mother. Now the kid actually does not talk at all during this entire episode. But mom says "No, you wanna look at the book" and the child nods. And so mother starts opening the book; "What's that?" Child looks but does not respond verbally. Mother points to something else and say what's that. Child looks, does not respond verbally. Then mom says something about the cat property. Child 'Cat says meow, meow", and the child smiles. And the mother is like "This is what I'm gonna talk about. That's a dog, and they go woof, woof." A dog property. And the child smiles. "And that's his tail," another dog property, and the child smiles. And then I mean this mother is just scintillating, and the kid is loving it! Um, and we're getting all of this lovely category information during an IJA episode. Follow in utterances during passive attention do not include this kind of information. So in this episode, the mother is joining the child in looking at a balloon, saying should we, should we do the balloon; there's an activity, this is from, uh, the stat, Wendy Stone's stat; and so you're s'posed to you know play with a balloon, stretch it out, and then you blow it up and you let it, you let it fly out. The child just looks at the balloon, and mom says "Can I blow the balloon?" So she knows what she's s'posed to do, and the child just looks at the balloon. /and mom is trying to get them engaged in some way. "Ah, look; look what I have." But the child just continues to look at the balloon, and then mom blows it up and sends it off, and the, and says "wow, where did it go?" And the balloon flies off and the child looks elsewhere. And there's no, I mean there could have been so many things that mom could of said about the balloon, like it was stretchy and what color it was, and, and, you know, but, maybe because the child was not doing any kind of responding, mom didn't say much more.

So, follow in utterances during IJA may indeed provide the input that highlights object categories and properties that affords children making comparisons across object categories, and that might facilitate the induction of the shape bias. So I really am about to finish.

Conclusion one. The shape bias is an important early marker of children semantics, especially semantic sense. It facilitates subsequent word learning. The shape bias connects with later categorization abilities, and children with ASD have difficult with the shape bias. That's our first conclusion.

But our second conclusion, is that children with ASD's difficulties with the shape bias may be linked to their difficulties with attributing to or acting on the attentions to or of others. But I think more likely the rare incidence of the informative input that emerges during such intentional episodes. So I think, and we're doing the coding now to, uh, flesh this out, that it's the input that's happening during IJA that is so helpful to the kids.

But I kinda wanted to end with a challenge to practitioners, since that's who I'm talking to, uh, a lot of in this audience. Oh my God. There's an urgent need to develop interventions, okay. And I would love to talk with you about all this. And thank you very much. See I was just done. (Laugh) (Some of the audience laughs and everyone applauds)

**MARGARET:** I apologize, I was so caught up in the mystery, (Several people laugh) I didn't, I didn't look at the time. So I do apologize. Uh, but, uh, perhaps if there's one question, two questions, we can take that.

**Q:** Hi, I'm Allison from Ohio State.

**LETITIA NAIGLES:** Hi Alice.

**Q:** Um, Letty I love your data. (Both laugh) Um, so I know your kids, um, all had ABA, right. Where we're not teaching our parents follow in. Do you think you would get the same results, with kids not having the shape bias, if they were in more of a naturalistic behavioral intervention? So do you, like would you expect to perhaps see something different, where you've got practitioners really trying to train this up in kids?

**LETITIA NAIGLES:** So I think that's a great question. Um, I should just say, I didn't talk about the therapy that, that the kids were getting. Um, they all, all getting ABA at least 20 hours a week, uh, for start. And the reason we selected them for that was, um, because, um, we had so many other variables that we didn't want to have therapy also, also varying. But it is entirely possible. And because I think that my data are starting to show that different kinds of input can in fact facilitate developing a shape bias, I don't think that they're doomed. And so therefore, I think that other kinds of therapy could indeed facilitate this, and I would love to see with kids who are getting other kinds of therapy if they are showing the same difficulties as the kids that I've studied. I mean I do know for exam—there's a, a lab in the UK that has, that has tested the shape bias and does not find it in their kids either. So it isn't just my kids.

**MARGARET:** Alright I think that was just marvelous.

**LETITIA NAIGLES:** Thank you so much for staying. (Laughs)

**MARGARET:** Thank you so much. (Applause) Okay, to our research symposium, uh, presenters and travel awardees, just please stay for one minute while Helen wraps up.

**HELEN:** I just wanna take this opportunity to thank you all for being here today. But I especially would like us all to give a round of applause not just for our speakers and our presenters, and the audience in terms of their questions, but most especially to Margaret Rogers, who really did… (Applause) all the work in organizing this amazing day for every single one of us to enjoy. Thank you Margaret.