"IT'S A KID'S WORLD"
SHOW 505
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EPISODE OPEN

ALAN ALDA Hi, I'm Alan Alda. In this edition, we're going to use magic to find out how kids see the world.

ALAN ALDA (NARRATION) We'll be bouncing babies and watching them walk. We'll hear that we are born to talk....

STEVEN PINKER What's this called?

PETER A wug.

ALAN ALDA (NARRATION) .... but that we have to learn to deceive.

BOY I had my fingers crossed.

KARA'S VOICE It's great to see you again.

ALAN ALDA (NARRATION) And we'll hear from a girl who's never spoken.

ALAN ALDA Hiya, Kara.

ALAN ALDA Join me now for It's a Kid's World, on Scientific American Frontiers.

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BODY SENSE

ALAN ALDA There's nothing more miraculous than watching a child grow up. When Isabel was born, pretty much all she could do was lie around waving her arms and feet, eating and looking cute. Now look at her. She six months old, she smiles, she sits, she can reach for toys - or my nose - she can follow me with her

eyes. Soon she'll be crawling, standing, walking - the next thing you know she'll be dating and winning the Nobel Prize. Just imagine how abuzz her head must be with all the things going on around her, all the things she's finding out she can do. On this show we going to be trying to get inside the heads of kids, from infants to 10-year olds, to find out how they make the journey from babies to little grown-ups. And we'll be starting with how they figure out one of the basics: how to get their bodies to move just the way they want them to.

ALAN ALDA (NARRATION) It's a question that has intrigued scientists for at least 60 years, since this 3-month old was filmed learning to sit... then 3 months later to crawl... and at 9 months, take his first supported steps. The film was made by psychologist Myrtle McGraw, who in the 1930's did some startling experiments - like dunking a 2-week old in a pool to see if he could swim. Luckily, he could. Her most famous experiment was with these twins, Jimmy on the left and Johnny on the right. Johnny was given some unusual opportunities. Introduced to roller skates at 13 months, he was soon an expert. Johnny's physical training continued as he grew older, and he out performed his untrained twin on tests of physical strength and agility. But on the basics - sitting, crawling, walking - Johnny didn't develop any better more quickly than Jimmy.

GENE GOLDFIELD Why don't you bring Matthew in..

ALAN ALDA (NARRATION) Myrtle McGraw's research inspired generations of psychologists to try to find out how much of a baby's physical development is inborn, and how much comes from on-the-job training.

GENE GOLDFIELD We're going to prime the pump a little bit here and see if we can give him the idea that he can bounce in this.

ALAN ALDA (NARRATION) I recently visited one of these psychologists, Harvard's Gene Goldfield, on the day he was meeting 6-month old Mathew.

GENE GOLDFIELD Oops.

ALAN ALDA You're suppose to bounce, not fly.

GENE GOLDFIELD They don't know what to in this situation. These are no instructions. There's no instructor. And so what do you do? Well, you do whatever you have available, and what babies have available is that they can kick and look and listen and feel.

ALAN ALDA Bounce! Bounce!

ALAN ALDA (NARRATION) Now Matthew certainly isn't genetically programmed to operate a baby bouncer...

ALAN ALDA And bounce!

ALAN ALDA (NARRATION) .....And in this first encounter he didn't discover its secret.

ALAN ALDA If you step off the edge of the earth like that, it's hard.

ALAN ALDA On her first try, 6-month old Eve didn't get very far either. But by the time of my visit 10 days later..

ALAN ALDA Wait a minute, this is contagious. I like this, you're right.

ALAN ALDA (NARRATION) Eve's feet and legs have now figured out for themselves exactly when and how hard to kick to get the bouncer bouncing. Eve herself is just having fun.

GENE GOLDFIELD Clearly what she's doing is paying attention to the fact that something she's doing is producing some effect, and it's very motivating.

ALAN ALDA Ah, she discovers video!

ALAN ALDA (NARRATION) Eve's brain isn't figuring out the physics of the bouncer - it's just enjoying the result. Nor have her genes programmed her to bounce. What's happened is that her body has discovered for itself just what to do.

ALAN ALDA That's great, isn't it?

ALAN ALDA (NARRATION) This idea that babies bodies aren't rigidly pre-programmed but have to learn for themselves is at the core of Esther Thelen's research.

ESTHER THELEN I hope the baby's in a good mood.

DRIVER I think she will be. Mom said that she's well rested and she's been fed, so she should be in pretty good shape.

ALAN ALDA (NARRATION) Not many research laboratories are able to travel to the subjects they study rather than the other way around.

ESTHER THELEN Hi. Come on out. How's your baby?

MOM Doing great.

ESTHER THELEN Good. Take her out the van.

ALAN ALDA (NARRATION) All of Esther Thelen's research is designed to catch babies in the act of acquiring some new skill - and then to try and figure out how the babies did it. Her newest research project is on how babies learn to control their kicking - while they 're are still getting used to the idea that they have legs. Back in her lab at the University of Indiana, she's already spent several years exploring how babies begin to use their arms.

ESTHER THELEN Ready? Madeleine....

ALAN ALDA (NARRATION) Baby Madeleine, only 3 months old, hasn't yet quite got the idea that arms can be used for reaching.

ESTHER THELEN You can see the interest in her eyes. The problem is, how do they get their arms to do it? Here they have these two springy things hanging off of their shoulders, and their problem is how to get first of all just the right amount of muscle contraction to get their hands up, and then they also have to calibrate the space, they have to know where the object is.

ALAN ALDA (NARRATION) What Esther wants to know is how the babies are doing all this - so that Kathryn, for instance, only 5 weeks older than Madeleine, now has reaching down to a fine art.

ESTHER THELEN There you go! Good. You got it.

ALAN ALDA (NARRATION) Esther videotapes the babies.

ESTHER THELEN Watch move his arms, flap his arms up and down. He's waiting for the toy.

ALAN ALDA (NARRATION) Then from two different angles, she can follow exactly how the baby goes about reaching. In slow motion, 4-month old Gabriel seems to be flailing around almost at random. Here's the route his hand takes before he finally gets the toy. But 7 months later, Gabriel reaches out confidently.... ..... and his hand moves smoothly to its goal.

ESTHER THELEN Here it is!

ALAN ALDA (NARRATION) So while all babies finish up reaching in the same way, they each get there by their own, often circuitous, route - suggesting to Esther Thelen that how to reach isn't simply programmed in our genes.

ESTHER THELEN Good girl!

ALAN ALDA (NARRATION) And neither is walking.

EVERYONE Good Job!

ESTHER THELEN When a baby takes his or her first step, it looks as though the behavior just suddenly appeared. But actually the baby has been working on that problem for a year beforehand. So we want to start way before a baby can walk and try and track the components that go into walking.

MOTHER He's very excited about it.

ALAN ALDA (NARRATION) Seven-month old Eli is still a long way from walking...

ESTHER THELEN Let's see your legs!

ALAN ALDA (NARRATION) But Esther want to know if the muscles in his legs are already getting prepared.

ESTHER THELEN I'm now putting on these little sensors that will pick up and amplify the very small electrical changes in his muscles as he contracts them. And this is really the same as having an EKG. If in fact I put these on his chest I'd get heartbeat. But I'm going to get muscle contractions, and these are the little amplifiers.

ALAN ALDA (NARRATION) So that a computer will be able to track exactly how his legs move, Eli is also fitted out with stick-on reflectors.

ESTHER THELEN Here's your chance.

ALAN ALDA (NARRATION) Like all babies, when he was born, Eli would step when held upright. Usually assumed to be some sort of primitive reflex, the behavior soon disappears.

ESTHER THELEN You gonna walk? But once Eli is placed on the treadmill..

ESTHER THELEN There you go! Walker!

ALAN ALDA (NARRATION) ...the stepping behavior comes back.

ESTHER THELEN Well, walker, yeah.

ALAN ALDA (NARRATION) So one key component of walking -stepping - does seem to be inborn.

ESTHER THELEN There you go. Good stepping!

ESTHER THELEN I think it probably is built in to children from the start. And the stretch of the legs on the treadmill is enough to start that alternating process going.

ALAN ALDA (NARRATION) But there is more to walking than stepping - as 1 year old Sabra is finding out. When her weight is supported and she doesn't have to balance, she walks on the treadmill just fine. And when her walk is analyzed by computer, she has a steady rhythmic gait. The signals from her leg muscles show they are smoothly coordinated as they produce each step. But now Sabra has a tougher test. Her balance is still assisted by having her hang on to a cart, but this time her legs have to hold her up as well as walk along. And now her gait is much more clumsy. What's more, her leg muscles have lost their regular rhythm. Finally Sabra's is on her own. Having to both bear her weight and to balance overwhelms the neatly organized stepping action she could make when supported. Esther Thelen and her colleagues are just beginning to figure out what's going on as a baby learns to walk. But already it's clear that while stepping may be built in, babies, legs have to figure out for themselves how to stand and balance before they can rediscover the skill they were born with.

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THE MAGIC YEARS?

LIAM THE MAGICIAN Boys and girls, ladies and gentlemen. All you guys ready to see a magic show?

ALAN ALDA (NARRATION) My enthusiastic young companions are about to bake a cake.

LIAM THE MAGICIAN ...raise their hands and give me a good ingredient for our cake. What do you want...

CHILD Flour.

LIAM THE MAGICIAN Sure, put some flour in there.

LIAM THE MAGICIAN Well, like great, great, great. Thank you very much. Whoa. 1 -- 2 -- 3...

ALAN ALDA (NARRATION) And it is, of course, a magic cake. It came from nowhere. Then there's the even more awesome magic bag.

LIAM THE MAGICIAN ...magic bag. Now on the count of three... What's the magic word again?

CHILDREN Hocus pocus!

ALAN ALDA (NARRATION) How did that happen?

LIAM THE MAGICIAN Excuse me. Would you help me, sir?

ALAN ALDA Me?

LIAM THE MAGICIAN Yeah, sure.

ALAN ALDA Alright.

ALAN ALDA (NARRATION) Now what's happening? There's this big man going up on stage... Now they are putting the magician in the box. They are really sealing him in tight.

ASSISTANT Now you are going to hold the magic curtain.

ALAN ALDA Hold it?

ASSISTANT Wave the magic curtain.

ALAN ALDA Like that?

ASSISTANT Now, wave the magic curtain and raise it up above your head.

ALAN ALDA Is that high enough?

ASSISTANT A little higher up above your head.

LIAM THE MAGICIAN How's that?

ASSISTANT Wonderful!

ALAN ALDA (NARRATION) Liam the Magician is also a Harvard psychologist. After his shows, he asks kids from the audience to explain what they have seen. How does seven-year-old Dana think the magician got out of the box?

DANA I don't know.

ALAN ALDA Was it, do you think that anybody could do that? DANA No.

ALAN ALDA Just him? DANA Yup.

ALAN ALDA And what makes him able to do it? DANA Because he's magic.

ALAN ALDA He's magic?

ALAN ALDA (NARRATION) Daniel is three.

ALAN ALDA Why would the balloon change into the bird?

DANIEL Because he's, that's magic.

ALAN ALDA That's magic, I see.

LIAM THE MAGICIAN Oh it is? That's pretty neat.

ALAN ALDA (NARRATION) Magic. For psychologists, it's a perfect way to explore the young and developing mind. At the University of Illinois, psychologist Karl Rosengren is finding out where this idea of magic comes from in the first place.

FIRST PARENT Is that the froggie?

SECOND PARENT And there is that red bow.

ALAN ALDA (NARRATION) Parents are asked to watch a videotaped magic show, with their children.

CHILD That's not a story...

WOMAN Do you have magic fingers when you ...

ALAN ALDA (NARRATION) While Karl watches them watching.

WOMAN What is Dean going to do with this now?

ALAN ALDA (NARRATION) His basic conclusion -- parents provide special explanations for extraordinary people and events.

WOMAN Look. He changed them, didn't he? He did magic again.

KARL ROSENGREN Parents do sort of build up all of these stories about fantastic people, people that can do all sorts of things--tooth fairies, Santa Claus, magicians--who have special powers that differentiate themselves from other individuals in our culture. And without the parents who are providing some support for that, it's unlikely that the child is going to come up with these kinds of explanations entirely on their own. Let's go find Terry.

ALAN ALDA (NARRATION) But there is more to magic than just parental suggestion. Kids have to be ready to believe. This experiment uses an impressive-looking machine to change the size of things.

KARL ROSENGREN This is a special kind of machine. This machine is going to try to make Terry small. Do you think the machine can make Terry small? No? I'm going to put Terry right here. And then we will see if we can make the room and Terry small. O.K.? Let's say bye-bye to Terry. Bye-bye Terry. O.K.

ALAN ALDA (NARRATION) To add atmosphere, electronic sounds are played.

KARL ROSENGREN Do you think the room is going to be bigger or do you think it is going to small? Small. Shall we go see it? O.K., let's go see it.

ANDREW Come on, come on, Dad. Let's go find Terry.

KARL ROSENGREN Can you find Terry? Where is Terry? He was in the room. Look in the middle--isn't that Terry? Do you see Terry?

ANDREW There he is!

ALAN ALDA (NARRATION) Far from being amazed at this magic event, three-year-old Andrew goes straight to the shrunken room as if nothing had happened.

MAN Do you think the machine made it small?

ANDREW I don't know.

KARL ROSENGREN To them, this is a machine just like a TV or a VCR that can be remotely controlled, or like a remote garage door opener. It's, it's a new machine that can do this thing, and they might be surprised the first time, but very quickly they sort of accept this as something within the realm of possibility.

ALAN ALDA (NARRATION) Consistently, three and four year olds accept that the machine changes the size of the room. They have not yet had enough experience with the world to know such a thing is not only novel, but probably not even possible.

KARL ROSENGREN O.K., let's go find Terry. Let's go find Terry. Let's go find Terry. Where is Terry? There he is.

ANDREW It made it big.

KARL ROSENGREN It made it big. One of the important things that children must learn is what kinds of things are typical or possible in the world, and until the child sort of differentiates those things that are possible from those things that are not, in a sense there is no room for magic.

ALAN ALDA (NARRATION) Just down the hall from Karl, Renee Baillargeon is finding out when that sense of the possible begins to develop. Renee's group puts on magic shows for babies -- with results that have astonished her colleagues around the world. Each show tests whether babies know some basic physical rule -- that objects can't just disappear, for example.

RENEE BAILLARGEON If babies have the knowledge, they will be puzzled or surprised or intrigued by our magical events, and we know when babies are surprised or puzzled, they tend to scrutinize the events, to look and look and look at them. And so what we do in our experiments is compare infants' responses to magical events, and non-magical or real events, to see whether they look longer at the magical than at the real ones.

ALAN ALDA (NARRATION) As Holly's attention is captured, a hidden observer starts the timer. This time it's a non-magical, normal event. The three-month-old is soon bored -- she looks away -- and the clock is stopped. Now for the impossible, or magical event. Holly stares. She really scrutinizes the event. That means she is surprised. Even at three months, she knows the world doesn't work this way. Backstage there's a simple explanation -- two dolls moved independently. But Holly is riveted -- and even startled by such an illogical sight. Over many trials, three-month-olds have been consistently surprised by the disappearing doll trick. They all seem to understand it's not possible. But take a look at the next result. Babies like Felix, who were just two weeks older, were not surprised. Renee concluded their world view was more sophisticated.

RENEE BAILLARGEON These babies spontaneously came to the conclusion that we were using two different objects, two Minis, to produce the event. And so

what we did to test this interpretation was to lower the screen at the start of each event. We say, uh uh, this is not what is going on here.

ALAN ALDA (NARRATION) O.K., he thinks, I see they've got just one doll up there. But unknown to Felix, when the arch is raised, the second doll is slipped back in. And once again, these slightly older babies were back to being surprised -- which seems to confirm Renee's conclusion that they had figured out the original trick. In the box experiment, Renee's been testing what babies know about falling. Three-month-olds like Holly don't find the non-magical event interesting. They soon look away. But in the magical variation... That's much more interesting. Really worth staring at. So it seems that by three months, babies have learned that unsupported things should fall. But once again, there was a twist to the story. Slightly older babies usually weren't upset when the box just hung in midair. Now it was the researchers' turn to be surprised.

RENEE BAILLARGEON We were very, very puzzled by that result, and it actually took us weeks and weeks and months of thinking through what could be going on and trying all kinds of different hypotheses, until finally one day we came to this idea that, my goodness! What if they thought that somehow the finger, which was the only thing in contact with the box, had become attached to it? And that is why they weren't surprised. They were generating an explanation -- in this case an incorrect one, but a relatively plausible one -- for the box's failure to fall.

ALAN ALDA (NARRATION) To test this explanation, they changed the trick so that the finger lost contact with the box. And sure enough, the babies were once again startled by the sight.

RENEE BAILLARGEON It is absolutely remarkable that such little babies, when shown our surprising events, you know, are actively thinking about what we showed them, and actively searching for and finding explanations for what they see. And I think it really gives us a fascinating insight into what babies are doing when they look at the world around them.

ALAN ALDA (NARRATION) So if babies can be so logical, how can kids believe in magic? The answer seems to be that around age five or six, there are still gaps in children's knowledge of the physical world.

LIAM THE MAGICIAN We'll get you out of there -- one sec.

ALAN ALDA (NARRATION) They are prepared to fill those gaps with a sort of catch-all explanation... It must be magic. But by age seven, a firm sense of reality has set in.

ALAN ALDA I got a question for you. How did I get into the box?

CHILD Um, there was a hole over here and you opened it.

ALAN ALDA Yeah?

CHILD Because there was a hole.

ALAN ALDA A hole in the box.

CHILD I saw that trick before but I forget how it is done.

ALAN ALDA Oh, it's a trick?

CHILD Oh, I know how. When you waved it up, you must have opened the box and you switched places.

AUDIENCE One... Two... Three...

ALAN ALDA (NARRATION) In fact, it's not until we are much older that we allow ourselves to suspend our hard-won beliefs...

LIAM THE MAGICIAN Brian, your underwear came off!

ALAN ALDA (NARRATION) And just enjoy the show.

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BORN TO TALK

STEVEN PINKER Do you know what this thing's called? It's called a "wug."

ALAN ALDA (NARRATION) Three - year old Peter is learning a new word.

PETER Wug.

ALAN ALDA (NARRATION) So, for that matter, am I.

STEVEN PINKER I've got another one...

ALAN ALDA (NARRATION) Our teacher is Steven Pinker, a psychologist who believes children have an instinct for language.

STEVEN PINKER I've got two of them... I've got two...

PETER Wugs.

STEVEN PINKER That's right.

ALAN ALDA (NARRATION) It's kids' astonishing ability to soak up language that's led Pinker to conclude we must be born with its building blocks already in our heads.

STEVEN PINKER That's called a "toma. " Can you say toma?

PETER No.

STEVEN PINKER No? That's a hard one? Can you say toe?

PETER Toe.

STEVEN PINKER Can you say ma?

PETER Ma.

STEVEN PINKER Can you say toe-ma?

PETER Toma

STEVEN PINKER Oh, you can say it! I knew you could say it.

ALAN ALDA (NARRATION) Pinker and his colleagues at MIT have taught nonsense words to hundreds of kids to see if they'll apply the same rules of grammar to made-up words as they do to real ones.

STEVEN PINKER If that's a toma, and that's a toma, I have two...

PETER Tomas

STEVEN PINKER That's exactly what I've got.

STEVEN PINKER Human language is very, very special. It's not like most of the mechanical language devices that we have such as our friend over here. Now he's got programmed into him a few dozen canned sentences. And he just blurts them out verbatim. But people, including kids, aren't like that. We don't have whole sentences prefrabicated in our brains. We put them together on the fly. So I could tell you giant 30 ft purple gerbils are attacking Boston. I could tell you that Michael Jackson married Elvis's daughter. Brand new things you have no way of expecting....

ALAN All these incredible things..

STEVEN PINKER All of these amazing things..

ALAN And somehow I would understand what you were saying.

STEVEN PINKER And you could understand what I was saying. And the reason we can do it is that we have got grammatical rules in our heads. Not the kind of rules that your school marm tried to drill into about spilt infinitives. But things that allow you to string words together. Assemble words out of bits of words to convey brand new thoughts.

STEVEN PINKER Now Alan's going to show you this one..

ALAN ALDA (NARRATION) The wugs and tomas show how quickly kids pick up the rule for making plurals.

STEVEN PINKER Do you know that guy?

ERIN Cookie Monster.

STEVEN PINKER Okay. Now we're going to teach you how to chan.

ALAN Here's how you chan.

ALAN ALDA (NARRATION) Kids also quickly learn grammatical rules for verbs. Listen for Erin's past tense of "to chan".

ALAN What did I just do?

ERIN Channed Cookie Monster.

ALAN ALDA (NARRATION) Simply from listening to the conversations going on around her...

STEVEN PINKER There! That's how you pell.

ALAN ALDA (NARRATION) .....Erin has learned how to make the past tense of verbs - by applying another rule of English - add an E.D.

STEVEN PINKER What did you just do?

ERIN I pelled Big Bird.

STEVEN PINKER You did!

STEVEN PINKER If you asked a kid what they are doing, they couldn't tell you this. But that's sort of what's going on in the background of their mind. Then whenever they hear a new word- to pell- and they have to talk about what happened in the past, they can say pelled, even though they have obviously never heard anyone say pelled before.

ALAN Is that how you how you know they've internalized a rule? That they can take a brand new word and put it in the past tense by adding an "ed" which they know is the way you do it?

STEVEN PINKER Exactly. If they just said, stayed, played, talked, swallowed- we have know way of knowing whether they put it together on the fly using a rule, or wrote memorized from their parents. But if they can say things like pelled or channed; or for the plural, if they can talk about two wugs or two tomas, since they never have heard wugs - we know that since we taught it to them there and then - we know they have to put it together on the fly.

ALAN ALDA (NARRATION) Steve Pinker's favorite example of how well children pick-up the rules of language comes when they make mistakes - using a rule where they shouldn't. The earmuffs prevent the lion from hearing...

STEVEN PINKER and

ERIN Now he can't see either.

ALAN ALDA (NARRATION) .....so only Erin hears my story.

ALAN ALDA (telling story) The frog is kind of bored. So he decides to go for a walk. He walks outside and finds a pad and pencil in the street. So he picks up the pencil and decides to draw a picture of a car. And he walks over to Elmo's house and gives the picture to Elmo. And Elmo says "Great! I love pictures! I am going to give this to a friend of mine!" So, he walks over to Alan's house and he sticks the picture on Alan's head. That's the story.

ALAN ALDA (NARRATION) Telling the lion the story requires putting it in the past tense. Listen for how Erin handles the irregular verbs.

ERIN So he drawed a picture of a car. And he gave it ..and he said what a nice picture, I think I'm going to give it to Elmo. So he walked to Elmo's house and gave it to Elmo. And Elmo said I know who needs a picture like this. And Elmo walked over and sticked it on..

ALAN ALDA Alan.

ERIN Alan's head.

STEVEN PINKER That's very good

STEVEN PINKER That's another way we know that they are not just memorizing words. That they are right from the beginning sort of abstracting out these rules and applying them to new forms. Because if they are saying bringed - they obviously haven't heard Mom and Dad say bringed. Mom and Dad say brought, but at that moment the child is trying to use bring in the past tense, brought isn't coming to mind fast enough. If they are at the age where they know add an "ed" to form a past tense..

ALAN ALDA Even though they have heard brought, they will say bring because the rule is sort of powerful to them.

STEVEN PINKER Well, I think the rule is there to fill in the gap whenever the past tense doesn't come to mind quickly enough.

ALAN ALDA (NARRATION) So firmly and so naturally do children grasp the rules of language that Pinker is convinced our brains are built with language in mind.

STEVEN PINKER What did the airplane just do?

PETER Fly.

ALAN ALDA (NARRATION) Humans, he believes, are born with an instinct for language - an instinct that carries us through even when a particular language's annoying little details still have to be learned.

PETER I just flied it.

STEVEN PINKER Obviously no language is innate. Take any kid from any race, bring them up in any culture and they will learn the language equally quickly. So no particular language is in the genes. But what might be in the genes is the ability to acquire language...

STEVEN PINKER Can you say that?

ERIN Toma

STEVEN PINKER So it's not any particular lanquage. It's the bits and pieces that language is built out of that I think they are born with.

STEVEN PINKER Can you tell me what I have on this table?

ERIN Two tomas

STEVEN PINKER That's right!

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CHANGING MINDS

ALAN ALDA (NARRATION) All parents know that pre-schoolers have some very odd ideas.

GIRL Tonight this will glow in the dark...

ALAN ALDA (NARRATION) Not, as we've already seen, about how the world works- but about what they and others think.

GIRL I'm now drawing a picture of a TV...

ALAN ALDA (NARRATION) In fact, even parents don't realize what a very strange mental world little kids inhabit. This is University of Toronto psychologist Philip Zalazo, about to play a card game with 3-year old Jonathan. The object of the game is to see if Jonathan can sort the cards using a simple rule.

PHILIP ZALAZO And in the shape game, if I show you a boat like this, I want you to put it in to this box. But if I show you a rabbit like this one, I want you to put it over here. Look, here's a red boat, which box does that go in?

JONATHAN In here.

PHILIP ZALAZO Okay. Boats go here, rabbits go here in the shape game. Look, here is a blue rabbit. Which box does that go in?

JONATHAN In here.

PHILIP ZALAZO Okay. Let's do if one more time, then we'll play a new game. If it's a boat it goes here, but rabbits have to go in this box...

ALAN ALDA (NARRATION) Jonathan's got this all game figured out. But now Phil changes the rules

PHILIP ZALAZO Now, you know what, we're going to play a new game. We're not going to play the shape game, we're going to play the color game. In the color game, if I show you a blue one you have to put it in this box. But I show you an red one like that, then I want you to put it over here. Okay? Right look at this. Here's a red boat. Which box does this go in, in the color game?

JONATHAN Here.

PHILIP ZALAZO OK. You know what? Can you show me where do the blue ones go in the color game?

JONATHAN In here.

PHILIP ZALAZO And where do the red ones go?

JONATHAN In here.

PHILIP ZALAZO So what about this blue rabbit? Which box does that go in?

JONATHAN In here.

ALAN ALDA (NARRATION) Even though Jonathan has just the repeated the rules for the new color game, he keeps playing by the rules of the old shape game. Now the obvious explanation is that its easier to sort by shape than color. So with Libby, Phil started with the color game - which she plays just fine. Now Phil switches to the shape game.

PHILIP ZALAZO Can you show me, where do the boat go in the shape game? And where do the rabbits go? Look, here's a red boat. Where does that go in the shape game?

ALAN ALDA (NARRATION) Libby, just like Jonathan and all the 3-year olds Phil Zalazo has tested, seems to get stuck on the first rule she learns. It's as if the 3-year old mind somehow doesn't know what it knows. Nothing demonstrates that better then a simple but startling experiment Janet Astington, also of the University of Toronto, does with 3-year olds like Jacob, and a juice box.

JANET ASTINGTON What's in the box?

JACOB Juice.

JANET ASTINGTON Oh, look at that! What are they?

JACOB Ropes.

ALAN ALDA (NARRATION) Jacob calls the ribbons ropes - which is fine, because it's the next question that counts.

JANET ASTINGTON Now, what did you think was in the box before I turned it over?

JACOB Ropes.

JANET ASTINGTON It's surprising when, you think, well surely they should remember, they just said juice a moment ago. It's really surprising when they say that they thought there were ribbons in there. And you realize that they don't they just don't think about the world in the same way we do.

ALAN ALDA (NARRATION) Not only is Jacob now convinced he always thought there were ropes in the box. He also believes if he thinks something, so must everyone else.

JANET ASTINGTON Now, Jesse hasn't seen inside this box. What will Jesse think is inside before I turn it over?

JACOB Ropes.

ALAN ALDA (NARRATION) The innocence of the 3-year old mind is both wonderful and a little spooky. And it's led Toronto's Tom Keenen and David Olsen to play an elaborate game to find out if young children understand deception. One of the players is 3-year old Ross.

TOM KEENEN This is Jonathan, and this is his big sister Katie and that's Jonathan and Katie's mother. And I want you to pretend that they're real people, just like you and me, O.K.? Now look at Jonathan. Jonathan has big feet. And Katie has little feet. Now watch what happens as they walk through the four. They make footprints. O.K. Do you see the footprints they make? Now, can you tell me which footprints are Jonathan's footprints? Which ones did he make? That's right, those are Jonathan's footprints. O.K., now can you point to Katie's footprint? Which ones did Katie make? Very good. O.K., now, what we're going to do, I'm going to tell you a little story about Katie and Jonathan.

ALAN ALDA (NARRATION) The story takes place in the family's kitchen. Mom spilled flour all over the floor while baking the muffins that Jonathan and Katie now can't wait to eat.

TOM KEENEN So they ask Mom if they can have some muffins. But Mom says, "You can't have muffins right now, dinner's almost ready." So Katie and Jonathan go back to their bedroom. Now Mom hears the phone ring. So she goes downstairs to answer the phone. And when she's downstairs she can't see us and she can't hear us, okay. Okay, now. You know what Katie does? Katie decides she's going to take some muffins. So here comes Katie. But before she takes the muffins, she puts on Jonathan's great big shoes.

ALAN ALDA (NARRATION) Tom spells out for Ross exactly why Katie switches shoes.

TOM KEENEN So here goes Katie. She put on Jonathan's shoes so she'll leave big footprints in the flour and so that her Mom will think that Jonathan took the muffins. O.K.? So here she goes....Katie grabs the muffins and eats them all up. Now Katie hears her mother coming back, so she runs off to the bedroom. And here comes Mom. Now Mom sees that the muffins are all gone. And Mom also sees the big footprints in the flour. Now, can you tell me who ate the muffins? Which one ate the muffins, was it Katie or was it Jonathan?

ROSS Katie.

TOM KEENEN Right. And did Mom see Katie eat the muffins? No, she didn't, did she? O.K. Now are there big or little footprints in the flour? Are those the big ones or the little ones?

ROSS Big ones.

TOM KEENEN They're the big ones, OK.....

ROSS So they're Jonathan's!

TOM KEENEN Okay. So, who will Mom think ate the muffins? Will she think it was Katie or will she think it was Jonathan?

ROSS Katie!

ALAN ALDA (NARRATION) Despite apparently following the logic of the story every step of the way, Ross still can't see that Mom doesn't know what he knows. This belief that thoughts in you head are somehow public knowledge - that what you think, everyone thinks - is almost the definition of childish innocence. Watch this wonderful example with psychologist Joan Peskin and 3- year old Jacob.

JOAN PESKIN You're going to choose one of the stickers and he's going to choose one of the stickers. But he always chooses first. And he always chooses

one that you really want. He doesn't care if you're sad. Let's put monkey into another room so that he doesn't know which sticker you really want. You tell me, which sticker do you not want? Okay. Now I'm going to bring back Mean Monkey, and he's going to choose first. Remember, he always wants the sticker you really want. He doesn't care if you're sad. So think of what you can do or say so that he doesn't get the one that you really want. Here comes Mean Monkey. "Hmm, which sticker am I going to choose? Jacob, which sticker do your really want? "Oh, well I'm going to take that one! So you get to take this one."

ALAN ALDA (NARRATION) Joan repeats the experiment several times with each child, giving them ample opportunity to deceive the monkey as to what they really want.

JOAN PESKIN Tell me, which sticker do you really like? That one. And which sticker do you not want. That one. Okay. "Umm, Jacob, which sticker are you going to take? "Well, I'm going to take..."

ALAN ALDA (NARRATION) Bravely accepting, 3-year old Jacob never figures out that the monkey can be fooled. But what of Patrick, 18 months older - and already with a knowing gleam in his eyes?

JOAN PESKIN Let's put monkey in another room so that he doesn't know which sticker you really want. Okay. Which one do you really like, point to the one your really like. That one. And which sticker do you really not want? Which is a yucky sticker? That one. Okay. We'll leave those stickers there, and I'm going to bring in Mean Monkey. "Hmm, let me see which one I want. Patrick, which one do your really like? "Oh, well, I'm going to take that one, and you get to have that one."

PATRICK I had my fingers crossed!

ALAN ALDA (NARRATION) Patrick has also crossed a threshold into the adult world. He's now old enough to know that he can think things that others don't. That his thoughts are his alone.

JOAN PESKIN From about four and a half to five they suddenly and rapidly get that knowledge. They begin to think about people's thoughts. They begin to think that somebody can think something different from what they know. That people's thoughts vary, are private, maybe incorrect; people can have false thoughts about something that they know to be true

JOAN ASTINGTON Once you understand that, then you can explain all sorts of things about why people do things which seem strange to you. They're looking for things and you know that's not where they are. It also means then that you can understand how to surprise people, how to trick people because once you've

made this spilt between the mind and the world then you can think about people's minds and manipulate the way the world is so that they come to believe certain things about it.

ALAN ALDA (NARRATION) Teachers, parents - and grandparents - are endlessly trying to fathom the minds of the very young. It's no wonder we find it so fascinating and so frustrating: they really are in a world of their own.

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SPEAKING FOR HERSELF

ALAN ALDA (NARRATION) Our final story is about is about how Kara Johansen came to make a telephone call to her sister Melly - an ordinary event made extraordinary by the fact that Kara, born with cerebral palsy, has never talked. I first met Kara 18 months ago. Her mother, Pam Johansen spoke aloud what Kara had to say by reading the letters Kara looked at on a plastic alphabet board.

PAM JOHANSEN A, N, D- and K- and S, O. And someone - someone says it. I appreciated pam Johansen's skill at translating for Kara even better when I tried it myself.

ALAN ALDA What was the play about? S, E, W. No? X - Sex? No? - Well, it was the letter I saw.

ALAN ALDA (NARRATION) Kara's family and close friends are almost as skilled as Pam Johansen at using the board. The communication it allows is central to the bond that exists between Kara and her sister, Melly.

MELLY JOHANSEN Kara and I are really close and we have been that way every since she was little. And a lot of times people categorize her- she can't do this, she can't go on a roller-coaster, she can't off a diving board. And that has never been a barrier between us , because she has done all of that and that is what keeps us together most of the time - because we have overcome so much together.

MELLY JOHANSEN I don't want to do this!

ALAN ALDA (NARRATION) But two years ago, Melly started boarding school - and now sisterly chats are much more difficult.

MELLY JOHANSEN Its hard for us to communicate. It has to be over the phone and there needs to be a person communicating with Kara just to be able to tell me what she is saying. If there was a way that I could talk to her directly, it would

be perfect. No-one better appreciates Kara's need to talk directly than the person who has always been her principal voice - her mother.

PAM JOHANSEN Kara loves Melly and Melly loves Kara. And Kara would love to privately talk to her sister without any other person, without an adult - without a mother - to censor what was being said. And she would love to communicate with Melly on her own, very privately, and talk their secret stuff that they have to share.

ALAN ALDA (NARRATION) Ricky Razdan is co-founder of I-scan, a company that builds devices - mainly for the military and advertising companies - that can tell where people are looking.

RICKY RAZDEN So you can see an image of my eye up there, my pupil, and a reflection off my cornea - that is the bright spot. And Al is going to turn on a couple of functions and we are going to be tracking my pupil movement. So as I look left or right and up and down, you should see the crosshair moving with my pupil.

ALAN ALDA (NARRATION) In the spring of 1994, Howard Shane and his colleagues at Boston's Children's Hospital in Boston began working with I-scan to see if tracking her eyes could give Kara an independent voice.

HOWARD SHANE Kara, all we are doing now is just experimenting. And you have to have an open.... an open what Kara? You know the next word? Open what?

PAM JOHANSEN M, I, N, D.

HOWARD SHANE Great. Let us try some things out. O.K.?

ALAN ALDA (NARRATION) Howard Shane first met Kara when she was three - and he knows her to have very definite opinions. She especially dislikes things on her head - and in this case who can blame her?

PAM JOHANSEN It's T, O, O- its too- B, U, L , K - it's too bulky?

ALAN ALDA (NARRATION) Kara tolerates the headgear long enough for the researchers to confirm her gaze is steady enough to be tracked. But this first session also confirms Kara's opinion of things on her head.

PAM JOHANSEN It's sliding down over her eyes.

HOWARD SHANE Just use your eyes and follow my fingers. Are you comfortable now? Alright. Just your eyes- just your eyes- just your eyes. So another option is explored. If her head could somehow be steadied, then perhaps the eye-tracking system could simply be mounted in front of her, instead of on a head-band.

RICKY RAZDAN Her eye control is really good. It's what we thought, but we weren't sure. And I think with that kind of head stability - no problem.

ALAN ALDA (NARRATION) Over the spring and summer of 1994, Kara and Pam Johansen made many visits to Children's. Work on the new system was going slowly. And Pam Johansen was acutely aware that Kara's need for independent communication was becoming more urgent.

PAM JOHANSEN O.K. Make a third wish. Pam Johansen had begun to lose her own battle with cancer. She died on October 21st. Three months later, accompanied by her father, Kara was back at Children's. SUE RUSSELL Finally Kara, after working so many months, we finally got a mechanism to keep your head nice and still for the eye tracking system. Let me get it just right. O.K.?

ALAN ALDA (NARRATION) The helmet might seem an odd device for someone who hates things on her head, but by holding her head steady it freed Kara from having a camera system dangled in front of her face. Now the camera is mounted in front of her. From alongside it, an invisible infrared beam shines at her eye. The system tracks her eye with the help of two crosshairs - one centered on her pupil, the other on the reflection of the infrared beam. By comparing the position of the two crosshairs, a computer can tell precisely where her eye is pointed. The system is calibrated by having Kara look at numbered squares on a screen. When her eye fixes on a square, it lights up. Once the device knows exactly where on the screen she is looking, then the numbered squares can be replaced by letters of the alphabet...

RICKY RAZDAN If you don't think it's right there, just look around that area until it highlights.

ALAN ALDA (NARRATION) Or by phrases that can be spoken aloud by a voice synthesizer.

VOICE It' s great to see you again.

ALAN ALDA What a nice reception! Hiya Kara! It 's great to see you again too!

ALAN ALDA (NARRATION) Kara had prepared several phrases in anticipation of my visit - including a reminder of the first time we met.

VOICE I haven't done any more plays about sex!

ALAN ALDA Having you been spending a lot of time trying to get this machine to work right?

VOICE Yes.

ALAN ALDA How is going with school? You manage to get your school work done while doing all this?

VOICE I made the honor roll.

ALAN ALDA That's wonderful. O.K. if I try this?

VOICE Yes.

ALAN ALDA (NARRATION) I got to try out the test version of what might eventually become an alphabet board like the one Kara uses now. But this one could be linked to a word processor that would allow her to write, plus a voice synthesizer that could real aloud what she had written.

VOICE Hello Dr Watson.

ALAN ALDA (NARRATION) But getting the letters to turn red could sometimes be frustratingly difficult.

ALAN ALDA I can sort of guess what problems Kara must have. Because when I look at a letter, and I just may be slightly out of calibration.. I almost get it to turn red. but it doesn't quite. I can feel myself starting to strain- starting to will it to register my gaze, and I tense up.

ALAN ALDA (NARRATION) If the system can be fine-tuned to Kara's special needs, it can also be adapted to others'.

ALAN ALDA What do you think this will lead to? What do see as the future of this whole method?

HOWARD SHANE For Kara and for others I see this as a way for people with severe motor impairments to be able to write. To be able to communicate, to be able to control computers. I think the potential is unlimited.

ALAN ALDA She could even control other devices- maybe? Not just computers. Through a computer anything else.

HOWARD SHANE Oh sure. She'll be able to dial the telephone. I mean that's kind of agreement- a tacit agreement that Kara and I have . That she is going to be able to make a telephone call. That's the deal we made. That is what got her back into this .

ALAN ALDA I hear her perking up. She is ready to be a telephone hound.

ALAN ALDA (NARRATION) In January 1995, almost a year after work on the eye tracking system began, Melly Johansen - away at her boarding school in Maine - received a telephone call from her sister.

MELLY JOHANSEN Hello. Hello?

VOICE Hi Melly. Its Kara.

MELLY JOHANSEN Hi Kara.

VOICE I'm using the I-Scan computer system for this phone conversation.

MELLY JOHANSEN That's good. Do you like it?

VOICE Yes.

MELLY JOHANSEN Did you have fun in school today?

VOICE No.

MELLY JOHANSEN Why not because it was Friday and you had to go?

VOICE When you play basketball, did you win?

MELLY JOHANSEN Of course not, we never win. I scored eight points. And the other eight points, I assisted. Kara, how is school going?

VOICE Good, but very stressful.

MELLY JOHANSEN Excited about coming up next weekend?

VOICE Yes.

MELLY JOHANSEN Good. I 'm really excited about you coming up too. Okay, kiddo, I got to go.

ALAN ALDA (NARRATION) This was the first time Melly and Kara had ever talked by phone without someone else -usually her mother - speaking for Kara.

MELLY JOHANSEN I will see you next weekend when you come up. Okay? Of course, this conversation was hardly private or spontaneous. But in spelling out her final message, Kara was taking the first step toward the independent voice her mother had so wished for her.

VOICE I love you, Melly.

MELLY JOHANSEN I love you. Bye-bye.

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