Nurturing the Brain:
Cathleen Kraft

Jonathan Faletti: Our first presenter is Dr. Colleen Kraft. Dr. Kraft was a member of the first Head Start class in 1965. Currently she is the medical director of the Health Network at Cincinnati Children's, and she is also currently the chair of the advisory committee of the National Center on Health. So without further adieu, ladies and gentlemen, Dr. Kraft.

Dr. Colleen Kraft: Well thank you and thank you for coming and listening to us tonight. I'm going to be talking a little bit about nurturing the brain. And the whole idea of early brain development is what builds a child brain is very different than what we hear on TV, what we hear on the radio, this program, that program. And we all know that. But what's the science behind early brain development? And how does that play into how your children react and the environments that then go to help to develop children's brains? So what we know is that our current conceptual framework in early childhood is that it's not a particular program or particular music video. It is nurturing relationships; it's supportive environments that help to build that healthy trajectory and that positive trajectory so that a child goes from early learning to being successful in school to being successful in life. But as we know, with more than 20 percent of our children in this country living in poverty, there are adverse conditions that lead to impaired health and development. And how does that play then into brain development?

Well three big areas that have been advances in our understanding of how the child's brain develops will help us explain this. One of them is life-course science, how those early learning and those early experiences help to develop not only your brain but your ability to function as a citizen, your ability to do well in school, your ability to do well throughout life. Secondly the idea of epigenetics. If you and I were identical twins and you grew up in a supportive environment, in an enriched environment with lots of words, with somebody responsive to you, and I grew up in an area where there was neglect or abuse, what we know is that the environment around your genes and my genes is different. And even though we may be identical twins, you're going to grow up very differently than I will. I will be much more likely to have developmental delays. You would be much more likely to become the honor student. And then finally developmental neuroscience. What have we learned about the development of a child's brain that actually lets us know what we need to do to nurture that brain? So starting off with life-course science, what we know is that early experiences, both good and bad, are strongly associated with behaviors and health and education and productivity decades later.

And this is something that was known as the adverse childhood experiences. This is a study that's known as the most important study that nobody knows about. Who's heard about the adverse childhood experiences here? I will tell you, this audience probably has a higher percentage of anybody that I've heard that know about this study. But what we know is that when adults were asked about chronic illness and they were asked if they had a history of physical abuse, emotional abuse, neglect, somebody in their family who had a substance abuse problem, somebody in their family who was incarcerated, we know that these individuals were much more likely to later on in life have cancer, have rheumatic arthritis, to have heart disease,

things that just didn't make sense. Why would these stresses show up with chronic disease later on in life? Well we know that with children that early adverse experiences also have an impact on their life. And what we know the most prevalent form of child maltreatment is, is neglect. It's really not being responsive. It's not coming to the aid when those children are crying or those children need to be fed or hugged or interacted with.

And we also know that significant adversity leads to developmental delays in the early years. So in the first three years, those children who have more than three adverse childhood experiences – they have separation from their caretaker, they have a parent who may be involved in substance abuse or be mentally ill, they have a parent who may be incarcerated – so many of the kids that I see – I see a high Medicaid population are kids in these categories. That they are much more likely to have developmental delays. Why is that? Why is it that the environment really helps to – really impacts the brain development in that way? When we look at kids in poverty, the first graph here shows the percentage of kids who don't have adverse childhood experiences; and these are kids who live in poverty. So about half of the kids who live in poverty don't have adverse childhood experiences. But the higher your income, the more likely you are to not have adverse childhood experiences. And the lower your income, the much more likely you are to have three or more adverse childhood experiences. So we're already setting up our kids in poverty for poor brain development because of what we know with the relationship between poverty and adverse childhood experiences. So as we're developing that model of human health and disease, the early childhood environment, the early childhood ecology, strongly associates with lifelong developmental outcomes.

So the questions we have are: What are those mechanisms that underlie those outcomes? What's the meaning of stress or ecology with these kids? How do we measure what's going on that impacts that brain development so we can nurture the brain? So when you look at the adversity or stress definition, Dr. Jack Shonkoff, in the National Scientific Council on the Developing Child, looked at this and actually measured this based on some of the neurochemicals. So the hypothalamic pituitary axis is a brain chemical signal that makes chemicals like cortisol, like epinephrine – which is adrenaline – and norepinephrine, these are all stress-type chemicals.

And what they did was they looked at research that involved animal models, that involved human models that actually measured these chemicals in response to stressors. For young children, for older individuals, for animals. And what they did was they came up with a terminology based on that objective physiologic reaction, a positive, tolerable, and toxic stress. So to go through these, positive stress is that brief, infrequent elevation of cortisol, of epinephrine or norepinephrine, that is really normative childhood experience. So think about it this way. You're a 15-month-old and somebody has just told you no and you're having that temper tantrum on the ground. Your cortisol, your epinephrine, your norepinephrine are rising. But you get to a point where your body can't make that anymore and those levels start to fall. And in the presence of a social-emotional buffer – in the presence of a parent or a caregiver who can help to calm you, console you, and then redirect you after you've calmed down – those levels come to baseline. And what we know is that we need those stress chemicals to go

up then come down in normative ways. And think about this for a young child. What does that mean? Positive stress means it's bedtime. You have to go to bed. I'm going to cry but then I'm going to get better. You have to stop playing now because it's time to come and eat. I'm going to have a tantrum or I'm going to not like that very much, but I'm going to learn that this is what I need to do because this helps me to develop my brain. So routines are something that really develops the brain. And having children know what we expect from them, having them know what to expect from us, all of that is what nurtures the brain. Because really, this builds motivation and resiliency, and positive stress is not the absence of stress. And you know that. You know where there's no positive stress going on in families. And that a toddler who doesn't have a sleep schedule, who doesn't have an eating schedule, is somebody who is not going to be regulated, and that's a real problem in terms of nurturing the brain. So routines are super important.

Toxic stress is real different. Instead of that brief intermittent, up and down of those cortisol and epinephrine and norepinephrine, there is long-lasting, frequent, strong intensity. This is the child that is worried that they're going to be physically abused, or they're worried if they cry, will somebody come to get them? Or maybe somebody will hit them. Or maybe nobody will come and get them. And what that does over time is that keeps those levels of cortisol and epinephrine and norepinephrine high. And that bathes their brain in these chemicals and it keeps them from being able to function normally. And think about this. You have all taken care of children who have come through the foster care system because they've been abused or neglected. And what happens? Their levels of cortisol and their levels of epinephrine and norepinephrine are way up here. And so you go to play with them or you go to hug them, and they hit you or they bite you. And that's because they always are functioning here. And any kind of movement to them makes them just rise. And they have fight or flight, which in most people becomes their alternate pathway. In these kids it becomes their main pathway. And they have insufficient social-emotional buffering. And that is the absence of that caregiver, of that important person that helps them come down to normal. So this is toxic stress. It potentially has permanent results on the brain. It causes that environment that sets up the epigenetic problems. So the environment that has made me not functional and you functional as our identical twins is all about epigenetics. That environment chemically changes the DNA.

So it makes different proteins, it builds different types of cells in the brain, and the brain architecture is not the same as it is with a child who grows up with routines, who grows up with a nurturing environment, who grows up with caregivers who take care of them. And we know that early experiences are crucial, so by age three, 80% of our synaptic connections – which are the connections between the different brain cells – are already made. And by the second decade, those connections that are going to be strong are going to stay. And those connections that are not as strong are pruned away. So increased experiences define the wiring of an infant's brain. I talk a little bit about the types of what we call plasticity, which is the way that a brain cell can bounce back. One is called synaptic plasticity. That's the variation in the strength between those connections. It's the development of working memory and long-term memory.

So if I were to give you a phrase and asked you to answer it and said, "Mary had a little..."

Lamb. You may not have read that nursery rhyme to somebody for 20 years but you still know it. And the reason that you know it is that that synaptic connection is that strong. And that's how you know basic arithmetic. That's how you know that you can learn to read each time. That's how you remember to ride a bicycle, even if you haven't done it for 30 years. That's synaptic plasticity. And it's something that we look to develop in our kids. What we find is that that sets off your ability to develop long-term memory. It also is the development of working memory. And one of the things that you'll notice as you work with kids who have been abused, neglected in the foster care system, is many of them have difficulty with working memory, which is being able to multitask, which is being able to do things like subtract when you've got a larger number on the bottom and a smaller number on the top. That's all part of working memory and that's something that develops very, very early. Cellular plasticity is a little bit different. That's the variation of the number or the count of those different synapses in the brain. And there are billions and billions of connections that are made early on and that they're pruned away later.

So the human brain at birth has some of those synaptic connections, some of those brain cells that move together. By six years old, there are billions and billions of connections. And what the brain does over the second decade is it prunes away those connections. A really typical example of this is seeing a five-year-old boy with ADHD. What does that child do? They are running around and jumping up and down and climbing on the ceiling. Well that same child at age 15 is sleeping all day like the rest of the 15-year-olds. What they have problems with are more their attention and executive function, but they don't have the hyperactivity. And that's because that tends to be pruned away as kids get older. But what we find is that those kids where the synaptic connections are strong in language, in words, in singing, in understanding that there's nurturing that goes on there, in routines, in responsiveness, that stays there. And things like falling and skinning your knees, and temper tantrums, and some of the other things that are adverse in your life – even some major things.

So you could have a child who has a parent leave, or the death of a parent, or one adverse childhood experience. But if there's a caregiver who's able to give that social-emotional buffer, then you're still able to see those kids grow those strong synaptic connections. And what gets pruned away is the bad stuff. For many of our kids though, if what they learn and those strong connections are fear, they're anger, they're irritability, what happens is the things that get pruned away are your memory, are your ability to talk, your ability for language, your understanding for routine. And again, this really explains why a number of our kids, as they get into school age and adolescence, have problems that stem from very, very early on. It's the way that their brain develops. It has everything to do with the synaptic plasticity. Because as you look at the brain and what's developing at different times and different ages. So you're born with the ability to process visually, your occipital lobe. With your vital functions – your breathing, you're swallowing – with your cerebellum that helps you conduct smooth-type movements. If you have neglect at this point in time, you don't develop a lot of these skills above and beyond that infant age. As you get to four months of age, your parietal lobe kicks in. so when you think about a four-month-old, you're thinking about a child that are doing some things very different than an infant.

So one of the things I tell my families all the time is that the reason that a child loses that grasp reflex is that when you're four months old, you're supposed to learn how to reach out for something purposefully. And if you do this every time somebody puts something in your hand, you're not going to learn how to do that. So the integration of sensory data and movement, this is why a four-month-old laughs at you and giggles. It's why a four-month-old will roll from front to back at the same time that they're beginning to babble. All of that is beginning to be part of their development, and it happens all at the same time. So think about a child who's being neglected at four months of age. Nobody is watching them roll over. Nobody is watching them do some of those things or talking back at them or smiling or laughing. That doesn't develop correctly. You get to 12 months of age and that's when your limbic system develops. So that's your emotions, that's your impulsivity, and that correlates with your temper tantrums. This is actually why a four-month-old does not have temper tantrums. Because their limbic system of their brain hasn't developed yet. But by 12 months of age, they have the ability to understand and they have the ability to act out if they're not getting what they want. What they don't have is the ability to use their words. That comes in around two years of age, when you get to the temporal lobe.

And so it's really important as they're beginning to process sound and language to talk to kids about words and using words and using words to talk about feelings. So one of the things that I tell my families to do all the time – and this is a great little 1-2 minute demonstration of how you teach that at two years of age. And this is something two-year-olds love to do.

I teach them three emotions: Happy, sad, and angry. So we're happy. We're going to dance around. We're going to jump up and down. We're sad. When we're sad, we have to go give mommy a hug. We're angry. Something made us angry. Oh you're crying. Does that mean you're angry? When you're angry, we need to find our calm down thing. And it might be a special toy. It might be writing on a piece of paper. It might be going and giving somebody a hug. But we need to find our calm down thing. And what you'll find is that two-year-olds love this. And two-year-olds love saying, "Okay mommy, you're angry now," and mommy gets to act out what angry is. And the two-year-old gets to tell them to find their calm down thing, which is actually a really neat thing to do, because what happens at two years of age is that parents begin to have to model. What do you do when you're angry?

And I tell my parents all the time: There are some times that, to nurture your child's brain, when you are angry, you got to put mommy in timeout. And that does two things. First of all, it gives you a chance to breathe. Secondly, kids hate that. If you put mommy in timeout, they will do everything they can to get you out of there. So you'll get, "We'll be good." But again, nurturing that brain is really teaching those emotions, taking this feeling in here, putting it in words, and then doing something about it. So that's something that's really important right around that two-year time of age. And then your frontal lobe is something that develops as kids get older. That's your abstract thought and reasoning. That's your executive function. And what we know is that this doesn't develop all the way until your mid-20s. And I know we know people who don't ever have this develop, but this is – but mid-20s, if you think about that,

that's a lot of where our parents are. So as we're talking with parents, knowing that even some of our parents who have not had adverse childhood experiences may be functioning in not quite the frontal lobe development yet, and that sometimes we have to be really concrete in terms of our suggestions for them so that they can develop and nurture their baby's brain.

So what we know is the impact of childhood stress gives you that increased fight or flight, that cortisol, that epinephrine, that norepinephrine, that then makes changes in brain architecture, and results in that hyper-responsive stress response, decreased calm, and decreased coping. And that becomes the vicious cycle of toxic stress. When you have toxic stress, you have that vicious cycle of those elevated chemicals and then the response from that child is that it's decreased, that you have a child who gets angry and irritable, even when you're trying to do something nice for them. And that becomes much, much more difficult to treat. So if you think about human health and disease, the ecology, the environment becomes biology. It's embedded in your cells and in your system and in your DNA and becomes part of your biology. And that drives the development across the lifespan. And we think about this in pediatrics as the basic science of pediatrics. What we know is that early development environment impacts the biology of that child and then impacts their brain development, and that's where you have that trajectory develop healthy or develop in an adverse way.

So what we're looking at doing in early childhood to nurture the brain is preventing toxic stress and maladaptive skills, and providing social-emotional buffers and adaptive skills. So what we want to do is this yin/yang of protecting the brain and building new skills. And that's what we do in our advice with our parents, with our children, and what I do in my work, and what we do through Head Start and preschool. And what we know is that quality early care and education pays off in the cost benefit analysis of this. And we know this by our data, but we know this really intuitively as well too. If we have an environment like the nurse family partnership, or one of our home visiting environments where we have teenagers who are first-time mothers who really don't know about nurturing the brain, and we have people teach them and model this for them. And that child's brain will be nurtured, and the trajectory will be healthy, and that there's a $5.70 return on investment for every dollar spent on nurse family partnership. Similarly with the Abecedarian Project, which was early care and education ages 0-5, the whole concept being that early care and education is really not minus nine months, but the first thing we can do with a baby is, once they're born, to begin to nurture their brain, is to start to work with them in that stimulating, supportive environment. And then Perry Preschool, which looked at early education 3-4. All of these programs that nurture the brain have shown as huge return on investments for every dollar that we have spent on them.

So very important in terms of nurturing the brain, our conclusion is that our advances in developmental science have really forced us to reconsider the early childhood origins of lifelong health and disease. And they challenge us to get it right the first time. We know what causes the problems. We know how to prevent those problems. Let's get it right the first time. And it beckons for community-based programs to protect the brain and to build new skills. Because what we know is that it's easier to build strong brains and build strong children than to repair broken men.

Thank you.

Jonathan: Okay, thank you very much, Dr. Kraft.

[End video]