Dr. Jack P. Shonkoff - The Neuroscience of Nurturing Neurons

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Jack P. Shonkoff, M.D. is the Julius B. Richmond FAMRI Professor of Child Health and Development and founding director of the university-wide Center on the Developing Child at Harvard University. He also chairs the National Scientific Council on the Developing Child, a multidisciplinary collaboration comprising leading scholars in neuroscience, developmental psychology, pediatrics, and economics, whose mission is to bring sound and accurate science to bear on public decision-making affecting the lives of young children.

In 2002, Dr. Shonkoff was honored with a lifetime appointment as a national associate of the National Academies for his extraordinary contributions to the National Academy of Sciences. Dr. Shonkoff chaired the Committee on Integrating the Science of Early Childhood Development for the Institute of Medicine and the National Research Council, and coedited its final report, "From Neurons to Neighborhoods: The Science of Early Childhood Development." He also served as chair of The Board on Children, Youth, and Families, and as a member of the panel on child care policy, the committee on the assessment of family violence interventions, and the roundtable on Head Start research.

"The active ingredient in the environment that's having an influence on development is the quality of the relationships that children have with the important people in their lives. That's what it's all about". - Jack P. Shonkoff, M.D.

The following transcript has not been edited for journal or magazine publication (see 'Interview Notes' for more details). Bold is used to emphasize our [Children of the Code] sense of the importance of what is being said and does not necessarily reflect gestures or tones of emphasis that occurred during the interview.

Personal Background:

David Boulton: Thanks for taking the time to talk with us.

Dr. Jack P. Shonkoff: My pleasure.

David Boulton: It's an honor. I was working with a friend of mine in the California legislature when I first encountered your work. I remember thinking "somebody is finally saying: all right, let's stop for a moment and gather up what we know and put together a cogent, balanced case for how we should be investing ourselves in stewarding our children."

Dr. Jack P. Shonkoff: Right, right. That's what we're trying to do, we're trying to really be rigorous on the science, but also talk English, and use some common sense.

David Boulton: You did a great job. I think it really created an opening that's still unfolding today.

Dr. Jack P. Shonkoff: Thanks, that's great. And, there's a lot more work to do, so....

David Boulton: Yes, yes. And that's why we're here.

Dr. Jack P. Shonkoff: Good.

David Boulton: Let's start with a brief thumbnail of you and your background. We're want the people that are watching or reading these interviews to have a sense of where somebody comes from, not just what they've concluded or what they've discovered, but what's driving their process of discovery, what is it that pulled their passions and interests into the work they do.

Dr. Jack P. Shonkoff: Right. Well, I'm a pediatrician by training. So I started out my career expecting to take care of kids and families. And my early interest in pediatrics was pretty clichéd. I saw it as a way to make the world a better place, to be involved in the care and protection of children. So but over the years, as I got more involved in the challenges facing young children I realized that the answers to their health needs went far beyond the doctor's office and the hospital, so I became much more interested in broader policy issues, and moved from the medical world into the world of social policy.

And now I'm coming back full circle and trying to get in touch with the neuroscience and the politics and the policy, and see how we could be doing a much better job making the world a more inviting and supportive place for young children.

David Boulton: We really do need that. One of the things that we're interested in is how we co-register these different planes of research and data so that their preponderance, their co-implicate power, can help us in ways that the arguments about fragments can't get to.

Two Committees:

David Boulton: So maybe we could talk about the committee, that you chaired, that led to this seminal work.

Dr. Jack P. Shonkoff: Actually, there are two committees to talk about. One committee was set up under the auspices of the Institute of Medicine at the National Academy of Sciences to study the broad knowledge base that we have about development in the early years of life—both the research on brain development and the behavioral and social sciences. That was a committee set up with a particular task, a particular purpose that extended over two and a half years.

We reviewed all of the available research on what influences development in the first five years of life, and produced a report called *From Neurons to Neighborhoods: the Science of Early Childhood Development*, which was at that time the professional highlight of my life. It was a great opportunity to work with an amazingly bright and competent and caring group of scientists.

The report came out in late 2000. And those of us who worked on the report were very committed, at the time we were producing it, to the idea that when the report was finished we weren't just going to sit back and let it collect dust on people's shelves. We really wanted to go forward and use the report, not as a partisan advocacy piece, but as a way to really bring science, credible science to the public's understanding, to the policy arena, to the service delivery world.

So we formed another group, which is four years old now, called The National Scientific Council on the Developing Child, which I have the honor of chairing. And this is a group of thirteen scientists, half of them from the committee that did *Neurons to Neighborhoods*, and the other half coming from the MacArthur Foundation Network on Early Experience and Brain Development.

Our goal in this group is to communicate the science and the continuing new science, because there's been a lot of work since *Neurons to Neighborhoods* came out, so that we can educate not only the general public, but particularly opinion leaders and decision makers and policy makers. **We want to close this unacceptable gap between what science tells us about early development and what we're doing to support young children.**

David Boulton: Excellent, thank you. So let's talk about the report's conclusions and what you've learned since then in the subsequent more action-oriented committee.

From Neurons to Neighborhoods:

Dr. Jack P. Shonkoff: There were many conclusions and recommendations in the original report, *From Neurons to Neighborhoods*. And the basic themes really focused on the importance of understanding that development is influenced by an interaction between nature and nurture; that everyone is born with a unique genetic predisposition, but **a large part of development is very much influenced by personal experience and by the environment in which children live.** So, one point that was made very strongly in the report was that this long-standing scientific debate of nature versus nurture is, from a science perspective, a dead issue. **There's no such thing as nature without nurture or nurture without nature.** So that was one very important message from the report, and that comes from neuroscience as well as from behavioral sciences.

A second point was the importance of paying more attention to the social and emotional development of young children, not instead of the more traditional focus on their intellectual development and their language development, **but equally important**. And the reason for that is because there is a very strong science of emotional development and social development. It's not just kind of a touchy-feely kind of phenomenon that scientists can't study. **We have a great deal of brain research that tells us how emotions are very much embedded in the architecture of the brain and the function of the brain.**

So the report was very clear, particularly in speaking to some of the debates going on in our country right now about whether we should be focusing more, for example, in Head Start, on early literacy experiences. Our conclusion from the science is that **absolutely early literacy experiences are very important for young children, but they're no more important than paying attention to children's social health and their emotional well-being.**

There was a lot of interest at the time the report came out about how to optimally prepare children to be ready to succeed in school—the school readiness agenda. How do we help children come to school ready to learn? Well, the *Neurons to Neighborhoods* report was very emphatic in stating that **children are born ready to learn. We don't have to make them ready to learn. We don't have to teach them how to learn. They are wired from the beginning to learn, and they're wired to experience and to master the world around them.**

So our focus was on not so much a scientific formula for how to ignite a passion for learning in young children, but drawing on a great deal of science to show how **children can't help but want to learn about what's going on around them, and our job is to provide an optimal environment in which each child can pursue his or her development as far as it will go.**

Another important challenge and charge for the committee that did this report was to then look at science and say: What are the implications of the science for public policies, for programs? And our major message after two and a half years of looking very carefully at the science was to say that we have a very rich science of early childhood development, and that there's a tremendous amount that we know, and that science has been growing very rapidly. A good deal of what we know we didn't know about ten years ago, twenty years ago, thirty years ago.

And a good deal of that knowledge is informing the way parents raise their children, and the way programs are set up, and the way our policies are established. But in spite of the good use of that

knowledge, **there's still a tremendous gap in many places between what we know and what we do.** And closing that gap is a very important part of what the message was in the report, *From Neurons to Neighborhoods*. And so putting our action where our words are, the National Scientific Council on the Developing Child was set up to address just that particular challenge of closing the gap between what we know and what we do.

Emotion and Cognition:

David Boulton: So I hear you saying that emotional development is not just a side issue or surface thing that's not as important as perhaps cognitive development. We've really come to learn that they're inseparable. They're distinctions we make in our mind in order to support our different modes of analysis, but at a functional level, **inside of what makes us what we are, they're parts of the same process. They're inseparable.**

Dr. Jack P. Shonkoff: Exactly.

David Boulton: In our case, with reading work, it's very clear that the affects regulate cognitive entrainment - **how somebody feels about themselves, changes how much frustration they can handle...**

Dr. Jack P. Shonkoff: Exactly.

David Boulton: ...this in turn affects how much cognitive load they can handle. And so it's just ridiculous to think they're separable.

Dr. Jack P. Shonkoff: Yes.

David Boulton: Is there anything else you want to say about the relationship between affect and cognition?

Dr. Jack P. Shonkoff: I think our understanding of the relation between cognitive development and emotional development has really accelerated and is continuing to accelerate. Traditionally, most people, when they think of the brain, they think of intelligence. I mean, for many, "brain" means "intellect." And intelligence is just one thing or job that the brain does. Our feelings, our emotions, how we interact with other people, what kinds of fantasy thoughts we have, all of that is happening in the brain as well.

And we have some amazingly compelling neuroscience that shows us how emotional experiences, **the quality of the relationships that children have with the important people in their lives, that those relationships and the interactions that go with those relationships and the feelings that go with those relationships actually influence the emerging architecture of the brain. They sculpt the wiring of the brain.** There is no part of the brain, whether it be the way the brain thinks or the way the brain feels, there's no part of it that isn't influenced by these interactions and how they affect the brain circuits being established. And that happens from the very beginning. So not only are these experiences influencing brain development, but they also very much have an influence on the more traditional intellectual things that we pay attention to.

Reading:

So let's take reading, for example. **Obviously there are very important cognitive underpinnings involved in reading.** And there's a significant amount of intellectual development and language development that's necessary to master reading. But your ability to read is also very much

influenced by your feelings and social development. So **if a child can't sit still, if a child is preoccupied with feelings of sadness or anxiety, or if a child can't control his or her impulses, or is dealing with unresolved aggressive feelings, they all interfere with the ability to sit and master the skill of reading.**

When we look at how that's related to this issue of school readiness, again, emotional and social competence is as important as cognitive abilities and reading skills. So let's be very concrete about it—you come into your first day, whether it's kindergarten or first grade. Is it important for you to have had a rich array of early literacy experiences? Absolutely. If you know the alphabet when you enter kindergarten, or you can read some words, does that put you on the road toward success in school? Absolutely. But if you know the alphabet, or if you can read when you enter kindergarten, but you can't sit still, or you can't wait your turn, or you can't function well in a group or control your impulses, how you deal with other children, you are not going to succeed in school no matter how advanced your literacy competency is. So it's a matter of both. And I'm not saying one is more important than the other, but I'm clearly saying that **they're interrelated with each other**.

But we did some focus groups before we began the process of working on *Neurons to Neighborhoods*, because we wanted to be sure that we were going to attend to the things that were important to a variety of audiences. You know, as a group of academics, we were haunted by the danger of being irrelevant with what we're doing. So we did focus groups with preschool teachers and a variety of other folks and one kindergarten teacher said to us, in response to a question about what are the important ingredients of school readiness, she said, **"From my perspective, my experience, the problem is we have too many children coming to kindergarten who are either mad, bad, or sad. The problem is not that they can't add."** So when it comes to school readiness, if the challenge for a teacher is to teach a child the alphabet or teach a child how to decode words or how to read, that's something teachers are trained to do; it's part of their job.

And in some ways, in many cases, that's easier than helping a child who is kind of consumed with anxiety or sadness, or a child who does not know how to behave in a group with other children. Those problems will interfere with school success, as much as the inability to decode words. So when it comes to success in school, when it comes to helping development, we have to look at all aspects of a child's abilities.

David Boulton: Staying on this theme, lets drill down into a couple more points: As we said before, these things are inseparable, so whether it's an emotional attitude or bias like "bad, mad, sad" or it's the threshold at which a child drops to: "I'm not good at this -- I'm no good -- I'm not smart", **emotions are affecting the cognitive ability to do the work.** When someone goes into shame in relation to the frustration and strain of whatever their challenge is, it is affecting their cognitive ability to do the work ...to do the learning. And so this comes right down to the knife's edge...

Dr. Jack P. Shonkoff: Yep.

David Boulton: ...of what's happening in the microsecond movements of emotional attention in the world of cognitive processing.

Dr. Jack P. Shonkoff: Right.

David Boulton: Is there some aspect of that we can further explore?

Relationship Quality:

Dr. Jack P. Shonkoff: I think the thing that's really important for us to understand -- and again, I'm speaking from the perspective of science now, not just my own personal opinion -- for as long as people have studied development, the question has always been asked about, **how much does the environment influence development, and how much of it is hardwired?** What we've learned from the human genome project—in fact, we've learned this as much as we've learned it

from behavioral scientist—is that **the most important dimension of the environment that influences how children develop competencies is the quality of the relationships that they have with important people in their lives.**

So whether it's a child learning some particular task, mastering some skill, or developing abilities to regulate their own emotions, all of that happens in the context of relationships. Obviously that starts in the family, it starts with the parents, but it includes many other people who are important in children's lives. For the majority of young children in this country today it includes the people who they spend many days with in early child care programs and early education and preschool programs.

So, although children are very self-motivated, from infancy the drive for learning is inside the child, the richness of the learning that takes place is very much in the context of relationships with other people. It's not something that children just do on their own. That's not to say that kids can't learn things when left by themselves. You leave a child alone in an environment with things to explore, then a child can learn. But a good deal of what the child learns is in the context of meaningful interactions with other people.

If those interactions are nurturing and individualized and positive, and they provide a safe and stimulating environment in which to learn, then that results in a healthy brain architecture as the brain is developing. If the environment is unstable, neglectful, abusive, not individualized, if it's unstable in the sense that people are changing all the time, that also affects the architecture. That's why staff turnover in childcare programs is such a problem, because every time a relationship is broken and a new relationship is established, that is a stress for a child. It's not an insurmountable stress.

All of that happens in the context of learning. That's how children are learning about the world. And reading, obviously, in our culture is very important, but it's imbedded in learning a whole lot of other things. And all of this is expressed in the developing architecture of the brain.

You know, for a long time, the brain was a black box. People said, "Well, you know, something is happening there, but we don't really know." Now we know. We are learning a great deal. We obviously have a lot more to learn. But we're learning so much about how the wiring of the brain, how its architecture is very much shaped by experience and the environment. And what we've learned is that **the active ingredient in the environment that's having an influence on development is the quality of the relationships that children have with the important people in their lives. That's what it's all about.** That's where the action is. It's not in what's on the television, it's not in whether we have more expensive or less expensive toys, it's about the nature of those relationships that provide the context in which children learn about the world and learn about themselves.

David Boulton: Excellent.

Learning Disabilities:

David Boulton: Clearly, **we are born learning oriented**, and there are different features of the learning environments that we're in that either support or inhibit that orientation. Our emotional relationships and how well we're led into ways of learning that actually work for us, for example. All of these things are different features of the environment that support or inhibit the extending of our innate learning orientation.

In the learning disability world there's a general consensus that about four to six percent or so of the learning disabilities that we identify seem to have some innate neurobiological origin, and that **the vast majority of 'learning disabilities' -- which is a really fuzzy term -- are acquired.** In other words, **when we're in unhealthy learning environments, we learn in ways that can be learning**

***disabling*.** And that includes both the emotional and cognitive dimensions. Is there something along these lines you can speak to?

Dr. Jack P. Shonkoff: I would be very suspicious of hard numbers about the different types of learning disabilities or learning problems, and I'll tell you why. Learning disabilities is an area that I actually used to spend a lot of time working on earlier in my career. I don't do learning disability work, haven't done it for years, and I focus mostly on very young children, where the learning disability is a little bit more ambiguous. So I'm not an expert in this area, okay?

But, I think given what we know about learning, about the development of the brain, about the development of all areas of common human ability, I think **it's misleading to talk about a learning problem being primarily biological, or being largely environmental, because as I said earlier, you can't separate biology from experience when is comes to development.** The old-fashioned way of understanding that has been superseded by our current knowledge.

And again, it was the cracking of the human genome that really put the final nail in the coffin of this dichotomy between biology/genetics and experience, because genetic expression, **the actual functioning of the genes as they make their proteins, does not take place in a vacuum out of context. Gene expression is influenced by the environment. It's influenced by experience. We have a very exciting neuroscience that shows us how different experiences can actually change gene expression in the brain, in the developing brain.**

So when we talk about learning and we talk about problems in learning, I think it's reasonable to ask, well, what are the contributions here from the biological side? How much of this different way of learning or this difficulty in learning is related to a brain that's working differently, and **how much of it is related to the environment and the degree to which the environment is supporting or not supporting learning?** But we have to remember that the environment is influencing the development of the brain. So **if the environment is not supportive of learning, that nonsupportive environment has probably had some influence on the way the brain has developed.**

It's dangerous to overstate that because sometimes people interpret that as meaning that something bad happened to the brain, and now you can't fix it, you have to get around it.

David Boulton: That's second order from the first point, right?

Dr. Jack P. Shonkoff: Right.

David Boulton: I'm with you. We've talked with James Wendorf, (director of the National Center for Learning Disabilities)..

Dr. Jack P. Shonkoff: Yes.

David Boulton: ...Sally Shaywitz (Pediatric Neuroscientist at Yale and author of Overcoming Dyslexia)...

Dr. Jack P. Shonkoff: Sure.

David Boulton: Reid Lyon (Ex-Branch Chief responsible for learning and development at the National Institute for Child Health and Human Development) and many of the people in this field.

Dr. Jack P. Shonkoff: You're getting different perspectives on the same science, right?

David Boulton: I am. But what interests me is that these variations in learning environments are causing a lot of "learning disabilities" -- not learning disabilities in the sense of these numbers or the congressional meaning of the term, and not necessarily that they are or are not remediate-able later

on, but rather that, **a child's capacity or ability to learn in any particular dimension is being enabled or constrained by the learning environments that they're in.**

Adaptation:

Dr. Jack P. Shonkoff: Right. So maybe another way to think about that is to say that our brains are designed to be adaptive, by their very nature, brains are designed to try to get things right, to adapt positively. And sometimes that adaptive capacity has to face some kind of underlying biological problem, and therefore, the brain, in its best efforts, is trying to adapt to the biological problem. And that is what our therapies and interventions are all about -- it's not hocus-pocus magic, it's trying to strengthen the brain's capacity to adapt.

Sometimes the problem is more in the environment than it is in the brain itself, and the problem in the environment can stress or strain or interfere with the brain's normal adaptive capacities, because the brain is very sensitive to the environment in its development. But **whether the problem or the underlying challenge is intrinsic to the brain or is in the environment, at any given time, the brain, in its functioning, is working optimally to come up with a positive adaptation.**

Now, what is a positive adaptation? It's not something that's absolute or out of context. A positive adaptation has to do with adapting to something. And the something is the culture and the environment in which a child grows up. So if you grow up in a society like ours, where literacy and analytic thinking is very important, the brain needs to develop good capacities in that area. In other contexts, there may be other capacities that are more important. So there's a strong cultural bias about what the necessary skills are to be considered successful.

But this is an ongoing process, and the brain is very plastic. People talk about this term "neuroplasticity." **And the one thing we know about plasticity, which is the capacity to adjust and adapt, is it's greatest when the brain is immature, and it is less as the brain becomes more mature. It's never completely gone. There is plasticity in the brains of adults.**

Just think about how habits that are developed are easy to break early, and they're harder to break later. We have a certain way of doing things, we have a certain way of thinking about things. The younger you are, the easier it is to change; the older you are, the harder it is to change. But mature adults can change their behaviors. Mature adults learn new things that they didn't know before.

So we shouldn't think of the brain as fixed in its ways -- nor is the environment fixed. But that's another irony. I think **in the old days when we talked about "nature versus nurture," the assumption was: If it was genetic it meant you couldn't really do anything about it; and if it was the environment, then we could change it. Here's the ultimate irony: in this post-genome project world, it may be easier to change the genome than it is to change the environment. Kind of ironic, isn't it?**

But either way, the brain and its functioning and our development is reliant on both. And it's not just an additive phenomenon; they affect each other. The environment affects the biology of the brain. And the biology of the brain affects the way each individual deals with the environment.

So I think the learning disabilities area -- as I said, I'm not an expert in learning disabilities, but it's very complicated. There's no question that there are children with serious learning problems that have to do with the fact that their brain works very differently from the usual brain. There are also children who have problems learning because their brain is working like most brains work, but they're in environments that are putting unusual stresses on their ability to learn. And in most cases it's some combination of both.

And how do we deal with learning problems? We try to understand as well as we can what the particular style of learning is for a child, and then match the experiences and the environment, the

teaching environment and the interactive environment the best way we can to really complement that child's style of learning. And that field has come a long way, and I think still we ain't seen nothing yet. I mean, I think a lot of the breakthroughs in understanding learning disabilities and learning problems are ahead of us. And the one thing that we shouldn't lose sight of is that **there is also the phenomenon of learning differences, which is different from a learning disability. And one of the other characteristics of the brain, the human brain and human abilities is the tremendous variation within a normal population**. And obviously we're all very concerned about not wanting to label difference as deficiency.

David Boulton: Right.

Dr. Jack P. Shonkoff: That's a challenge.

David Boulton: Just to close on the learning disabilities topic: It's really clear when you push on this that there's no bottom's up science. The numbers I mentioned earlier were backed into: What percentage we can't reach with our models of intervention, and therefore, what's leftover that doesn't seem to be influence-able is a "disability". You said some children may have problems due to something about their brain that's less environmentally influenced, and others -- you know, that it has more to do with their environment, almost like it could be one or the other.

Dr. Jack P. Shonkoff: But it's always both.

David Boulton: It's always both. And **if we were to look at the enormous variation in how well children are learning, it seems to me that the learning environment, the quality of the learning environment; the dimension of language richness, the speed complexity of language going on, the affective tone, the call to engagement rather than the push to shut down, that these qualities are shaping our children.**

Dr. Jack P. Shonkoff: Right.

David Boulton: So, this huge influence over these early years, as children are coming into themselves, seems to me be much more to do with their environments than we….

Dr. Jack P. Shonkoff: Well, let me respond in this way...

David Boulton: Okay.

Both Art and Science in Raising Children:

Dr. Jack P. Shonkoff: I'm speaking on faith here...

David Boulton: Sure.

Dr. Jack P. Shonkoff: ... because I'll have no control over what you choose to take of what I'm saying, and where it fits in the sequence of events, but...

David Boulton: Okay.

Dr. Jack P. Shonkoff: ...I had good parenting, so I've got a basic core of inner trust. But here's part of what I'm saying: I don't want what I'm saying to be juxtaposed against people who are experts in learning disabilities, to make it look like I'm pretending I'm an expert in learning disabilities.

David Boulton: You won't be.

Dr. Jack P. Shonkoff: So what I'm doing is speaking from a different perspective. I'm speaking from the perspective of what we know about the science of development, with academic learning and learning disabilities as a subset of that. And I'm speaking more from the perspective of broad principles of development across the board. Don't be misled. There's nobody who doesn't have a point of view. Even the most rigorous scientist has a perspective on things.

So here's my point of view, which colors what I'm saying: I really believe in and spend most of my working hours focused on the science of development. But when we translate that into thinking about children, and thinking about how do we use this science to have a positive influence on the development of children, then I come down very hard on a perspective that says that **the raising of children is an art as well as a science**, and that the promised land, from my perspective, is not the day when we make this entirely science driven. That's not what the raising of children should be all about. There's a hefty dose of art here, and also a hefty dose of flying by the seat of your pants.

So we have a very rich knowledge base, science, that a large part of the population is hungry for, and particularly the more educated -- the more economically secure part of the population can't get enough of the science. And that's good, as long as people don't lose a sense of perspective, and think that the answer to successful child rearing is science. It's a piece. It's a big piece. It can be tremendously valuable. But there's a lot of raising kids that is flying by the seat of your pants. The best parents make dozens of mistakes every day, and do things that the science says you shouldn't do. And that's okay, because if children were that fragile, we would be extinct, like dinosaurs. We're very adaptive as a species.

So if you put all that stuff together, and then think about how much development takes place in a cultural context, then here are some of the problems that our culture presents for how we use the science, and how we understand the imperfection of raising kids: We're a very individualistic, competitive society, so parents who have resources and who have education, want their kids to have the benefits of having a competitive advantage in a very competitive individualistic society.

So that raises the ante a lot for how carefully we look at children's development, how much we determine whether they are learning optimally or whether they need help with their learning. And sometimes that's really good because it helps us identify children who have vulnerabilities in their learning, and we can give them the benefits of what we know about how to enhance their learning, and that's great. But sometimes it creates a situation that can't be met, which may be a discrepancy between what a child's capabilities are and what the adults in his or her life want him or her to be. And that's where sometimes there may be concerns about the child's learning, not because there's anything wrong with the child's learning, but because the child's learning capacity is not at a level that that parent wants the child to be, or that teacher wants the child to be, because of external pressures.

And so it brings us back to this question of -- in the subtle areas, not in the obvious areas, because the obvious areas are easy -- the gray zone, where we do more and more evaluating to find out what is underlying this child's learning problems. And the fact of the matter is not only are brains very complicated, but there are no perfect brains around, and there isn't any child or adult who can survive being put under a microscope and come out totally clean. I mean, all of us have things we're better at, things we're not as good at, and relative differences in our competencies, all in a normal range, except for those who have extreme impairments. You know, it's the joke about the town where everybody is above average.

So this is where I think science can only take us so far. It's where values become very important. It's where aspirations become really important. **And my plea, my hope, is to say that we don't disregard the tremendous value of the scientific knowledge that we have, but that we don't turn child rearing and child evaluation into something that is one-hundred percent science driven, without a hefty sense of common sense and a perspective on what's important in life.**

So there are two kinds of young children who are very vulnerable -- well, there are more than two, but to over-simplify it -- who are the vulnerable high-risk kids in our society. The largest problem we have in terms of vulnerability of children is low-income, highly stressed environments. Environments where the impact of daily stress, particularly if compounded by exposure to violence or mental

illness in the family, particularly maternal depression, which is very common, or substance abuse, **that level of stress, that kind of toxic stress in the environment of a young child, is actually interfering with the development of the brain.**

It results in the release of chemicals in the brain like cortisol, which interferes with normal brain architecture development. So we do know children in toxic stress situations, not just low-income, but highly kind of threatening environments, have problems with the development of their brain -- not irreversible problems in terms of their development, but problems. So clearly that's a very high-risk group of children.

But there's another vulnerable high-risk group of children who live in environments that are economically secure, where there's a lot of education and a loving family. I'm not being critical, but sometimes there are pressures put on children, not just pressures in terms of expectations, but pressures in terms of the wealth and maybe the overabundance of enrichment experiences for them, where they're left with very little time to be young children.

And that's a very different kind of threat. If you had to choose between the two, I would take that threat over the threat of violence and severe depravation. But it's another kind of interference with health and development, which needs to also give children a lot of time to just kind of learn on their own, and just kind of have fun, and be kids. And having fun and playing is a very important medium for learning about the world.

David Boulton: Which connects back to what you were saying: let's learn from the science, but let's not translate that into some kind of script that we're using to control how children are developing.

Dr. Jack P. Shonkoff: Right.

David Boulton: They need the freedom for their intelligence to learn their own way.

Dr. Jack P. Shonkoff: Right.

David Boulton: And we need to pick up and connect with that as we extend into those things that we think are critical for them to succeed in the world. But we also can't constrain and choke and channel that to such a mechanical, scientifically driven, degree.

Dr. Jack P. Shonkoff: Right, absolutely. And the goal is not someday to be able to highly script the rearing of young children, driven by scientific knowledge. I think the goal is someday to have a richer and richer scientific knowledge base to help us guide, in terms of general principles, how to create environments in which children can grow up healthy and competent.

David Boulton: Right. We had long conversations with Siegfried Englemann, the director and founder of the Direct Instruction movement in this country about the pros and cons of microscripting education. So I'm with you in all of that. And I appreciate where you're coming from. From our perspective**, the value of science is to help us reveal certain challenges that we otherwise take for granted so we can align our relating to children in a way that's more responsible to the kind of challenges that they're going through than the take-it-for-granted super simplistic assumptions we commonly have about these things. And that's where we get into reading, because that's a particular case where that's true.**