Interview Transcripts – North American Edition

Names starting with S to Z

This document contains transcripts of the expert interviews in *Introduction to The Science of Early Child Development, North American Edition*. Transcripts are listed alphabetically by the name of the interviewee and the name of the video clip. Click on a name below to go to that person's interview transcripts:

Santos – experience (1:55)

Brain Development – 1.2 Experience-based brain development

We've learned more in the last 30 years about what's happening in those early years of development than we ever knew in the preceding 2500 years. So most of that research is new and has only been recently begun to be applied to thinking. In terms of what's happening in there – it really starts from conception. Like often we think about children sort of after they have been born and we often need to remind ourselves that so much happens in the prenatal period during pregnancy, and so, in terms of how we support kids it really needs to start with supporting parents and pregnant moms especially. In terms of what's happening developmentally, the story of how the brain develops I think is what really captured the imagination of the public and everybody that's been working on this today.

The thing you refer to in terms of sculpting is sort of a metaphor for what happens at the level of the neurons in the brain. So unlike most of the rest of living beings in the world, human beings, at birth, their brains are not formed fully developed, that is, that after the child is born much is still required to help that baby[1]s brain develop in a way that will increase that child[1]s life chances and potential.

And that, as I say, experience-based learning is heavily dependent on the social environment of the child. So in addition to the things that I think we take as givens - a child needs enough food and water, and warmth and physical safety. The way the brain develops in the early years is heavily dependent on the presence of nurturing relationships, on the presence of caring adults in the child[1]s life, such that, they talk about the sculpting, the connections in the child[1]s brain, really depends on that interaction. So it's really incumbent on us, from that research perspective, to consider how best to support that happening.

I do want to mention that there has often been a lot of talk about, kind of the early years being a critical period or sensitive period of development. And while that's true, a mistake that's often made is that it all sort of ends, the chances sort of end, all before kids enter school, which is not the case.

If you look across the life course, from when a child is conceived through their life into adulthood, the most enormous point of activity in terms of brain development are in the early years - there is another peak in early adolescence which is another discussion.

Santos – importance of caregiving (2:20)

Brain Development – 3. Practices for healthy brain development

Although a baby is born with all the neurons in the brain that an adult has, about a hundred billion, sort of like the number of stars in the milky way is a way of thinking how complex the brain is most of those neurons are not well connected, hence they are dependent on the experience of the child in the first few years and pregnancy period. When you look at pictures of the brain at that level you see those connections happening through those early years. You find that, at around that age two and three probably you looked at from a developmental perspective, that¹s the time that there is the most connections in the brain because the child¹s brain is so active. In fact, if you define being smart as the ability to learn new things, babies far and away out pace adults in terms of their ability to learn. They are literally geniuses in terms of the way they approach the world.

Another thing we¹ve learned about those early years is that it used to be assumed that babies were born as blank slates, they don¹t know very much, they didn¹t do very much, they just sat there, cried every now and then, and then you feed them. The truth is with the new research is that babies are born with already an enormous amount of knowledge of how the world works and how it is organized and how to live in the world. What they rely on caring adults for is to help shape that learning further in all domains of development, their social development, emotionally and in terms of their learning ability, so that sculpting that occurs really depends on that interaction in every way with caring adults, whether that¹s playing, talking or reading or any number of ways that adults typically interact when they encounter a child.

We find is that there has been a lot of worry on the part of parents and adults that care for children as to what you do with these babies and how best to maximize their development. When, in fact, the kinds of things that I think the research shows that most adults unconsciously do when they're around children, which is to pick them up and cuddle them and play with them and talk to them in baby talk and all that. All of those things that we sort of unconsciously do are in fact some of the best things we can do with a child. You don't need any special toys or books, with apologies to the people who sell those things. What you need is a caring adult with a consistent time, space and opportunity to be in the life of the child in that important period.

Schonert-Reichl – adult self-care (1:35)

Coping & competence – 2.4 Executive function

There's nothing like feeling connected to your colleagues, to other parents that are supportive rather than can interfere. Interestingly there was a study done several years ago of teachers, to look at this notion of stress contagion. And researchers were interested in seeing- it was early years of elementary school- what were the things that stressed out teachers and did that stressed out teacher actually ripple down in to the classroom. And they found the number one top stressor for teachers was not getting respect from their colleagues.

So if I think about any of those centres or things is how important that context of collaboration connection and supportiveness is important for the adults. So if I had advice and people were saying we want to bring in these programs, I'd say first spend time connecting with the adults and creating a kind, collaborative, supportive context before you start thinking about just going to the kids. I think a lot of people feel – I think they don't think of that first and I think people who go and work with children, people who have that, feel that it's somewhat indulgent to start with themselves, to take care of themselves because they want to help the children. But I want to say to them now the research is really showing that when you take care of yourself first, it benefits the children. The children do benefit and because your own well-being creates a more positive atmosphere for children.

Schonert-Reichl – EDI update- wave 6 results (2:09)

DH 2.3 Monitoring early child development

We just recently released our EDI Wave 6 results to look at how the EDI has been changing over the past decade in terms of trends over time across the Kindergarten children in British Columbia. And we noticed two major trends. One on the good news side is that vulnerability in language and cognitive development is actually decreasing. So from the time we began the Wave 2 it was 2003-2004 that has been a downward trend of decreased vulnerability. So we know now that there's probably been many efforts across the province to focus on the language and it's often one that people know how to address, right, to deal with literacy.

But on the other hand, a more sort of bad news story I guess would be increasing vulnerability on two domains. One is called emotional maturity and the other one is called social competence. So over the past decade we've actually seen increased vulnerability across children in British Columbia on those two dimensions. Now often we look and see what could be the cause; what could be the factors? It could be the increased burden on families. I've mentioned; I've talked about research that I've done with a colleague on stress contagion where we find that actually stress is contagious from adults to children as we have increasing pressures on parents that there's increased stress at home and that children, especially in the area of social competence and emotional maturity are experiencing that. Could there be also if you think of social media, are we all taken away too much of being on our cell phones or being, even I think of the work place and how much more employees are being pressured to be available 24/7. You know, and so is that another stress that then cascades down in to the family life; that then children are the collateral damage for that.

Schonert-Reichl – mindfulness research (2:27)

Coping & competence -2.4 Executive function

So mindfulness is one area of research that has been gaining increasing attention. Mindfulness defined typically refers to being in the present moment without judgment and paying attention on purpose. For the past decade I've been studying mindfulness in school age children particularly around a program called MindUP developed by the Hawn Foundation.

The MindUP program is for school age children that integrates mindfulness and social and emotional learning. So the children that receive the program which could be pre-K to grade 2, 3 to grade 5, 6 to grade 8, actually three times a day practice mindfulness. They call them "brain breaks" actually, where the children take a moment, take breaths, pay attention to their breath. But they also do things like mindful movement, mindful tasting – a favourite among many children, as well as mindful listening.

And for the past decade I've been doing research on this MindUP program to see does it really benefit children in terms of their social and emotional well-being, in terms of their ability to self-regulate, decrease stress. A lot of those factors that we've seen in the adult research on mindfulness that shows these positive benefits but we haven't known until now. And my research on MindUP with grade 4 to 7 children and another study on grade 4 to 5 finds in fact, that this mindfulness program or social and emotional program with mindfulness components actually does promote positive well-being in children, decreased stress as well as make them more positive in their lives with friends and with their teachers.

One of the things I just want to say, it's interesting in this study that we looked at peer relationships and we asked kids to actually nominate their peers on how much they're kind, how much they help others, how much they cooperate. And the children who received the MindUP program increased on all of those compared to children who did not receive the program, which we call a control group. Those children actually got worse throughout the school year. In our research on the MindUP program, we not only found improved social and emotional skills as well as increased capacity for empathy and caring for others, we actually found that those children who received the MindUP program had math test scores that were 15% higher than the children who did not get the program.

Schonert-Reichl – mindfulness research key messages (2:15)

Coping & competence – 2.4 Executive function

Some of the research out of mindfulness as well as the social and emotional learning for parents, I think there's a couple of key messages I'd like to emphasize. One is that you can teach these skills of children– that children can learn to manage their emotions, to become more emotionally capable. They're malleable. We know now the brain is plastic, that you can teach these skills and I think that parents should know that even if they have a child with this kind of temperament, don't look at it as written in stone, that you can actually provide the context for them to learn these skills.

Which leads to my second key message – it's all about the context. The children all do better when they have less stress. And so the one thing about the mindfulness program is by giving children the strategies to calm down, to learn about their brain, then they're more ready to learn and actually acquire other skills related to compassion and kindness and being able to take others' perspectives because when we're stressed, we have tunnel vision, all of us. You know, we look at one thing and we can't see anyone around us because of that stress.

And the last key message I really would like to emphasize is how our own well-being and our own social and emotional competence, our ability to manage stress is so critical first and foremost. So if I had to think about parents who are going to promote mindfulness with their children, I would say start with yourselves or do it together with your child. Practice it together. Don't look at it as something to do because as a parent I don't know, and I'll ask parents out there, have you ever been really stressed out and words came out of your mouth that you never thought would come out. You know, where you just like, oh, I don't have time for that, you know when we're all stressed and we always feel bad when we do anything like that. But we're all human so we have to do that.

Actually that's another thing that is really critical – self-compassion. It's a whole emerging field in the mindfulness area is practicing self-compassion because I think sometimes we're our own worst critics. So anyway, so the idea that parents, that we have to give permission to take care of ourselves first.

Schonert-Reichl – MindUp engaging students (1:37)

Coping & competence – 2.4 Executive function

When I began doing this work on MindUP, this mindfulness-based program, it was going to be implemented in kindergarten classrooms up till grade 8. Well, I went in to it very skeptical. I thought, ok, really? I could not imagine kindergarten children even grade 1, sitting still for a few minutes breathing, paying attention to their breath. I thought this is just not going to work and boy, was I proven wrong. I felt that they really got it quicker than the older children. It was like they were more ready for it. I went and visited a lot of kindergarten classrooms and the children right away had that ability to be in the present moment. And if you think about young children, they are in the present moment. You know the idea of taking a mindful walk and looking for things that you could see on the sidewalk – they're so present. They pay attention to those things. So it really was an easy sell for the little ones. A bit harder sell for the older kids in some ways because they are a bit more skeptical.

But the one thing about the MindUP program that I think is a real draw for all children is it begins by teaching children about their brain. So they learn about the different parts of their brain, the prefrontal cortex, the hippocampus, the amygdala and they learn about the functions of those parts of their brain. And what I think really gets children engaged to learn that they can have control over their brain, that their thoughts – And teachers really love it because they feel like it's not just taking away from the curriculum, that they're actually adding to it by bringing all the latest research on neuroscience.

Shanker – brain development trajectory (4:46)

Brain Development – 2.5 The social brain

At the beginning of the therapy, what we see is, we get the standard measures using various psychometric tools that tell us exactly where that child is compared to their peers in terms of their ability to process information, solve problems, use symbols. And then we begin about 35 hours a week of therapy in which we work very closely with the parents. And then at regular intervals we study their brain. And what we want to see is, is there a progression in the activation of the anterior cingulate. In other words, are we actually, beginning to bring that part of the brain that wasn't active, that wasn't processing this social information, can we bring it online?

So, the children in our study range in age from two until four. And they are all at roughly the same kind of a developmental level; it's a level at which these kids are having a lot of trouble managing social interactions, processing social information and they have problems with language and problems solving. They also have numerous biological problems that we work on for example, using occupational therapists.

One of the questions we are most interested in is, is it possible to enable a child who for biological reasons has had this kind of a skewed neurobiological trajectory. And what we mean by that is, that the course of how their brain develops has been disrupted because of their inability to process social interaction, to engage in typical social relationships which according to all the work we've done, are the sort of driving mechanism in the development of the brain in the first couple of years of life.

We know, that if we take an older child, a child of say five or six, who has not had the social relationships and give them very intensive therapy that what we can do is, we can train them to, let's say, memorize certain kinds of social scripts. In extreme cases the child might memorize something like "when someone raises the corners of their mouth and their eyes crinkle at the edges that means they're smiling and happy. Happy means that they like what you are saying. And this is all a very kind of rote memorized task for them and we try to give them lots of tasks.

When we study the brains of this sort of a child what we see is that those parts of the brain that regulate memory are very, very active. So what we've done is we've capitalized on those centres, those systems, that regulate memory but we haven't really touched those systems that regulate social information, social interaction. What we want to know is, if we start to work with a child much younger than this, when the brain is still fairly plastic, when the brain is still capable of forming substantial new connections, and if we adopt a therapy which is designed to mobilize the child's awareness of, and understanding of social information, can we get those parts of the brain active, developing? So that instead of it being the memory systems that regulate their social interactions, it's, as in with most of us, the parts of the brain such as the anterior cingulate and the orbital frontal which unconsciously regulate our social interactions.

And so far what we're seeing is, that if we can get the child at a young age, while we still have a window of plasticity, that there are very encouraging signs that it is indeed possible to return a child to this sort of healthy neurobiological trajectory.

Shanker – caregivers (2:06)

Brain Development – 1. Early brain development

However, nature had one more ace up its sleeve. Nature, since it was giving birth to these brains that were so small and undeveloped at birth, could also use the opportunity to make our brain highly adaptable. We are the most adaptable species. The infant's brain can adapt to anything from the Arctic to the Sahara, to a very safe and secure environment to a very hazardous environment. The connections that are formed in the first two years of life are molded by the kinds of experiences that that child encounters. And the primary vehicle for these experiences are the caregivers. This is a defenseless creature that relies on its caregiver for security, food and learning, and stimulation. And so what we find is, that beginning at birth, through the caregiver's facial expressions, through the gleam in their eyes, they are stimulating and regulating how that little baby's brain develops. What sorts of connections develop?

We know that there's an enormous explosion of the growth of the synapses, of synaptic genesis in the first eight months. At that point we know that a significant process of pruning starts to occur. Those connections that are turning out to be most useful are the ones that will be kept, that will be preserved, that will serve as the sort of foundation for the growing architecture of the brain. Again, these connections come through the primary caregivers. They serve as the sort of conduit--the lens--that introduces the child to the world. Their gestures, their facial expressions indicate to the child: this is interesting, this is new, this is frightening, this is to be avoided.

Shanker – defining self-regulation and self-control (1:53)

Coping & Competence – 1.1 Self-regulation

One of the questions that we get asked most frequently is, “What exactly is self-regulation?” So we actually did a study on this and it turns out that there are 447 different definitions of self-regulation, yes and it’s no wonder that people are confused.

In simplest terms what that refers to is how we manage stress, how we regulate the amount of energy and tension that we have and then recover from stress. There are all these hundreds of different definitions of self-regulation and what’s very interesting about them is how many of them are actually about self-control, not about self-regulation. It’s very easy for parents especially to be confused- what’s the difference between them? There’s a very simple guideline for how you’d distinguish between them, at least conceptually, and that is self-control is about inhibiting an impulse. But self-regulation is really about addressing and removing or preventing those impulses in the first place. The impulses themselves are invariably a result of heightened stress and so what we’re working on when we address self-regulation in a child is the various kinds of stresses that lead that child to become highly impulsive or to need to exercise self-control.

So what we’ve learned from doing this over the years is that self-regulation is what makes self-control possible or in most cases unnecessary.

Shanker – developmental disorders (1:47)

Coping & Competence – 1.1 Self-regulation

We created this self-reg wheel,and this wheel is telling us something incredibly important about self-regulation. If you look at the wheel, at twelve o'clock we have developmental disorders, and by developmental disorders we mean things like: autism, or ADHD or learning disorder, and the point of implicating self-regulation here is not to say that these disorders are caused by problems in self-regulation, these are neuro-genetic disorders, these are disorders that, you know, everyday we're learning something new about the sorts of core, perceptual and motor mechanisms that have been impaired in these children.

The nature of the biological, the neuro-genetic challenges that these kids with disorders have is such that it interferes with, it obstructs these interactive experiences. It obstructs their capacity to engage with their primary caregivers, so as to deliver this information to the parts of the brain that are coming online. So what happens is that the child develops problems in self-regulation as a downstream consequence of the neuro-genetic challenges which interfere with their social interactions. Now what happens is so many of the symptoms that we associate with the various developmental disorders, so many of these symptoms are actually downstream consequences of the impediment to social interaction which in turn causes impediment to the development of self-regulation.

Shanker – developmental expressions of stress (2:37)

Coping & Competence – 2.3 Emotional learning

So the question that you've just asked me is whether there are what we might call "developmentally identifiable landmarks," whatever, to differentiate between say how a toddler might express stress behaviour versus a teenager. It's a difficult question and I'll tell you why. The first part of the question is yes. So typically what happens-let's take a toddler-is we'll see very pronounced changes in facial complexion and they might go very pale or very, very red and will have very pronounced changes in vocal behaviour, so their voice will generally speaking go up. They become very volatile, very labile is the technical term. They become very volatile and their emotions swing all over the place.

So those are typical toddler into preschool expressions of this. One of the things that children are getting much better at is concealing these sort of raw emotions. So they're learning how to suppress their emotional expressions and so on. And by the time they are young teens, they can even look you in the eye. They've gotten so good at inhibiting their anxiety, concealing their anxiety that they can look at you in the eye and even maintain a straight face. However, if it becomes strong enough, if the arousal is strong enough that older child or that teen will in fact regress to the level of a toddler. The behaviours will in fact regress as well. This is very difficult for parents for example who have an older child or a tween that is truly behaving like a young toddler but because of their age we insist on treating them as a young adult or whatever. But in fact in functional terms, in terms of what's happening in their brain, they are at a toddler's level. I would go so far as to say that older adults, could regress to the level of a toddler.

Shanker – down-regulating (part 1) (3:02)

Coping & Competence – 3.1 Understanding feelings & behaviour

Essentially, the way the human brain is wired is that if someone, even our own child, is in red brain, we will instantly go into red brain ourselves. And this was clearly a strong survival mechanism for our species. It provided, for example, when there was a danger, a threat to the community, to the group, the instant effect of arousal. So this is a problem for us. It's a problem for us especially as parents because when our child is in red brain one of the most important aspects of this is that they are unable, it's very hard for them to turn off their limbic alarm, to go back into blue brain. But if we-so they need us. The problem is that if we are in red brain ourselves then we cannot exercise that sort of regulating or co-regulating role.

Let's suppose that our child has engaged in some sort of a stress behaviour that is really very important that we learn from this- that, "You mustn't do this sort of thing."
So one of the big lessons here for parents is we first have to get ourselves back into blue brain. Then we have to get our child back into blue brain. There is-we do not have that window to teach, explain, learn from this experience while the child is in red brain. The question then is, when is it the right time? Once we've got the kid back into blue brain, when's the right time for us to discuss this? Now we can discuss it calmly, you know, why it happened, why it's inappropriate, etc. etc. And that's a question that only a parent can figure out. Sometimes it might be an hour later. Maybe it's going to be the next day. But the important lesson is you will not be able to turn this into a learning experience while either of you is in red brain.

When we go into red brain ourselves, we fall back into this punishment mentality and the problem is that it doesn't work. It makes everything worse. So positive discipline was created specifically to really vanquish this ancient mind-set and to come up with constructive ways that we can actually help a child, not harm a child.

Shanker – down-regulating (part 2) (2:46)

Coping & Competence – 3.1 Understanding feelings & behavior

The most important mechanism for humans is social engagement. So the one thing we don't want to do is to take away or somehow banish the most important mechanism for a young child, which is that older more regulated brain to help the child.

Having said that, there are times when we have found that it is enormously beneficial for the child to have that quiet space where the child actually finds social engagement itself overwhelming. Think for example, of a young child with autism. So we know from studying these children that social engagement is a stress, eye gaze is a stress, proximity is a stress and if I have a child who is in this red brain state, this may be too much. So what we do in these situations is we will use a quiet space which is very comfortable and in our practice what we would use at MEHRIT was-we had this sort of huge oversized beanbag chair which is a wonderful punishment tool. The reason it's wonderful is because the child can nuzzle into it and they're really calming down their nervous system. And the idea here was that if the child wasn't ready for engagement, to give the child the space to calm down, to get back into blue brain, to let everything soothe.

The most important lesson in all this-I mean one of the questions we were continually asked is, "How do I know if I'm doing this right? How do I know if this is meeting what you're describing?" And the answer is if the child asked for it. If the child says to you, you know, I need to go sit in my-we would make it really cool by the way. We had the large beanbag chair. We would have one of those foot massagers. We would have a weighted blanket or a weighted throw. We would even have noise cancelling headphones-all these things to make this a truly down regulating experience. We actually could use this then as a tool for self-regulation. "How do you feel now? How did you feel this? How did you feel before? The next time you're starting to feel that way you can quietly get up…" And it's when children start to do that, that we know they're learning self-regulation.

Shanker – educational outcomes (1:33)

Coping & Competence -1.1 Self-regulation

There's a high correlation between mental and physical problems - that a child that has the one is likely to have the other at different points in their lifespan, and so as you go around the wheel you'll see that you've now gone from psychology into classical health- so we're looking at the health crises that we're dealing with as a society until we get to 11 o'clock, and 11 o'clock is educational outcomes. While now we've got just so much research that's come out since 2000 shown that self-regulation is absolutely fundamental, critical to how well kids are going to do in school

Why are we seeing this incredible concordance, this incredible correlation between poor educational outcomes and problems from 1-5 or 6-11? Is it because they're stupid? Is it because they have a low IQ? Is it because they're just not smart enough to understand what kinds of things they should do to enjoy health? No. it's because a common pathway has been impaired. This core pathway in the brain, if it is over-worked in the early years of life, if the child is responding to too many stressors, so that he's constantly putting his foot on the break, constantly activating the parasympathetic nervous system, there will be a cost, and the cost is going to be the child's well-being, and the cost is going to manifest in any of the problems you see on that graph, and probably in several.

Shanker – evolution (2:55)

Brain Development – 1. Early brain development

So one of the questions that we wanted to understand from very early on, is why is the parent, why are the primary caregivers, so important to this whole process of early brain development? And to answer that we began to actually study evolution. We studied this very closely. And there is a growing awareness in the neuro-scientific community that looks at the evolution of the human brain. That nature was confronted with a very interesting dilemma when it was evolving the human brain. On the one hand, it discovered that bipedalism, the ability to walk on two legs, gave humans a wonderful advantage over all other species. On the other hand, it was discovering that a big brain gave us another wonderful advantage in terms of our ability to plan, to remember, to project. This created a dilemma, and the dilemma was how big a brain could nature evolve, while still enabling our females to walk on two legs. Because they had to give birth to this big brain thing.

Nature came up with a very interesting solution. It had us give birth to our babies, in essence, prematurely. Our babies, to quote what Stephen J. Gould said, are "fetuses outside of the womb" for the first nine months of life. So they are born with approximately ¼ the size of their adult brain. Now, nature had to ensure that these babies would receive the appropriate kinds of experience that are necessary for the developing architecture of this emerging brain. So, what nature did was, it gave us all sorts of mechanisms that ensured that the primary caregiver, usually the birth mother, would stay in close proximity with her infant.

And so we have things like certain hormones that are actually released by the baby crawling up the mother's ventrum immediately after birth to search for milk which it does by its olfactory sense. And when we study this we see that it releases oxytocin in the mother, the so-called cuddle hormone. It also stimulates GI hormones. It also does things to the baby's brain. So we have these mechanisms, that are largely innate, that ensure that we will have this kind of close caregiver-infant relationship for the first couple of years, which is the period during which the child's brain goes through this enormous burst of development.

Shanker – example of self-regulation (4:39)

Coping & Competence – 1.1 Self-regulation

Self-regulation is the story about how much gas a child has in their tank, and what are the things that a child is using up their gas on? The way we started to think about this I put my car in cruise control, and I noticed that I was burning about 8 liters per 100 kilometers, when I was on a flat surface, and then the car had to go up a hill and I suddenly jumped from 8 liters per 100 to 40 liters per 100, and then as I went down the decline it went down to 3. And I realized that, you know, we have this assumption that every child is sort of, you know, they're on a level footing, they're all, you know, if they're not paying attention, if they're not paying attention it's because they're not trying.

Well, I'll give you the perfect example, and then I'll explain its significance for all children. I was in a classroom, I'd been asked to come in, and I'd been asked by the school because the school had a little girl in this class, she was a 9 year old, and she, the school, this child, the child was hyperactive, and the school wanted her placed on a stimulant and the parents were resisting. And the parents were resisting because they had read up about possible side effects etc., sleep problems, aggression, and so really what the school wanted was for me to convince mom and dad that the child should be placed on a stimulant. So, when I came into the class the little girl was sitting in the front row to my right, and I ignored her for about the first 5 minutes, thinking that I could demonstrate how easy it was to control this child's behavior by inhibiting it, and of course it didn't work.

And so finally I turned to her and I said "Yes, sweetheart something seems to be bothering you, what's the problem?" and she said to me: "Sir, sir, sir, I can't hear you because of the noise from the fan". So I looked around and there was no fan on the ceiling, but what there was was an air intake vent, you know, fresh air intake vent, and it was making a slight noise. But this little girl had such hypersensitive auditory processing, that she had to work very hard to block out the distraction from the ceiling fan, from the vent. And she was using up so much energy trying to concentrate on me, trying to inhibit a distraction, that she couldn't control her behavior. And what it told us was she was just like my car going up the incline, this little girl was burning 40 liters per 100. I can have two children sitting beside each other, and I've got one kid who's ticking along at 8 kilometers, you know, 8 liters per 100, and guess what? Teachers love that kid. That's the kid that, that's the kid that we're going to smile at, you know it's all unconscious, we're going to smile at him, we're going to encourage him, we're going to say: "Good boy, you did it again!" and then I've got the little girl who's burning 40, and we find it annoying, we find it annoying when this little kid is bouncing around.
Unfortunately our behavior is now going to make everything worse because of the stuff I was explaining before. The more we arouse negative emotions in that child, the greater the strain becomes on the child, everything is getting worse now, when really all it was was a case where this little girl was working way harder than the little boy beside her. When you think about stressors, we tend to think of you know, like, what kinds of stress could a child have, but we now know, we have tons of research now showing us that the stress on a child; it might be environmental, it might be familial, it might be biological, it might be the stress of finding bright

lights or loud noises, or noises, or just the presence of other children requires an enormous amount of energy in order to inhibit these distractions. The key for these children is under no circumstances do we want to be punitive with that child, do we want to try to control, discipline that child, shame that child, instead what we want to figure out is what are the loads on this kid and what can we do to mitigate them.

Shanker – introduction self-regulation (1:57)

Coping & Competence – 1.1 Self-regulation

The key to understanding self-regulation is that it is a capacity that develops post-natally, it's a capacity that develops essentially in the first five or six years of life, and it's for that reason, this is the critical reason why we are so concerned about the early years and about early child development.

So how does a child develop this capacity to self-regulate? The short answer is that a child develops the capacity to self-regulate by being regulated. A child is engaged in almost non-stop interactions with their primary caregivers in the early years of life, and the caregiver serves as a sort of external brain who is regulating the child, whose brain is still quite immature, quite undeveloped, and exploding in the early years, and the caregiver has to perform this regulatory function for the child because those systems of the brain are only slowly developing in the early years, and it's through these constant back and forth interactions with their primary caregivers that the child begins to develop the capacity to do if for herself.

The child begins by being regulated to self-regulate, the way it happens is that the necessary information is being delivered into the parts of the brain that are coming online in the early years of life, so for example, the dorsal lateral prefrontal cortex which Adele Diamond studies so carefully, we know that this goes through a massive growth spurt between ages of three and five, but it's essential that during those ages the child is engaging in regulating experiences in order to deliver the necessary information to this maturating brain system so that the child can begin to take this over for themselves.

Shanker – mental health (3:03)

Coping & Competence – 1.1 Self-regulation

Now we have this huge and constantly growing body of research tying for example at one o'clock, internalizing disorders: so problems, you know, anxiety disorder, depression, mood disorder, tying this into significant challenges in self-regulation. It's the same with, the next wheel, externalizing disorders, these are, you know, conduct disorders, aggression, bullying, and now we're seeing this as somehow fundamentally tied to problems in self-regulation. This is absolutely critical, imperative for the revolution that's occurring in how we understand, reframe children's behavior, because if it's a problem in self-regulation that lies at the heart, for example, of a child with a conduct disorder, it means that what's happening-that child is a challenge in the first level that we talked about when we looked at the levels of self-regulation namely their arousal regulation, their autonomic nervous system, it's not a problem that their inhibitory muscle is too weak that this needs to be disciplined, this needs to be strengthened through punishment and reward, no, no, it's because the child's nervous system is under, it's been drained too much- too many stressors. And what's happening is the child does not have enough capacity, enough resources to deal with further stressors and that's what triggers the impulse, that it represents what I believe is a truly profound revolution in how we try to, if not prevent, at least dramatically mitigate these kinds of problems that we see at two and three o'clock, these problems of mood disorder, these problems of behavior. We're not going for management, instead we're going to try to understand the challenges on the child and then reduce them.

So the next two wheels you're still in the realm of classic abnormal psych so we're looking now at risky behaviors, so the child's vulnerability as they grow older as they're an adolescent to things like gambling, drugs, and here again we have a growing body of literature saying that what we should be looking at with these children is their self-regulation, what we should be trying to do is trying to figure out is the child chronically in an alastatic load condition, is the child chronically hypo or hyper-aroused, and if the child is than rather than trying to target the specific risky behavior that concerns us like, you know, alcohol or whatever, we want to figure out why is the child in this load condition, how can we reduce it, and thereby naturally see the inclination for the risky behavior naturally dissipate.

Shanker – obesity (3:52)

Coping & Competence – 1.1 Self-regulation

The next hub is obesity, so we know that this is a very serious problem now, 17% of our children are obese, 34% are significantly overweight, five-fold increase over 25 years. So we've tried lots of these campaigns with very little success, very little effectiveness now, where we're going to educate these children on healthy eating or the need to exercise. The problem of obesity really doesn't have anything to do with will-power, in fact, introducing the concept of will-power makes everything worse, and the reason is that when we look at the stressors on a child, when we look at the sorts of things that are draining the child's nervous system, one of the biggest is negative emotion, negative emotion has a huge draining affect, and that's things like anxiety, frustration, shame.

So now, if you start telling the child, or unconsciously conveying the message to the child 'you're obese because you're weak, you're obese because you lack will-power to resist that extra donut', whatever it is, now this child, on top of everything else that this poor kid is struggling with in life, we've now saddled this kid with strong negative emotion, which is going to further drain the system, so we're doing the worst things we could.

When we look at these kids we're starting to see a fairly significant pattern, the research is still at a very early stage, but what we're seeing is a recurring theme of poor sensory integration. And we're seeing a lot of kids that have poor sensory integration, and it may have something to do with modern life, it may have something to do with, as we look at the drivers of strong self-integration, the biggest driver is play, the biggest driver is physical play, it's under conditions of physical play where the child is driven by strong positive affect, the fun of playing, and play is the most energizing of anything we can do, it's the opposite of a negative emotion, it fuels the system, under this strong affect-driven system, you know fun, curiosity, whatever it is, the child is constantly stretching his body, the child is constantly doing things that create this integration, that create; the brain responds to the challenges we place on it, but if I have a child now that's spending an inordinate amount of time watching a video that's supposedly going to make him bright, and not playing, not running around, not exploring, not discovering, on top of everything else what we're doing is, we are, we are short circuiting, we're blocking those necessary physical experiences which drive sensory integration in the early years of life.

Now this poor kid is locked in a vicious circle because of the poor sensory integration, that child is going to avoid physical experiences as he starts to enter preschool or kindergarten. This is the kid now who is going to be drawn to things like the video game, and so now everything is starting to exacerbate, he's avoiding those very experiences namely running around, playing, etc., which we know, of all the things we've studied, have the greatest effect on balancing the self-regulatory system.

Shanker – parenting and temperament (2:13)

Coping & Competence – 1.2 Individual differences

Basically what we want to look at is what does the dance look like if I have a permissive mom, an authoritarian mom, or an authoritative mom and we want to pair that with different kinds of children? So we look at, we have different temperament variables, so we look at the highly reactive child, the highly seeking child, and so the idea here is that a) we will see certain kinds of patterns emerging between these, you know, particular profiles, so let's say permissive mom parent with reactive baby, but then of course all of our research here is driven by the fundamental question: how do we help?

Well in fact now we've got some very interesting science starting to be done on parenting and it's telling us a couple of things: first of all that there's a huge cost in parenting, that parenting is stressful, and we even have research that's now showing us the health costs associated with a highly demanding child. We also have some research showing us that not only is there a post-natal brain explosion in the child there is one in the maternal brain. Her brain is growing also, quite dramatically, in order to cope with the extra demands involved in raising a child. If I have a highly reactive child or I have a child with colic or, it's no wonder that parent stress is going to go way up, and we might see certain patterns of parenting emerge as a defensive mechanism. Rather than pathologizing the parent what we want to understand is how can we reduce, by studying these things, how do we reduce the strains on the dyads, can we help the dyad become self-regulated and then the answer is that the better the dyad becomes self-regulated, the better the parents are self-regulated, the better the child is self-regulated.

Shanker – self-regulation and self-control (3:49)

Coping & Competence – 1.1 Self-regulation

One of the questions that we've been asked over and over again is how does self-regulation relate to self-control, in fact a lot of people confuse the two, and we know from some research that started to be done in the 1970's and has been followed ever since, that children around the age of 4 start to differentiate in their self-control. What does that mean?

Well, an American psychologist called Walter Mischel designed this classic experiment where you say to a child: "Well you can have one marshmallow now, or if you wait until I return in 15 minutes I'll give you a couple marshmallows". And then you watch the children Now, think about this task first of all. This is a classic psychology task where really it's designed to create an anxiety, so what you're doing is you're leaving a child alone with a temptation in front of them, and you know, the promise of a future reward if he can control his impulse to grab the marshmallow.

So, what do we learn from this task? Well it turns out that about 30% of all 4 year olds can wait, and around 70% can't. So that's interesting, it's telling us that children are starting to differentiate in their self-control already by the age of 4. Then Moffat went a step further- what are the long-term implications? Well, we know that the children who wait, the 30%, score on average 201 points higher on their college entrance exams. We know that they have much lower incidence rates of physical and mental health problems, much less vulnerable to, much less vulnerable to risky behaviors, drugs, alcohol, much more likely to engage in pro-social behaviors, have a family life, earn more money, they'll have a better life.

So, for developmental scientists that's both fascinating and disturbing. We want to know okay, why? Why do these 30% have good self-control? We do these other 70%, why do these other 70% suffer? So we did some interesting things. We took the 30% who do well and we tire them. We tire them with just having them do arithmetic questions, which is very tiring for a little kid and then have them re-do the test. And guess what? They can't wait. And then we took the other 70% and we rest them up. We rest them up with active stretching and yoga, and deep breathing, and soft music, and have them re-do the test, and guess what? A majority can now wait.

Okay, so what's going on? What's happening is the more drained we are, the more anxious we are, then more vulnerable we are to impulses, the harder it is to control, the harder it is to delay gratification. So the point is let's figure out what the drains are. I think what the Mischel task is telling us is that the reason why children are differentiating at the age of 4 is because they're dividing into those two groups I mentioned before- the 30% are the kids that are burning 8 liters per 100, the 70% are varying degrees the kids that are burning 40 liters per 100. And so what we have to do is if we want them to develop self-control, and we have all this research telling us how important it is, we've got to figure out why are they burning 40.

Shanker – Shanker Self-regulation Method (3:17)

Coping & competence – 3.1 Understanding feelings & behaviours

There are five elements and the five elements are reframing behaviour, so everything you and I have talked about. Distinguishing, for example, between misbehaviour and stress behaviour, between oppositional defiance and what we call 'angstbeisser' which is what a cornered animal does when they're threatened. So we have all these distinctions and they're very important and reframing ourselves, reframing my own impulses, reframing my own- recognizing that these distinctions that we're drawing for children are every bit as relevant for ourselves or whoever.

The second step is recognizing the stresses. And really what we mean here is deepening our understanding of not just overt stresses but hidden stresses and often it's a sort of tandem exercise between reframing and recognizing. The better you get at reframing, the more you start to recognize. The better you recognize, the more you reframe also.

Then we talk in the third step about reducing stress and so there are many, many ways of doing that. To give you a very simple example, if a child is finding it very stressful in a noisy classroom and this is one of our major stresses for little guys, there are very simple techniques for reducing the stress. We have used headphones, earplugs, a quiet area in the classroom, a quiet area in the hall. So there is all kinds of ways of reducing stress once you actually know what the stresses are and here we emphasize that every single child is different. And equally, so what's stress for one child may not be for another.

Then the next step is we talk about reflecting and really what we want the child to learn is we want them to develop their awareness not just of when they're over-stressed. We want them to learn to recognize when they're becoming over-stressed, when they're getting close to that point of being over-stressed in order for self-regulation, the last step, to be really successful. The last step is responding. In order for the fifth step to be really successful, it's very hard to do much when you've gone past your point, when you've lost control or whatever, when you've had a meltdown. I mean think about the toddler who's had a meltdown. There's not much you can do at this point other than just soothe them. Is it possible to actually get a toddler to understand when they are approaching that point? Yes it is. Well if I can do it with a toddler, I can do with a teenager.

Shanker – self-regulation model (3:11)

Coping & Competence – 1.1 Self-regulation

The heart of self-regulation is really the autonomic nervous system, and there are two systems that are counter-balancing each other, the sympathetic nervous system and the parasympathetic nervous system, and you can understand this in terms of a simple analogy: the sympathetic nervous system is a system that supplies energy to meet various challenges, various demands, the way the body works is that if the body's going to direct its energy to meet some challenge that the child is trying to master will say, that energy has to come from somewhere else, and typically what happens, and we know this now from some wonderful research done by say, Steve Borges, what happens is the energy gets re-directed from the systems that are regulating your internal states: your temperature, food resources, so all of that, all of those resources get shunted over to those parts of the brain that are going to deal with this challenge, well you can only do this for long before the body starts to suffer, you can only concentrate for a problem for so long, or try to deal with some sort of stressor before the body starts to get hungry or tired or, and the body sends out a signal: now it's time to stop, it's time to rest, it's time to recover, and that's when the parasympathetic system kicks in.

The parasympathetic system is essentially a braking system, and this is essential to restore the body's equilibrium. So we have these two forces that are counteracting each other: one is like a gas pedal and the other one is like a brake pedal; when a child is really self-regulating well, we call is optimal regulation, when a child is going really, really well, there's a sort of seamless shifting back and forth between these two systems- the body spends some energy and then it recovers to prepare itself for the next challenge, whatever that might be, when a child starts to get into an allostatic condition, it's a condition where the balance between these two systems is a little bit out of whack, it's because there's been too many stressors, the child is constantly putting his foot on the gas pedal, and because of that, constantly putting his foot on the brakes. Brakes, we kind of think of as having brake pads that can start to wear out, essentially if the child has too many stressors, then he's activating his parasympathetic system, his braking system, the inhibition system a little bit too much, and this can have long-term consequences, it can have long-term consequences for how well that child will respond to stressors, physical and psychological, throughout the lifespan.

Shanker – self-regulation, self-control and the brain (1:25)

Coping & Competence - 2.3 Emotional learning

When we study self-control, when neuroscientists study self-control, we're really interested in a fairly specific part of the prefrontal cortex, the medial prefrontal cortex. When we study self-regulation, what we're really interested in is the sort of flow between the limbic system and various parts of the prefrontal cortex.

It could be the medial prefrontal, it could also be the dorsal lateral prefrontal or the ventral medial. But we have one specific system when we're looking at self-regulation which is the anterior cingulate cortex and by focusing on that it has two ends to it, two sides.

And when the child is in a state where they can in fact exercise self-control, the one side lights up. It's kind of blue on your imaging. When the child is in a dis-regulated state or what we call a "red brain state," the other side is. So you can actually see, you can actually study self-regulation and whether what you're doing is enhancing the child's calmness by seeing which side of this ACC is lit up. It's fascinating stuff to see.

Shanker – stress behaviour versus misbehaviour (1:40)

Coping & Competence - 2.3 Emotional learning

In our neural lab we were studying the anterior cingulate and when the prefrontal cortex is in control and you look at the images, they're all blue. And when the child's in a state of high arousal and very little capacity to control impulses for example, it's all red. Blue brain referring to when prefrontal is dominant; red brain referring to when limbic system is dominant.

Looking back at all the work that we did with the families, the one issue that came up more than any other is, "What exactly is this difference, this distinction between misbehaviour and stress behaviour?" So misbehaviour is in fact the blue brain behaviour. And what that means is that the child was capable of acting differently, of making a different choice, that the child knew what he or she was doing and really decided to disregard the possible consequences. Stress behaviour is a red brain behaviour. And stress behaviour means that the child had very little awareness of what he was doing or why, really did not choose to act the way he did and could not have prevented himself. These are really strong, powerful urges that come up from the limbic system.

Shanker – studying autism therapy and brain changes (2:01)

Brain Development – 2.5 The social brain

And when you think about it, that means that these kids are kids that have a lot of trouble with social interactions because also, social interactions revolve around what Stanley Greenspan and I call emotional signals. For example, facial expressions: with your facial expressions you're sending all sort of messages to whoever you're talking to that you're angry, happy, interested, bored. But the kids that we work with have a lot of trouble picking up this information; they have a lot of trouble attending to those parts of the face, the hands, the head that we use to send these messages to each other.

So when we look at a typically developing child, we see certain parts of the brain lighting up as the child processes this information. And we are particularly interested, in our lab, in what's going on in the anterior singular cortex. When we look at our children with autism, what we see is relatively little activity in those parts of the anterior cingulate that should be processing that information. Well for us, this was a tremendously exciting discovery because it gave us a sort of neurobiological benchmark that we could use, in addition to all of our behavioural measures, to see how effective the therapy is. So, we begin very intensive therapy, and we use a form of therapy developed by Greenspan called DIR and this is particularly useful for our purposes for two reasons: one is it is a therapy you can perform on very young children, preverbal children; and the second is, it's a therapy which focuses on the child's social/emotional capacities which are precisely the elements that we are interested in.

Shanker – studying the brain (2:20)

Brain Development – 2.5 The social brain

There was a dramatic breakthrough in the kind of research that developmentalists are doing a couple of years ago when Don Tucker created dense ray EEG which is a system that allows us to get a fairly in depth look at the cortex of fairly quite young children, in fact we can look at newborns. And the way you do this is, you have what is in essence a bathing cap that is dipped in a saline solution that you put on the child and you have either 128 or 256 electrodes that enable us through something called Source Modeling to get a fairly good picture at the way those parts of the brain that regulate emotion …

What we can look at is those parts of the brain that regulate emotion and see how these are interacting with the more cognitive parts of the brain. In our own research we are particularly interested, right now, in young children that have been diagnosed with Autism or Autistic Spectrum Disorders. And we give these kids a very intensive form of therapy and we want to discover two things. First of all we want to know is the therapy actually effective and the second thing we want to know is does the therapy produce measurable changes in brain functioning.

So, to do this, the very first thing we have to do is to get the kid used to wearing the bathing cap and with young children with autism this is certainly challenging but we've been, our head researcher Jim Steven, has been remarkably successful in getting these kids to wear the bathing cap. And then we want to see is there something distinctive about how they are processing certain kinds of information at the very beginning of the program, before treatment has begun. And we do see some striking patterns emerging now. One of these is that the children have a lot of difficulty processing emotional information.

Shanker – supporting self-regulation (3:43)

Coping & Competence – 3. Supports for coping and competence

How do we take the lessons that we were learning by working in this intense, therapeutic environment, and transform it into a model that could benefit every single kid, and here we had a brain wave and I think we'll share credit for this 50/50, and the brain wave was 'you know what? There's no reason why Early Child Educators can't do this, there's no reason why they can't have these skills, and in fact we'll go a step further: maybe, if you were to, if you were to teach this stuff to Early Educators and teachers, maybe you would see the same effects in them that we see in our parents. In other words, would it be the case that the better a Teacher, and an Early Educator, begins to understand what self-regulation is, the less stress they will feel in what is an extremely demanding job.

So we began to test that model too and we've done this in a study that's been going on in New Zealand for three years in Christchurch, and is now resulting in a university course, and we've made some very interesting discoveries in this, the first one is 'yeah, they can do it'. The first one is that it turns out that the more a teacher understands this, the more a teacher can begin to create an environment that enhances self-regulation for all children. So it might be the physical environment, she might want to look carefully at her, at the colors of her classroom, what she's putting on her walls, what kinds of desks, it might relate to the kinds of simple techniques she can introduce into a classroom to help a child really start to become a little bit dis-regulated, so these might be things like: little exercise thera-bands which a child can stretch or being able to get up from their desk and go onto a little swiss ball, the simple things that are very effective. And so what we're seeing as we do this study is, let me say three really, really interesting results, the first one is the kids do better, so yeah, the teachers get this, and in fact we can't keep up with their demand, they're constantly pestering me now, they want to read more and learn more, once they see it, they are as eager to learn as my therapists are, so that's good.

The second thing is that the teacher; that the whole environment in the classroom changes, it becomes a self-regulated classroom, and now we have some tools where we can measure this, and it turns out that the criteria for a self-regulated classroom, a group of children, are not what you might expect. It's not that the classroom is quiet, that everybody's doing the same task, the criteria for a self-regulated classroom is that the kids are in level four for long periods of time. And so a self-regulated classroom might have an awful lot going on in it, but when you look at it you'll see that every kid is happy and every kid's on task. And the third thing that we learned which is absolutely fascinating is the teacher's starting telling us that they wanted to do self-reports, and they all said the same thing that their own self-regulation was enhanced dramatically

Shanker – the Milton and Ethel Harris Research Initiative (5:18)

Brain Development – 2.5 The social brain

So in the year 2004, Milt and Ethel Harris created this institute: The Milton and Ethel Harris Research Initiative at York, and we had several mandates, Milt wanted this to be a state of the art developmental/cognitive-neural science institute, so the idea was that we would work with young children with autism, young children between the ages of 2 and 4, and we would look at the full spectrum of kids with autism, so not just high-functioning but any child, and we would use a method of intervention developed by Stanley Greenspan whose been my partner, was my partner for many years until he died a year ago, and Stanley's method is called DIR, and essentially the key to DIR is that you take teams of therapists to work with the child, and those teams will have a speech-language therapist, and occupational therapist, mental health specialist, psychologist or if necessary psychiatrist, nutritionist, and we do very intensive work with the child for two hours a week.

Now, the way the program works is that we are convinced that the key to helping these children learn how to self-regulate, and by learning how to self-regulate how to enter the social world, we're convinced that they key is mom and dad have to be the primary deliverers of this. So the way the institute works is the parents literally have to sign a contract, and the contract stipulates they will do a minimum of 20 hours per week applying the things that they learn with us in their two hour session, and in exchange they'll get free therapy for a year plus all of our tests, etc. When we started this we were very concerned about how parents would respond to, you know, this is a fairly demanding commitment on their part, in fact our parents have done on average about 24 hours a week, you know it's close to 4 hours a day, every single day, and so we thought we better measure parental stress before, during, and after, because even if the program worked it wouldn't be a long term success if parents found this too great a burden.

And to our great surprise, not only have the children done extremely well, so what we've seen is that the kids to begin to self-regulate significantly, I mean, optimal regulation, and we see significant, meaningful changes in their social behaviors. We see significant, meaningful changes in their ability to initiate interactions, their ability to engage in shared attention, we see significant changes in their overall affect, their happiness, and basically they become happy, and they become committed with their parents.

Well what was happening with mom and dad, that was our other big question, and to our amazement, we saw a huge drop in parental stress, so even though they were doing all this work, their stress dropped, and their overall stress dropped, their parenting style starts to change, so what is going on here? What is going on here? Well, we've talked a bit about the sort of attitudes that we have to kids with various problems like obesity, or behavior, and once you start thinking in terms of self-regulation, you're really trying to understand what's happening with a child, you're trying to understand what's going on inside the kid. Why is the kid having this reaction and what can I do to ameliorate it, to avoid it or reduce the load on the child, you're starting to see you

child with very different eyes, a different lens. You're not longer judging the child, you're not angry at the child; you're not seeing the child as being willfully non-compliant. Instead you're seeing that the child is having trouble staying regulated. The reason why we saw this is because of the work we did with our parents in the autism treatment program, as soon as; we had parent after parent telling us the same thing, as soon as they began to understand what was happening with their child, they felt this enormous load being lifted off their shoulders. It was a load that was socially imposed, it was a load that came from, you know, having a child with autism in a society that frowns on the kid that, you know, behaves in a certain way in a supermarket because, quite simply, the child's been overloaded by the bright lights and the cold air and the hard floors in the supermarket, and so they could let all that go, and as a result their overall stress was dramatically reduced.

Shanker – the Milton and Ethel Harris Research Initiatives (5:21)

Brain Development – 2.5 The social brain

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Shanker – therapy and caregivers (1:13)

Brain Development – 2.5 The social brain

So the more we understood this, the more apparent it became that whatever kind of therapy program we employed, had to be one that placed the caregiver at the heart of the delivery of the therapy. And there seemed to be all kinds of reasons for why the caregiver remains so important past this initial period of two years. Perhaps it's because, simply sort of a dose effect. The caregiver spends more time with the infant than any therapist possibly could. Perhaps there's a sort of intimacy factor, the fact that the child trusts the caregiver, but also that the child understands the caregiver's non-verbal signals, their non-verbal cues, far better than they understand anyone else's. Remember we all gesture in very subtly different ways. We use subtly different vocalizations, or looks on our face. So the child has a much better understanding of the caregiver's intentions than anyone else.

Silver – image of child (3:46)

Communicating & learning - 3.1 Guiding and teaching

So image of children is something that we've been exploring a lot in the last three years. We started after I came back from an institute at the beginning of my career as executive director at University Children's Centre. I was inspired to sort of look at values and what do those mission statements, philosophy statements, and vision statements really mean? You know, we have all those, most childcare centres do. Do you look at them? Or do they just stay inside your personnel policies. You know, what does it look like? Are you living those things?

Those were the questions that I started asking. So we had this conversation around values. We did this beautiful activity where, you know, everyone wrote down their top values and you know, we sort of went down from there based on all of the things that we could buy into, that we could agree on. That this is how we live our lives together at University Children's Centre.

So we sort of said, wait a second. Let's stop. Let's pause. Let's think about what we do every day and who we come to live with every day. And we went back to, what is our image of children? So having a conversation about what is University Children's Centre's image of children really changed the practice, the feeling, a bit of the culture. And to really look at how is it that we see children when they come through our doors?

So we really took a lot of time to sort of hone in on the words that were powerful to us. You know, the top that, you know, constantly we're coming out were capable, curious, unique, full of emotion. Those are all the things that, you know, we could all sort of just buy into and say yes, this is true in every group. This is true in every aspect of our work.

So from that point I thought, this is a really great conversation and I don't want it to stop here. I don't want it to fall flat. I want this to drive the program. And it really has. We sat down with those words and really crafted them based on all of the conversations that we've had, and then sent it out to every single team, all of these words. They strung the words together individually within their teams. They submitted them back to us. We sort of said, hey, look, you guys are saying the same thing. Your statements are the same, isn't that weird. You know, it's so strange that you can live in isolation in a toddler room and next door in the baby room they're feeling the same way. Because sometimes it does feel like when you're in a separate classroom that you have these walls built around you and it's really hard. But in that reflective practice we still need to come together and pull things back together.

So we did that by sort of saying, these are the statements that you've created, what can you all buy into? You know, what is true of your work. And then we had these conversations where everyone was saying, oh, who came up with that? Like, risk is so important in child's play. Risk is so important at all stages. And so we're

making connections between teams, and between locations, because we do have that second location with our school age program and the conversations that came out of that were not only rich, but they were meaningful.

So now we have a lens to see every interaction between - and one of the biggest things I feel came from that is the realization that all the things that we know are true of children are true of every single human and every single early childhood educator that we have here. So we treat each other in that same way. You know, that when you have an interaction, be it positive or not, you have to see the other person for coming for capability, competence, uniqueness and with emotion.

Silver - image of child informs practice (2:24)

Communicating & learning - 3.3 Creating curriculum

So image of children at University Children's Centre is not only a document that we have on our walls, in our policies and in our personnel handbooks. The four true things that we have identified as being the most important are competent, capable, unique and emotional. So when we look at children through that lens we know that in the moment, when they maybe are demonstrating an emotion, when they're struggling with being able to move on to the next task, because of all the things that they're bringing with them in the morning, perhaps, we know that if they're capable of doing something it doesn't mean they always have to do it. It doesn't mean that if a child is upset and, you know, not able to put their shoes on, it doesn't mean that they have to do it every time.

So we're supporting children by being understanding to the unique needs that they might have in the moment, but also recognizing that they don't always have to be capable. They don't always have to be competent.

However, on the flip side of that, educators need to let go of some of those things to know that, you know, when a child comes into the centre that they - they know that - what they want to do most often, a child has a plan, even if they don't come in and say today I'm going to do this. They already have made that plan because children are more reflective than adults. You know, they have more capabilities in that regard, I think. It comes more naturally to them. And I really feel very strongly that within our program and within our day-to-day routine we give opportunities for children to show their competencies, as opposed to teachers to do things because it's quicker, it's easier, and allow children to feel competent and capable by setting the environment for them to do so. By, you know, maybe putting that more heavy work in the classroom even though some educators are nervous by having big hollow blocks in the toddler room because what if they fall if they stack them over four? You know it’s okay to stack them higher because children are going to recognize that they can do it, and educators know the children enough that they can come and support when they know that it might end in a way that is going to take away that capable feeling of a toddler.

Silver – journey of reflective practice (2:23)

Communicating & learning - 3.3 Creating curriculum

Reflective practice is something that we hold in really high regard. With regards to reflective practice and how it impacts University Children's Centre day-to-day operations, we've really started in early 2000, before I actually worked for the organization, and we started a journey towards emergent curriculum. And I think that that was sort of the time that the majority of centres were sort of buying into this way of learning alongside children. And when I joined the team in 2003 we'd already sort of started seeing programs evolve into, you know, moving away from theme-based and into really following the lead of the children.

I was able to move out of a classroom and into a management position as a program coordinator, and at that time it really opened up my opportunities to do more research and to learn alongside the children and families and the staff that we have at University Children's Centre.

So that research and learning alongside in a different role really led me to look at what are the nuts and bolts? What are the, you know, the actual components that make an emerging curriculum function well? And to me at the end of the day in order to have an emergent program, you really need to have a reflective practice. You need to look through each interaction with children, interactions with teachers and also how you're researching what's happening and be reflective on all those pieces.

So we sort of moved away from calling ourselves an emergent program, even though I do still feel that those are the basis of where we've come from, and where we're going. I just feel that emergent curriculum is often used very loosely without real understanding or meaning of what that practice looks like. So in order to operate and to live in emergent curriculum I feel very strongly that you need to have reflective teachers and you need to be reflective in all areas of the organization.

So that's sort of where we started, from that emergent journey moving more into focusing on reflection and interactions and documentation and then now we're at this point where I feel that we can - we can honour what we do by saying we are reflective in our programming.

Silver - reflective practice in action – 3:09

Communicating & learning - 3.1 Guiding and teaching

In Halifax we have such beautiful tree-lined streets and unfortunately from time to time there's reasons to cut these trees down. So the infants were out for a walk and they were really interested in what this company was doing cutting down these huge trees. And the teacher said, can we have a piece of that tree? It's really important to us because we've seen it, you know, and we really want to have this tree in our centre.

And of course the response from the chainsaw operator was…okay. And very hesitant and he said, well how are you going to take this back. And they said, oh we have an empty seat in the stroller so we can certainly - you know, we can figure that out. Of course all the babies had come out of the stroller and then he put this stump in. So it's lived in that infant room for a very long time. So one of the Romper teachers when the children were really interested in hammering and, you know, using tools and that, she came to the babies and she said, you have a really beautiful clean stump. The ones in the playground are wet and dirty. Can we have your clean stump? Because we want to, you know, experience what it's like to hammer into that stump. And the teacher said, of course, what a great opportunity to, you know, to share that experience and tell the story of where the stump has come from, and now it's moved on to be in that classroom. So again those connections between classrooms, between teachers, and you know, sharing materials and ideas.

So I think that the teachers obviously are trying to support the interests of the children to see things that are being torn down and things that are being rebuilt, and really offer them real materials. And parents are certainly supportive of that because they know that in the environment the teachers are there with them, you know, with their safety goggles and all of the gear that allows it to be, well I guess safer, but also more exciting to the children. Because the more construction gear you can put on the better it is.

And I think that, that the parents get excited when there's something that, you know, the majority of the children are really interested in. And who could not be interested in hammering, you know, a hundred nails into a stump. It's pretty exciting. And also the teachers come to me for support to figure out, you know, they really love using a wrench, but we don't know how to do that. Like, how do we figure that out? So fortunately I've been able to - I made them, you know, the board that's in there. It's like a wrench screw board because I thought, oh, you know, guys, I really wanted to make one of these. Let's figure out how to do it. You know, so we sort of problem solved around that so that really they're meeting my needs too by, you know, being creative in a different way and supporting classrooms by offering materials that you can't just go and buy off of the shelves.

So I think that those are the most important and enriching experiences. To really slow down and pay attention to what's around you as an educator and to pick up on those pieces, and to know, where can I collect the things to make this happen, and make this an authentic real learning experience for the children.

Skinner – DNA and epigenetics (2:46)

Brain Development - 1.1 Brain architecture

The DNA is made up of billions of little base pairs that come along and they come together to make up the DNA. There are genes spread throughout the genome and each gene sort of have slightly different function in terms of the protein being produced and so forth in terms of what it does. And so essentially you have all these genes that come together that allow certain cell types to be a certain cell type, like a liver cell will be a liver cell and a neuron will be in your brain and be a neuron because of the certain sets of genes that are turned on at that time. And so that's sort of the way everything comes together going forward.

So epigenetics is defined as sort of molecular factors around the DNA that can regulate how the DNA functions. And usually that means which genes are on and off or at certain times of development how they get turned on and so forth. But basically it's the molecular factors around the DNA that can regulate how the DNA functions completely independent of DNA sequence. It does not care what the DNA sequence is. If there was a sequence dependent then it would be genetics. The fact that it's epigenetics means it doesn't matter what the sequence is. So it's really two different things. And then basically when the epigenetics changes it sort of regulates the stability of the DNA; how often it might get mutations, how it functions and long-term sort of how the genome, sort of all the DNA works. So it's molecular factors around the DNA that regulate how the DNA functions completely independent of DNA sequence.

Now we realize that the epigenetics can chemically modify things around the DNA, can totally silence a gene or turn on a gene, put it halfway in-between, and you'll have these different sets of genes not due to the sequence of the DNA but due to the epigenetics around that sequence as to whether it gets turned on and off. And so essentially it is what's one of the major factors that regulate the DNA. And so just the sequence, just genetics, just the sequence we thought was going to be enough to do all that but now we know in today's sort of science that it's not. It's just a small piece of a much bigger story and with epigenetics and genetics together it works much better-more efficiently.

Skinner – epigenetics and twins (1:33)

Brain Development – 2.1 A Genes and environments

Identical twins which have essentially the same genetics, when they're very young and born they will look alike, they'll have the same health and so forth. But when they get to be about teenagers or a little bit longer or certainly when they become adults, each one of the twins gets different environmental exposures. They may live in different places, they may have different diets, they have different exercise, their lifestyles will change a little bit. So over time then if you have 50 year old twins what's known is that the diseases that the two twins get are generally different. That's called discordant disease. The vast majority of identical twins do not have the same disease between the twins.

If biology was totally dependent on just the DNA sequence then those twins should get the same diseases but that's not what we see. So those environmental influences, those lifestyle changes, diet and everything else will slowly change the epigenetics around the DNA such that it changes what genes are on and off and the physiology of the different tissues so that eventually you'll have a higher susceptibility for this twin to get maybe obesity and a higher susceptibility for this twin maybe getting arthritis when they get old enough. So essentially those discordant diseases is not due the DNA sequence but the environmentally changed epigenetics.

Skinner – epigenetic transgenerational inheritance (7:13)

Brain Development - 2.1 A Genes and environments

So the question is how was it we actually came across this idea of transgenerational epigenetics, in other words an epigenetic mark that occurs in the sperm or the egg that gets transferred for all subsequent generations to come. So it's a form of non-genetic inheritance. Normally we think about inheritance being a replication of your DNA sequence and it goes to your offspring through your sperm or egg and then that's what you inherited basically. Now we realize that an equally important if not larger sort of field is epigenetic inheritance, so the question is where we-how we came across that idea.

So you have to understand most big discoveries in science don't necessarily happen because someone thought about it upfront before they even got into it. It's usually more a serendipitous observations.
We were studying the sex determination period when a testes or ovary start to develop in the fetus to determine whether it's going to be a male or a female. So I wanted to see what happens if this was interfered with. So we took an environmental chemical in a rat model. We used an outbred rat model, which is just a laboratory rat and essentially did the exposure during that sex determination period for the rat. And then essentially took this forward and then the offspring were born and we looked for any kind of deficiencies or abnormalities in the testes or ovary in normal sex determination. It turns out we found nothing. So this is a really good example of a failed experiment. We did the experiment, we did the whole sort of thing, we got all the results and there was no effect on sex determination.

So essentially the experiment failed, so the lesson is pay attention to your failed experiments because what we then did is we aged that animal out to a year of age and what we found is when they got to be a year of age we saw a whole bunch of the cells that are going to turn into the sperm, they started dying in the testes. Not all of them but there were a large number of them, so there was basically a reduction in sperm number and motility and basically-so when they became adults. So we published that study. So that was all fine and dandy and then what happened was several months later I had a postdoc in the lab. She came into my office and she was very upset because she accidentally bred those pups when they got older into the next generation. You have the F0 mother we exposed, the F1 generation is the pups; so she took the F1 pups when they were old enough and bred them to get the F2, so the grand-offspring from the mother-the original mother. She was upset because we didn't plan that experiment and just accidentally did a breeding. So I said, "Don't worry about it, just go look at the traits, look at the testes in these F2 generation animals". She did and she came back and said, "It's exactly like the first generation, 90% of the males had this testes deficiency".

So of course I didn't believe her and I made her go out and repeat it and we took it out four generations. And so essentially what we did is we found that at each generation for four generations 90% of the males had this testes phenotype. So, that's when we realized there's something going on here that was outside the norm of what we were thinking.

Normally what happens in a genetic inheritance situation was you get a trait like this testes phenotype that may be 90% in the first generation but then the next generation as you bred it out would go down to 50% approximately and then the next generation 50% of that; and so eventually within four or five generations you sort of have lost the phenotype or the trait. So essentially we didn't see that- it was 90% for four generations. So this told me that there had to be some other inheritance phenomena going on that wasn't genetics. That's when it made me start thinking about epigenetics. At the time the technology to study DNA methylation and epigenetics-this was sort of the late/mid 90's-wasn't really good but we did what we could and we found that there was indeed a DNA methylation change. There was a methyl group on the DNA that was different across the genome and it was present in the sperm for the four generations. And so that was our first observation of this ability for the environment, if it causes an epigenetic change in the sperm or the egg, that this has the capacity to go forward for generations to come. Only the F0 generation female was exposed. None of the subsequent four generations had any exposure and so this exposure was sort of causing an effect that was then transferred. The biggest activity, be it for us and many of the labs that have come into the area, is to try to figure out the mechanism for how this epigenetic inheritance works. And we're gaining a lot of speed on that but we don't know all the details, but that's basically what's going on. It's the epigenetics in the sperm or the egg is being programmed and then it gets passed through development processes for each generation.

And so this is this non-genetic form of inheritance called epigenetic transgenerational inheritance which is now a very different thing from genetic inheritance in the environment has the ability to dramatically modify this epigenetic inheritance and then go forward. And so the individual that lives in a certain environment or organism that lives in a certain environment versus another has a way to change its physiology and phenotypes or traits so that it can better adapt to this phenotype or this environment versus this environment. We've known that that process goes on for a long time, we just didn't know the mechanism and it turns to be epigenetics. And it explains huge amounts of things like how rapid evolutionary events occur which we couldn't explain with genetics, where potentially disease comes from, a change in the phenotype, where disease comes from. So lots of things we started to – we couldn't explain before could be explained through this epigenetic inheritance.

So for epigenetic transgenerational inheritance when the germ lines carrying what we call epimutations, these mutations in the epigenome which is – whether it's DNA methylation or other forms like non-coding RNA or other things-when those get programmed they're carried forward and that's the epigenetic transformation inheritance. So we identified it initially in rats. Subsequently it wasn't more than a year or so then some people showed it in mice. And so they thought 'well this is just a lab rodent sort of thing', but then pretty much everybody that's looked in any species they've sort of studied thoroughly has found this phenomenon. And that covers plants, flies, worms, fish, birds, rodents, pigs, and humans today.

Skinner – moving beyond genetic determinism (1:36)

Brain Development - 1.1 Brain architecture

There's a paradigm in science called genetic determinism and the concept is that the DNA sequence is basically the determinate for everything. It's like – I've heard of 'your genes determine who you are'. And so this idea is that genetic sequence allows certain genes to get expressed on and off, certain genes get expressed on and off. This changes how the cell functions, tissues function and eventually the biology of the organism. If there's a mutation in the DNA then essentially you'll have an abnormal gene expression, abnormal physiology and abnormal biology and this is where we thought most disease came from.

Today what we're moving towards is a slightly different concept in that's where; how epigenetics will actually come into play to regulate how that DNA functions. So it's not so much the sequence, it's really the epigenetics will allow us much more elegant control for what genes get turned on and off and then that will actually cause disease, health or whatever. This genetic determinism focus that's been there for 100 years; it was actually started with Mendel, sort of rediscovery of Mendel in the early 1900's. And so we've been studying it for a long time. It's been really critical to get us to where we are now, and genetics is absolutely important. But the epigenetics turns out to be a newer paradigm where it comes and works with the genetics in terms of how things work, much more different sort of going forward.

Slinde – a system for quality (2:48)

Communicating and learning - 3.3 Creating curriculum

I call it the Wheel of Development and really it's - you wouldn't recognize that wheel would you? Putting the children at the centre and then having the actors or the - the people discussing how can we ensure that this is quality provision that we are giving for our children. And this is all done, the discussions are all linked to the aims and the expectations set out in our regulations, the Kindergarten Act and the framework plan.

So, in that discussion there's staff, the parents, the local authorities, the kindergarten owners, and indeed also the children are being invited to talk about are we providing that kind of quality that we really need to have here? It's about planning - the pedagogies that is being acted out. It's about evaluating what is being done and it's about renewal and reflectiveness. And this is the Wheel of Quality.

But what I think is really, really important in this system for quality is actually that it's using the sources of data and research as the knowledge base for this type of discussion. And it's making data and research available to the practitioners, to the staff and parents and owners and authorities in order for having this kind of enlightened discussion. And it's providing on the other side also the tools that can facilitate this type of discussions. So, it's two - one is called, like, understanding where we are. [Norwegian phrase] And another one is about pedagogical documentation, and there is one on collegial mentoring and development across, fellowship of learners across the institutions.

And all these type of tools that has been made available. When we have revised, now, the framework plan, then of course these tools need to be updated. So when I was talking to you about the update that we need to do, it is about the legislation, when the legislation and the framework plan develops, then the tools that we need to have also need to encompass the new perspectives that we have and to be useful in that type of context.

It's fairly new, the system. But it is being evaluated by the directorates, so we will actually expect it to be further developed in the future based on the experiences now in the first implementation phase.

Slinde – importance of local community (1:46)

Ecology of Childhood - 3.2 Strengthening early child development programs

About the solutions that we wanted to find for really having inclusive early childhood education and care, that has to be found in the local settings, actually. And it has to be found also with the support of the local community.

So a lot of what we have seen in terms of having all families coming into kindergarten or barnehage, we need to have this active municipality to do reach out activities and to - to search for the families, to engage with the families in order to have them come. But also, to have the kind of pedagogy that is responsive to what is happening there.

So when we have a framework plan and we have the kind of legislation that we have, we are specific about saying that we want to have quality, but it shouldn't be so narrow as to sort of not allowing for the local variations. And this kind of responsiveness to the local needs, I think it's at the core.
it's allowing for the local autonomy while having national regulations and standards and policies. Because that is really about fairness, isn't it, across the country, and not having the kind of unwanted variations, but having the kind of rights based and flexible variations more sensitive to the needs.

Slinde – Norway and minority language children (3:30)

Ecology of Childhood – 2.2 Early child development programs

A large proportion of Norwegian children take part in early childhood education and care from age one and two. It's lower in the minority language families, the figures. But compared to a lot of countries, it's still very high. So actually, over 40 percent of minority language children one year of age is participating in early childhood education and care. And that goes for, I believe, 70 percent of the two-year-olds.

It's lower than it is in the overall figures, which would be around 90 percent for two-year-olds. But it's still - it's very, very high. And our research, when we did - it's been done a lot of pilots in providing a free core time in areas with high percentage of minority language families. And in these areas, when they have been looking into these areas and seeing how the impact has been of the free core time, what they found was that participation rates among the minority families, it raised - it was going up by 15 percent. And then as it progressed during the years they were using the tests in first grade on reading and math and first and second grade to see whether it had had an impact. And they actually were finding this impact for these children.

The propensity to score low on their reading tests or on the math, it was - it was way lower than for the children who had not participated for many years in early childhood education and care. And I think that is really a good illustration. And I think it's an important piece of research into the importance of investing - but also of making participation in early childhood education and care a kind of universal thing that you do in a society.

So, our minister was concerned with the lower participation rates than in the overall group of children. So, he invited … mothers unions and you know, groups of NGOs and practitioners and researchers to discuss this topic. What is it that does - that we still have discrepancies in participation? And they were pinpointing to structural sort of hindrances like you know, like the application, the way that the application has to be done, like the language being provided, like the kind of pedagogies also.

So, one of the clearest advice from minority language mothers was you need to take care of quality in order for us to come with our youngest children to your kindergartens. And in that way, it really fitted well also with the researchers because they were also pointing to it. It's not about provision. It's about quality provision in order to have the effects that we want to have.

Slinde – Norway's journey (3:29)

Communicating and learning - 3.3 Creating curriculum

It has been a journey. And it started, you know, way back in the 1800s with the asylum movement and Frobel as an inspiration for the - for the development of provision for the youngest children. And I think that these roots, being rooted in the asylum movement, that were about child protection and social welfare, and in addition in that kindergarten tradition of Frobel where you were providing the environments for children's development and learning.

It wasn't until in 1975 that we had a Kindergarten Act, or a 'Barnehagelov'. So, it really took a long time to have the first legislation that were pinpointing the exact institutions that were developed for the youngest children. Not in terms of them being social welfare or child protection, but in terms of being the pedagogical institutions that we have now.

And it took another 20 years to have the second legislation. In 1996, we had our first framework plan for the pedagogical content and the tasks of kindergartens, or barnehage. And that was really a milestone for us, to have a national curriculum framework or framework plan as we call it. And it - it codified in many ways the practice that was already there. It's about the kind of play, the playfulness, the kind of laughs the children have. It was also about outdoor play and it was about social interaction and social development.

So, these kind of topics were running through everything. And then you could have the learning areas such as communication and text or culture, arts and creativity. I was in Toronto last year and I was presented with Canadian pedagogical frameworks and to my mind a lot of the same type of topics is recognizable also here. In 1996 we had our first kindergarten framework plan. It took another 10 years and a lot of development until we had the third revised Kindergarten Act. So, in 2005, again we had a revision of the Kindergarten Act. Again, it was looking into the roles and responsibilities and it was specifying children's right to participation and parents' rights to participation. Which had been there all the time but which was sort of more specific.

It was again followed by a revised framework plan in 2006, it was a clearer regulation. Again in 2017, we have had a revision of the framework plan, and the text have been made even more clear. It's clarifying the responsibilities and the requirements of the kindergartens.

Slinde – Norway's policy framework (3:06)

Developmental Health - 3.2 Shaping public policies

So, the policies for kindergartens or barnehage, it's part of a number of policy areas in Norway, and it's always been. So, it's sort of linked to family policies, it's linked to gender equality policies, it's been linked to social welfare policies, and it's been linked to education policies. Lately since we were moved from the Ministry of Children and Family Affairs and Gender Equality into the education ministry in 2006 that happened, then of course we are - we can see and we can recognize how we fit into this broader, broader picture. It also provides us with a clearer pedagogical mandate. So that's how it links also with the developments in the regulation and the framework plan.

But at the same time, in terms of policies and provision, we have parental leave that is quite extensive. It means that you can have 54 weeks of paid parental leave that can be shared between the mother and father, or the mother and the mother, and the father and the father, it all depends. Having so many weeks of parental leave is really, really, I think providing the children also with - and the parents - with a solid start.

In terms of participation, hardly any children participate in kindergarten before the age of one. Whereas that used to be, of course, previously a demand when the parental leave was much shorter, and it wasn't the parental leave but the maternal leave actually. So, and workforce participation is rather high among mothers and fathers and when we did a survey some years ago it was over 80 percent of the young mothers and fathers that were currently working.

So, it really is important for them in order to combine - combine having a family with participating also in the workforce. And the kindergartens play a pivotal role in supporting the families and in providing good environments for their children. So, I think it's parental involvement, parental cooperation is very, very important in order to ensure the quality of what is happening there.

And school starting age is six years. And in Norway it's a lot about having the schools ready for children. And regardless of where the child is. So, we do not test children for whether they are ready to start school. It is for the school to be inclusive and they should be prepared for every child. So that's a policy, clear policy position.

Slinde – using data (2:05)

Developmental Health - 3.2 Shaping public policies

I mean lot of the discussions have been lately about the institutions being required to report data into the sort of having good statistics. And being a government official, I love statistics actually. I think it's one of the most interesting things to read, because it - it depicts developments.

In Norway we have had a large expansion since 2004, when we had a - which was another milestone. We had an agreement in parliament about now finally reaching the goal of full coverage.

So, a lot of young children were entering the kindergartens, the barnehage. And looking at those figures it means that, okay, if we have this large proportion of one-year-olds, of two-year-olds in our kindergarten, in our barnehage, how does this affect the way we work pedagogically? What will we do? What should we be aware of?

So, this kind of data is really helping and mirroring what you need to be looking at. The same goes for the proportion of minority - children with minority background, you also really need to have that kind of discussion. And for the local authorities. They need to see the developments in their municipalities and then they can put in the resources where they are needed.

And for us on a national level, what we saw was of course, we need to do some work in order to revise the pedagogical framework, the framework plan. Because we need to make sure that the way we are phrasing now, our regulation, is really meeting the needs of the children that are there now.

And then combining it with available research in a format that can be read by practitioners, staff, parents and local authorities.

Soderstrom – Many Baby Study (3:03)

Communicating & Learning - 2.1 Early language development

So, what we're doing right now is-this is part of a much larger study where babies from lots of different language communities were tested on their preference for infant-directed speech. And all of the original study was done in English infant-directed speech. And now we're testing babies in other languages, like in this case Norwegian.

[Norwegian spoken in background]

There's been a big change in how we think about doing infancy research. So in the old days it was each lab was doing its own little research project and you'd have – you know, it's very hard to recruit infant participants and it's hard to run those studies so we'd have these very small samples. And it's just really hard to know when you're comparing across studies, one that was done in Winnipeg and another one that was done in Paris. When you see differences, whether those differences have to do with the differences across those populations or across the languages or the ages of the babies or something about the differences in how the methods are run across the different labs. And they're also really small samples which can limit our ability to interpret what we find.

So, there's been this push to collect data in a much grander scale where we're sharing our procedures across different labs. In the study called the Many Baby Study that actually is close to 70 laboratories who were all collecting data for the same project. So, we can look at differences that have to do with subtle differences in how you run the method or differences in language or age at a scale that you just couldn't do with these sort of individual laboratory tests.

When you're running a study that is international and large scale like this, one of the challenges is to figure out if, because it's a language study, what language you're going to actually do the test in. So, in general about, I'm not sure of the exact numbers but somewhere probably around 90 percent of published studies are in North American English. So, there's this huge bias in our understanding of how language development works towards the peculiarities of the English language. And our European colleagues are always, for good reason, complaining about this. So when you do a grand study you want to be cognizant of those biases but at the same time because you're trying to base the research on the literature that's existing it – you know, you don't want to sort of randomly do a study in Norwegian without understanding how that fits in with the existing literature.

So, the original large scale Many Baby Study was done with the English language. But now we have this problem that we've now reinforced that bias. So that now there's an effort to do some of the same – to kind of repeat some of those tests with other languages to expand on our understanding of how this works not just in English but also across languages which is really, really important.

Soderstrom – message for parents (1:23)

Communicating & Learning - 1.1 Acquiring language

I think that the take-home message is that infant-directed speech or kind of the funny way that we talk to babies is definitely not bad. You know, sometimes there's a message that gets out there that you shouldn't talk baby talk to babies and I don't think the literature supports that perspective. There's a lot of good reason to believe that these characteristics and how we talk to babies are important. And there's a robust literature supporting the idea that the more babies get in terms of language input, especially sort of that one-on-one kind of interactive experience, is tied to language development.

So it does make a difference. But I always temper that a little bit with this knowledge that there are differences – there's individual differences and there's cultural differences in how we interact with babies and I would never want a mother to feel that you know, oh I must talk – I must engage with my baby all the time or I'm harming my baby. It's just something like anything in parenting that you know, it's good to interact with your baby, it's good to turn the television off. You know, it's good to read to your baby, but you don't want to make parents feel like they're – you know, they must be on all the time for their babies. People are real human beings. They live their lives and there's - every family has its own style.

Soderstrom – methods for studying infants (1:38)

Communicating & Learning - 2.1 Early language development

There are a lot fewer studies these days that use sucking procedures. Those are usually done with the really young infants, so newborns or first few months of life. And typically, again you would associate the sucking with a stimulus, so a sound or a visual display would appear when they suck. And when they – sometimes it's directly measuring like the faster they suck, you know, the more of the stimulus they get. Sometimes it's more of a criterion where if the sucking goes to below a certain rate then something would change. So, it's done in a couple different ways with the sucking procedures.

I think part of what's going on is that the visual measures with eye trackers have become so much better than they were even a decade ago that the eye-tracking techniques have kind of taken over even with very young babies where sucking procedures and also brain imaging techniques as well although they're much more expensive.

The sucking techniques require a lot more training. Maybe not than the brain imaging. But the sucking techniques require a lot more skill and training and sort of the equipment setup is more complex than some of the – especially the newer eye-tracking packages that are fairly plug and play. So, I think there's kind of a shift that's happening in the research community away from the sucking techniques and there just aren't as many labs that are sort of trained in those methods anymore.

Soderstrom – moral choice study (4:56)

Coping & Competence - 2.3 Emotional learning

[Dr. Soderstrom:] So this was a study that was originally developed by a researcher named Kiley Hamlin and what she was able to show was that infants would prefer shapes that were behaving in a way that was kind of a nice way of behaving over shapes that were behaving in a mean way. So, it was a way of being able to show that fairly young infants have this - some sort of degree of moral understanding.

[Researcher talking to parent:] Basically, she is going to be watching videos in whatever comfortable position you want to be in as long as she is just facing that middle screen, she's good to go.

[Dr. Soderstrom:] So, in this case what we do is the babies come in and the mother just closes her eyes so she doesn't see the visual display. And the baby's sitting on the mom's lap and then there's a visual – a video of a shape trying to get up a little hill and then you have two other shapes. One of the shapes is kind of pushing the original shape up the hill. That's the helper shape. And then there's a hinderer shape that pushes the shape down the hill. And then after they've accumulated a certain amount of looking to the videos and after they habituate to a certain amount to the videos to show that they've gotten what they want to out of it, then we do a test where we actually present a live three dimensional choice for them of the helper and the hinderer shapes and see which one they prefer to touch.

[Researcher talking to parent:] The second section of this study is a little more particular. So, it's only sixty seconds to choose a toy. So I'm going to come in with a choice board with two real life versions of the shapes from the videos that she just watched and I'm just to going basically see which one she wants to choose to play with. So this one has a bit more of a specific seating position that I'm going to ask you to be in. So, I'm just going to ask that you sit with both of your feet together and your knees together. You're going to hold her equally between both knees. Instead of pulling her back, just have her with her legs dangling over the edge so that she can reach more easily towards the shape. And then just have your hands just around the rib cage. Sometimes if your holding around it's a little bit harder for her to reach as well. So, it's just important during these sixty seconds that you are just being very conscious not to distract her, talk to her and that you are just kind of being her chair. So, try not to position her once you're in that first position.

[Researcher talking to baby:]

Look

Hi

Hi

Hi

Look

Hi

Hi

Hi

Who do you like?

We picked the blue one pretty fast.

Oh, we got the whole thing. Good job!

[Dr. Soderstrom:] And that's actually a really challenging thing with babies, especially the younger babies who might be reaching with both hands. So, there's quite a careful articulation of what counts as a choice.

Of course, it's very important in these studies that the infant's preference is not based on a preference for a triangle or a square but actually based on the videos that they were watching. So, there are a number of things done to prevent those biases. One of them is that they – when the original shapes were designed there was a lot of work put into making sure that they were equally salient or interesting to the babies in terms of their colours and their size and everything. And then in the design of the experiment, we make sure that for some babies it's the square that's the helper and for some babies, it's the triangle that's the helper. And also, the researcher is blind to which shape is the helper or the hinderer in that particular study. So, in fact, we don't even know which, whether it's the square or the triangle that was helper or the hinderer until after we do the data analysis. It gets recorded by the computer but we don't look at those data until all of the data have been collected.

And then since that original study emerged there's been attempts to replicate it. Some of them have been successful and some of them haven't. So, this research endeavour now is trying to do a larger scale replication because this particular protocol is actually really challenging to do and so when other laboratories were having trouble replicating one important possibility is just that they weren't doing it right. So Kylie is – and some other researchers like Kelsey Lucca and others have been sort of championing developing the protocol in a way that lots of laboratories can learn to do and so you can have a much larger scale replication effort where people are actually being trained by the original researchers and we can see - can this – how well does this replicate outside of those original laboratories.

Soderstrom – recording studies (2:20)

Communicating & Learning - 2.1 Early language development

Over the last ten years there's been a sort of a technology shift that has occurred that has changed the way that we think about understanding the language environment of infants. So in the past when we were studying what babies hear in terms of the speech input that they get, we would go into somebody's home or they would come into the lab and we would record them going about as natural an experience as they can for, you know, an hour or something. And then we would take those back to the lab and you know, transcribe them or analyze them acoustically or something like that. But what happened about ten years ago now, little bit more, was the emergence of technology that would allow us to get a full day's audio recording in people's homes and then do some fairly automated analysis because you know, even getting a ten-hour recording isn't really that helpful if you then have to transcribe ten hours because that takes a huge – that's a huge investment. It could take as many as 20 hours to analyze, you know, an hour of recording or more depending on what you're doing with it.

So the development of, you know, better recording technology but also sort of more automated ways of processing the recordings has really expanded our ability to get a real window into infants' real-world language experiences rather than this one hour snapshot where the mom is really attending to the fact that she's in front of an audio or video recorder. Families can really go about their regular day and there really is some reason to believe that although they're not unaware that they're being recorded that they really can get to the point of being comfortable and really getting a real-world snapshot of those experiences. And one of the things that this allows us to do is then to compare different families both within certain communities and across communities and look at the variability both within communities and across communities in how – what are those experiences that infants have. And that can really be important for informing our theory about what is the relationship between what infants are hearing and what they're understanding about language.

Soderstrom – studying infant language preferences (3:46)

Communicating & Learning - 2.1 Early language development

My name is Melanie Soderstrom. I'm an associate professor here at the University of Manitoba in the department of psychology and I run the baby language lab which is an experimental research lab with infants where we look at how babies learn their first language.

We bring babies into the lab and we play speech sounds for them and then we measure their interest in what they're listening to and we use that to learn about what they understand about language, what they prefer about language.

The first study uses a method called the head-turn preference procedure and the idea with the head-turn preference procedure is that we associate the speech sounds with a visual stimulus, just a visual display. And in the old days that was actually a flashing light. Now we do it-usually do it with video screens and so it's a flashing circle that changes to a checkerboard pattern. And it's just a way of measuring what the baby is interested in listening to.

So if they turn their head the speech sound plays. If they turn their head away after a certain amount of time the speech sound stops. And the babies learn really quickly that they can control what they're listening to.

So the baby comes into the lab. They're seated on the mom's lap. The mom is wearing a set of headphones that play kind of a weird mix of music and speech to try and mask what's being played so that they don't accidentally influence the baby's behaviour. And that's really important. And then the experimenter is in another room so they also can't hear what's being played and again bias things. And then when the baby's looking forward the screen on the side comes on. The baby looks to the side and then it changes to the checkerboard and we play the speech and like I said, as long as they're looking towards the screen the sound plays and if they look away the sound stops.

So the longer that they look towards the screens the more interested they are and so we can compare different types of speech. So in this particular study, we're looking at baby's interest in something called infant-directed speech. So the way that we talk to babies that's different from the way that we talk to adults.

It's been known for a number of decades that we speak differently to babies than to adults. And so there's been a lot of research looking at the different properties, the fact that we use a higher pitch and a more variable pitch, the fact that we speak more slowly and with more of a happy, positive affect and a number of other characteristics. And there's a lot of research supporting the idea that this is actually beneficial for babies in learning language. And then together with that, there's also a growing body of research that shows that babies prefer to listen to speech that's in that style versus in the adult-directed style which is kind of more monotone and longer sentences and things like that.

So they're hearing speech that's in this infant-directed speech mode and other speech that's more directed at an adult and we look to see whether they prefer the speech sounds in infant-directed speech over adult-directed speech.

In this particular study, the speech they're hearing is Norwegian because we're also looking at differences across languages and language communities in infants' preference.

We're measuring the length of the looking time on a given trial and if that looking time is longer then we interpret that to mean that the baby prefers that speech stimulus than if they look for a shorter period of time. But obviously, we can't get into the baby's head and this is an inference that we're making. This is one of the things that makes research with infants much different from with adults or even certain aged children where you can actually ask them, "hey, do you like this or do you not like this?" We have to make these inferences based on their behaviour and what can babies do. They can suck on things, they can look at things, they can grab for things. So those are the things that we measure.

Soderstrom – studying the impact of SES on language development (3:23)

Communicating & Learning - 2.1 Early language development

So, there was this original study called Hart and Risley. That was the authors' names. So the Hart and Risley study was ground-breaking in a sense that it was looking at the impact of socioeconomic status on the language experiences of infants. And the original finding was that there were differences in the quantity and the type of language exposure that infants from different socioeconomic backgrounds were exposed to and this was correlated with differences in their vocabulary development. And so this was calculated and the term was coined the 30 million word gap and its had quite an impact in our thinking about how to address social disparities. And so that was done with the research methods of the time and in fact, it was somewhat ground-breaking. I think sometimes people underestimate the amount of effort that was put into painstakingly hand transcribing all of those many hours of recording and so, you know, sometimes people criticize it was a small sample but gosh, there was years of effort that went into producing that result.

So that was kind of a seminal finding. Since then there's been quite a lot of research looking at the impact of socioeconomic status on the experiences and the language development of infants and there's a general consensus that there is an impact of socioeconomic status. What is driving that is, of course, the question. And so more recently there's been a debate that's emerged in the field around how we characterize and how we understand the nature of children's language experiences.

So one of the things that's kind of this thing that we're trying to resolve is that on the one hand, you have this very robust set of findings about differences across socioeconomic status. On the other, you have these very strong cross-cultural differences in what's considered sort of normative behaviour between mothers and infants. And we know of communities around the world where the idea of spending time talking directly to your children has, you know, that's just - it's very different. There's the – if you measure it there's just very little actual directed speech in these sort of one-on-one context. And at the current state of our understanding of these things there doesn't appear to be any reason to believe that those – children from those communities are disadvantaged when it comes to language development.
So, on the one hand, we have this robust literature that says that the amount of speech and the quality of the speech that you hear is directly tied to your vocabulary development and measures of language development. On the other we have these massive cross-cultural differences in the quantity and the types of speech that infants are exposed to and bringing those two literatures, these two robust literatures and understandings together in a way that paints a coherent picture, we're just not there yet.

Sokolowski - biological mechanisms of epigenetics (7:25)

Brain Development - 2.1 A Genes and environments

We used to say it's about DNA methylation, adding a chemical mark to the DNA sequence, which changes the expression of the gene or the gene product that's made. But now we know that epigenetic comprises a lot of different biological mechanisms that affect how much of the transcript, that's the RNA transcript, or how much of the protein is going to be involved in any given process.

The epigenetic mechanisms that are studied, that is studied the most in mammals is CpG DNA methylation. And it puts a mark on the DNA sequence and that mark is a little methyl tag, a little chemical tag. And depending on where that mark ends up, if it's near the start of a gene it can turn down-the way you use a dimmer switch in lighting-it can turn down the expression of that gene; it can turn down how much RNA the gene makes. And so it's been classically studied from the perspective of people who have a lot of stress or trauma. And genes involved in coping with stress like the genes involved in the glucocorticoid pathway are looked at and there's methylation marks that end up in the promoter of the glucocorticoid gene which turns down the amount of transcripts or RNA made, which has later consequences for how we cope with stress, our immune system and our health and longevity.

That's only one type of epigenetics, and there's other types of epigenetics that are important and have been studied more and more in the last few years. And from an update perspective one of those types is called histone modifications and here you have always the DNA sequences wrapped around these proteins called histones. That's now it normally lives, and those histones, the DNA is wrapped around and they're all tightly together.

I use the analogy of the DNA sequence being like a hair and the genes being beads on a string so now that DNA sequence has wrapped around these proteins and by that wrapping it all gets very, very much condensed and tight together. That's how our chromosomes look under a microscope. We don’t see a full DNA sequence. So when that DNA sequence is very tightly wrapped it’s very hard for the genes involved to have their DNA transcribed into RNA. In other words gene expression is also turned down. And what happens is that the DNA is wrapped around these histones and now instead of the methyl or chemical tags going on the DNA sequence, as in DNA methylation, they're added onto the histone tails. And here again depending on the type of tag you can have DNA expression turned down or turned up. The one that we study in my lab is a certain histone methyltransferase that represses gene expression. And just like with DNA methylation depending on where it lives, that mark, it can affect the expression of the gene. So it's like DNA methylation, histone modification, but instead of modifying the DNA it's modifying these histone tails that the DNA is wrapped around.

It is important to know that when it comes to gene expression it's not just one mark. There's a landscape of different epigenetic modifiers sitting on that gene and near that gene. And depending on what that landscape

is, the gene will either open itself to be transcribed to make RNA or it will close itself more tightly. And when it opens itself there's something called transcription factors that come in to start the transcription of the DNA and those transcription factors are the things that are responsive to the environmental experience. And so when you have the DNA really tightly coiled there's no room for those transcription factors to come in, bind the DNA right before the start site and make the RNA.

The main point is that in the past we thought there was just one epigenetic modification, the DNA methylation. And now we know there's many, all acting together on a gene with different environmental inputs affecting which ones go where and what the output will be from that gene. We also know that these DNA methyl marks are not only right next to the gene affecting gene expression but they're also found in places we can't really understand all over the genome and we don't know what they're doing but we want to understand that and that's something for the future.

The third kind of DNA of epigenetics is microRNA and they're also starting to be studied and these are just tiny little RNA sequences that attach to any RNA that's made and kind of sop it up so it can't be used. So these little RNAs are affecting, making these gene products not at the level of the DNA to the RNA at the level of transcription, but at the level of what we call translation when the RNA gets made into a protein.
And these microRNAs are particularly interesting because they target lots of different classes of genes. So one little mark of microRNA can reduce the expression of genes involved in sleep or cognition or stress responses or neglect for instance. So, they're a way to study how a whole process might be modified epigenetically so that the genes are changed according to experience. So it could be how sleep deprivation influences cognition, that's one of the things we study in my lab. Or if you have sleep deprivation some people need to catch up when they don't get enough of a night's sleep and other people are okay. And these kinds of things are affected by; regulated by lots of genes but there's also these epigenetic modifiers like these microRNAs that are fine tuning the expression of lots of genes involved in that process.

So those are the three things that are now mostly studied; the DNA methylation, there's different types, some make the lights less on the dimmer switch, some turn up the lights, here the lights means expression. There's histone modification which does much the same thing but it's not on the DNA sequence, it's on the histone tails, the little marks. And then there's microRNAs that are being studied because they seem to be important, kind of acting in a hierarchy high up affecting lots of other genes. And there may be more that are still being discovered. So it's not that DNA methylation as we thought was a mechanism for nurture, there's many different epigenetic ways that our experience gets embedded in our biology and now we're trying to understand that.

Sokolowski – cell differentiation (1:06)

Brain Development – 1.1 Brain architecture

So all the cells in our body have the same DNA compliment, and any individual arises from one sperm and one egg, and all the cells have the same DNA except for sperm and egg that have half. And so one question is: how is it that we end up differentiating how is it that some of our cells end up as liver, some as kidney, some as brain: And this has to do with how the environment around the cell talks to the DNA in that cell. So some of the DNA for some of the genes gets expressed- when you're making a liver cell, and other genes get expressed when you're making, for instance, a brain cell, so that's within an individual how there's differences in gene expression that give rise to different kinds of cells. The DNA is the same in all cells but the gene expression, the proteins that are made are different.

Sokolowski – gene (1:33)

Brain Development – 1.1 Brain architecture

A gene is a very long piece of DNA, so each of our chromosomes have long pieces of DNA, like a very, very, very long hair and it gets wrapped up together and that's our chromosome. And when we look, stretch out that long piece of DNA and divide it up, there's genes that are made of that DNA, so at one part of that long hair is the beginning of the gene, and one is the end of the gene. So the gene is a piece of our DNA and they're along this hair like beads on a string, and each of our chromosomes have a series of genes that are on them. And those genes may encode for, may contribute to differences in eye colour, differences in whether you have a hitchhiker's thumb or not, I don't, you can look at your thumb, some of them bend back a little more. Whether your earlobes are attached or not, whether you can roll your tongue, which I can, others can't. And so these genes can influence variation in those traits, and so you may have a gene that influences one of those traits, like whether you can roll your tongue or not, and that's one gene that is encoding tongue rolling, and one person may have one variant or one form of the gene, which is to roll your tongue, and one another may have the other variant of the gene, which is to not roll your tongue. And so for traits like that, the gene in a way determines the outcome, but for most other traits: behavioural traits, developmental traits, there is not a one-to-one relationship between the gene and the trait.

Sokolowski – gene by environment interaction (2:21)

Brain Development – 2.1 A Genes and environments

So gene-by environment interaction is, because of those differences in the alleles, you have different sensitivity to the same environment. So you have one environment, that let's say is an adverse early environment, and one individual that has a certain form of that gene is really not affected by that adverse environment, and the other is highly affected. So for the individual that isn't affected this is like the child who can move from place to place, family moves, different situations, lots of stress, and they seem to do okay. Whereas the other child that has early adversity, is highly sensitive, the gene expression, the amount of protein that gene makes with that particular DNA polymorphism, the gene expression is altered in that case and the child is highly vulnerable, But if you water that child carefully and you nurture it, the child will do exceptionally well, but if that child experiences a very bad adversity early in life it's very hard on them.

So genes contribute to sensitivity or susceptibility to environmental adversity, also to environmental enrichment. We're not just talking about adversity here, and so it's useful to think about enrichment because we don't want to focus on problems or diseases, we want to also focus on promotion and prevention, so promotion of good health.

So gene-by environment interaction is when you have different alleles or forms of a gene and they respond differently to the same environment. Now you could also build it in and say well, we have different environments, and poorer and a better environment and you could ask how do those individuals perform. Now of course it's more complicated than one gene. There are many, many genes in the genome, over 20,000 in humans, and some genes have larger effects than others. And that's where we can pull out the effects of certain genes and say, for instance, the serotonin transporter gene is important for sensitivity to the environment in certain situations of early experience, but it is also the case that other genes are also important.

Sokolowski – generational epigenetic transmission (5:14)

Brain Development – 2.2 Nurturing

So one of the exciting possibilities for epigenetic modification is that it may be inherited from one generation to the other, I don't mean inherited in the DNA sequence but the patterns in the way that the chromosomes were wrapped up or marked are inherited. And this would have to be somehow in the germ line, it would have to be in the egg or sperm or both of the parents, because that's what's continued into the next generation and Art Petronis who's a professor at the Centre of CAM-H, Centre for Addiction and Mental Health in Toronto, has recently taken sperm from humans and shown even from one man that the sperm have different epigenetic markings on it so there is some evidence that sperm can be differentially modified. So there is some evidence coming along that it could be that some of the patterning, if you've had a stress as a child and then you have your children, children could pass on the problem that your genes have with being able to cope with stress, so that's one idea.

The other way that it can be translated from generation to generation has to do with a kind of cultural transmission if you like where, and Michael Meany at Mc Gill has shown this with his high and low-licking mother rats, and so in this situation you have a distribution of behavior for a mother rat, so mothers look after their babies by licking and grooming them, and people have said this is synonymous to how humans look after their babies; we don't lick and groom our babies but we cuddle them, talk to them, touch them, and so the touching from the licking and grooming is similar, and certain mother rats tend to exhibit high-licking and grooming, so they would be at the high end licking and grooming continuum, and others exhibit low levels of licking and grooming, and when Michael takes those mothers and then looks at the babies, if the babies when they become mothers have had experience of high-licking and grooming, they tend to be high lickers and groomers, and similarly if the low-licking and grooming mothers have babies that have been low-licking and groomed, and they have babies, they tend to be low-licking and grooming and so that information alone doesn't tell you whether this is due to genetic polymorphism, or a kind of epigenetic process, but he did a cross-fostering study where he took two pups from a high licking and grooming mother, and put those pups in with a litter that was with a low-licking and grooming mother, and then he did the opposite, he took two pups from the low-licking and grooming mother and cross-fostered them with the high licking and grooming litter. So you have a pup that is from a high-licking and grooming mother that was "genetically" from high-licking and grooming, and then you ask "what does that pup do when she's a mom?" and you find that the main thing that matters is what your foster mom did, so if you were high-licked and groomed, whether it was your biological mother or your foster mom, you will be a high-licking and grooming mother, suggesting that it's like a kind of, it's due to the environment, it's a cultural kind of inheritance, it's not, there's not a genetic explanation for it, and he has shown that this is epigenetics.

So you can have grandmothers that were very high stressed, and had low-licking and grooming compared to high, and then you can give mothers, mothers who were all high-licking and grooming right, or all in the middle,

and you can still see some carryover from the grandmother in some cases so, in other words, how much is going to be transmitted in this cultural way, and how much can be modified depending on experience- we don't know.

And so there is evidence that it's translated from generation to generation. We don't know the biological mechanism, if you look at epigenetic marks, which are methylation patterns we all have them, twins differ in them, we all have them, and it isn't that they're totally stable through your life either, they come and they go so it's very new. And in humans it's very difficult to study because unlike mice and flies we can't take a part of the brain and say "well, what's happening in that part of the brain?" We have to use blood, and when we talk about gene expression it changes depending on what tissue you look at so the blood, information from the blood may not be at all representative of the brain. So, there's suggestion that these things can be translated but the biological analysis of it is still, I would say more work needs to be done. And the thing to keep in mind with epigenetics again is it's not fixed, so epigenetics is not deterministic, just like DNA variation is not deterministic, and you can enrich and change the epigenetic marking.

Sokolowski – nature vs. nurture controversy (1:48)

Brain Development – 1.2 Experience-based brain development

So now we know that it is not nature alone, and it is not nurture alone, and we can't even add them together and say, "well it's 30% nature and it's 70% nurture" that is also wrong. What it is, it's an interaction between nature and nurture, and interaction between genes and the environment, and that's an interplay between the genes and the environment, and I'll talk to you more about how the environment, the genes are listening to the environment, and that's what we mean by epigenetics - the genes are listening to what the environment is doing. And as a result of that listening more or less protein is made.

So one thing that we need to wipe out of our thinking is deterministic thinking. We don't talk about a gene for this, or a gene for that, and if you read in the paper that there's a gene for being violent, someone has quoted the scientist wrong, or the scientist was describing their research wrongly, and the work that we've done in my lab really shows that even in the cases where we have a single gene, we've identified it, we cloned it, we know there's two DNA variants, it predisposes animals to behave differently, all we have to do is alter the early environment of those animals and we completely change the gene expression, and also the behavior. So the allelic variation does not have a fixed effect in any way on the phenotype, and we can also go in later in life and boost up the gene expression in animals, and cure, or if you like- or restore the more normal behavior or that level of behavior, so that's what the common, modern day way of thinking, it's about gene-by environment interactions, the nature/nurture controversy is dead.

Sokolowski – research (2:53)

Brain Development – 2.1 A Genes and environments

So, that's hopefully helpful to have shown you the difference between gene-by environment interaction, epigenetics. Gene expression is involved in both, we have differences in gene expression because of gene-by environment interaction arising from differences in the DNA sequence, and how they respond or are sensitive to the different environments. We have differences in gene expression, epigenetics, arising from essentially the DNA being covered up so it cannot be expressed.

This new science of gene-by environment interactions and epigenetics is at its infancies, at its early stages, it's hugely exciting because of providing us an explanation if you like for nurture, and the interactions between nature and nurture, or genes by the environment, but in terms of the biological mechanism, it's really at its early stages, and it's; I would say too early to translate this directly, there may be some implications but we don't, for instance, want to go into the school and check the genes and say "this kid should be on this regime or that regime, I don't think we would actually ever be in that situation, on the other hand, we do have these exquisite individual differences between children, and we may be able to understand more about their background, and more about their pre-dispositions. How stable are these epigenetic patterns? We know they're stable but to some extent, do they last for a lifetime, people have said that this adverse early experience sets this path for later health, learning, functioning in society, we know that if you've had early adversity you have a higher chance of heart disease, obesity-related problems, obesity, but not everyone has that, just like there's some individuals who are smokers all their life, and so we want to understand those individual differences.

So the stability of those marks, those epigenetic marks, and how they translate from one generation to the other is not known, and then finally what is really not known is how the DNA polymorphisms interact with the epigenetics from a biological point of view, and that's happening as well. So we would like to have an understanding, of an environmental landscape- how it changes through time, how that environmental landscape interacts with the genetic, the genome, which is, the genome means all the genes, and then how they interact together to create neural circuits that interact with the environment. It's a huge job but we're getting there and it's probably, it is hugely exciting.

Sparling – conversational reading (2:08)

Communicating & Learning – 3.3 Creating curriculum

Conversational reading is a form of reading to children and one, again, this is done on a very individualized basis. With children under age three it's done one on one; the teacher sits down with one child and reads a book. She reads a book individually to every child every day. And often teachers who are doing this well will in fact read several books to each child every day and if you're working with children that are age three and four you read books in pairs, so you read to pairs of children and you have a special technique that you use in reading called the three S strategy, and the three S's are see, show, and say. The teacher tries to get the child to see the things on the page, the child is responding to the teacher's request to look at a certain thing, and the teacher's checking does the child look at that thing? And then show, you're trying to ask the child a question and the child gives you the answer by showing something on the page, by touching, pointing, covering, tickle, sometimes we say "tickle the monkeys toes," or "cover the tiger there on the page, and then by saying, and there we ask the child "what's this person doing" "who's this" and we ask things like "can you tell me what's going to happen next" so we're getting verbal answers.

What's important about this is this reaches right down to the tiniest babies up to quite advance four and five year olds when they're giving a whole paragraph answer and the very young child is simply giving a look or a point and teachers learn to be very skillful in understanding all these child behaviours and it makes conversational reading quite different from different kinds of reading because it reaches right down to very young children and those young children give meaningful responses on every page. The teacher does something, the child does something. The teacher does something, the child does something.

Sparling – educational program (1:03)

Ecology of Childhood – 2.2 Early child development programs

We believe that the results of this study, especially the first Abecedarian study and the big one we did on low birth weight children are the results of the educational program. That is the elements I talked to you about what happens in daycare. The reason we believe that is because we were careful for the kids who didn't get into the program, the ones who were in the control group, to see that they had good health care, to see that they had good social services to make sure that they got nutritional supplements for example during the first years of life such as iron fortified formula and so forth. Those elements that we tried to equalize out across the two groups, and that really makes us believe that the effect was much more reasonably associated with the educational program.

Sparling – enhanced caregiving (2:32)

Communicating & Learning – 3.3 Creating curriculum

The third element of the Abecedarian approach is enriched caregiving. Enriched caregiving is something that most people do intuitively, but we're bringing this to a higher level of consciousness and a higher level of intentionality and a greater frequency in terms of interactions. Enriched care giving is the care act, whatever you're doing – changing diapers, providing food, taking the coat off, combined with some teaching content, and those two things: care plus some educational content equals enriched caregiving.

Many people do this intuitively, but people who use the Abecedarian approach do it very purposefully and they do it frequently; they do a lot of this kind of talk and a lot of this kind of interaction. You talk about the colour of the coat as you're putting it on, you count the sleeves, you talk about the process of zipping the zipper; the zipper is going up, up, up, and you talk about the food, you name the food and the textures and you ask questions about the shape of the bowl. I was just doing a training today and teachers were asking questions about, they were talking about "let's count the spoons on the table," and they counted the spoons and they counted the forks and then they said "oh, spoons and forks together, are utensils, oh, how many utensils are there?"

So they are doing this right in the process of caregiving, and it's really interesting. I've talked to people who have used this and they say far from making my job more work for me, this makes my job easier because the kids are more engaged and they're more happier and so forth, and so they're learning at all times. Kids always learn during care giving, but they may only be learning that the adult just wants me to hurry up and finish my meal, or get that coat on quick, but they can learn good things and important educational content and the importance of enriched caregiving is that there is so much time that necessarily is taken to caregiving, and the way we make our program strong and powerful is by linking our education and our care, and our care carries the education forward. I often say there's no extra time needed. You were going to use that time anyway for caregiving, so you just add that extra component of education to it.

Sparling – introduction to abecedarian (2:23)

Ecology of Childhood – 2.2 Early child development programs

The Abecedarian project began in 1972, and at that time we were trying to scientifically determine if we could make the prediction that poor children and disadvantaged children would not do well in school not be true; make that prediction not happen. And, in fact, that is what we found. We could take children that by all previous experience not done well in school improve their school performance to a very substantial degree and have them have a better outcome both in school and in life.

The key components are educational components. Now, we believe that any program needs to have good health care and good social services and good transportation surrounding it, and Abecedarian had all those. But the key components are childcare, full time childcare year round, fifty weeks a year, and that has a certain set of characteristics. Those characteristics is that it uses learning games, it uses conversational reading, and it uses enriched care giving, and within all those three elements it uses a language priority. That is it focuses first and foremost on language as the most important thing that we do as early childhood people.

Abecedarian is an ordinary English language word, it comes from Latin and it means someone who is learning the rudiments, someone who's learning the basics. It's kind of a fun word. When I was a second grade teacher I used to use the word abecedarian on the first day of school and write on the board I am an abecedarian, I am someone who's learning the basics. And by the way, if you say kids, look at that word, what do you see about it, they see it has a b c d at the beginning, and that's no accident. The word has been created to refer to the alphabet, so it refers to the alphabet or someone who is learning the rudiments, but I want to be sure that I say that we don't necessarily teach the alphabet, it's just the alphabet is a metaphor for the basics, the building blocks.

Sparling – follow-up (1:35)

Developmental Health – 2.3 Monitoring early child development

There were 111 children in the original Abecedarian project. By the way, there have been a series of randomized studies, actually 15 different randomized samples since the first one. But the first 111 children, about fifty something in each group, were randomized at birth and we did our intervention throughout the first five years of life, and then we continued to measure after that. For example, after measuring across five years of life, we measured at age eight and then at age 15, and then at 21, and now we've measured at age 30, those results have just been published, and lo and behold this coming summer, the summer of 2012, our first child will reach 40, so we are now planning the age 40 follow up, and there have been over 200 journal articles and juried journals published on this group of, these children in the original group and the other groups that followed it.

I should say, too, that we're still following about 95 per cent of that original group at age 30. That is really a remarkable retention rate and we've worked really hard at that, but we've also been very lucky in doing that

Sparling – health findings (1:56)

Ecology of Childhood – 2.2 Early child development programs

One of the unexpected findings of the Abecedarian program is that when we measured at age 21, there were a variety of health outcomes. Children were healthier, they were less likely, oh, no, they weren't children anymore, they were young adults. They were less likely to have symptoms of depression.

They were more likely to have a healthy diet and a healthy lifestyle. They were less likely to use drugs and they had less risky behaviours. Now that was not something that we targeted, but I think what it shows is that if your life is going better in general, if you're succeeding in school, if you manage to go to university or a substantial proportion goes to university, then the odds of your taking care of your health, of having better health outcomes just increase. It was kind of an indirect effect and we're rather intrigued by that. When we study at age 40, we're going to look especially to further health effects because many of the groups we've studied have predicted poor health outcomes as they age, and so we think that may not be so true for this group.

There has been one economic analysis happen of the Abecedarian program and it basically shows that for every, when we measure at about age 21, for every dollar spent there's about a four dollar return to society, and that, by the way, is largely from the educational effect. We haven't even begun to get the health effects of that so when we go further out to older ages, it's very likely that those numbers will go up in terms of the return on your investment.

Sparling – learning games (3:12)

Communicating & Learning – 3.3 Creating curriculum

Learning games is a set of 200 activities and beginning in the 1970s we tested out all of these activities individually to see if they would work, see if they would produce change in children, see if teachers liked them, see if children would respond to them, and those have been written up and teachers use these like a cafeteria of ideas that they choose for each child so that each child has a little plan and this particular week he's working on these two learning games and next week he's still on those two but he's added a third one and so forth and so forth. So that each teacher's planned individually for each child and you would see during the day many things that would be quite familiar. You'd see circle time and you'd see centers and so forth, but you would see the teacher kind of settling in with one child at a time or sometimes just two children at a time, usually no larger than that, and taking a short period of time with tiny babies that might be only thirty seconds or two minutes, in an older child it might be five minutes, and those little episodes become key moments in the day that have what I call powerful teaching, special learning habits during that time and it supplements all of the other free play and social interaction and so forth that happens.

There are three basic kinds of learning games. The first is the kind that you enter in progress play. You wait until you see something happening in the child's play, and then you say ah, that relates to a certain learning game I have in mind, and you join that play and you add some value to that child's play.

The second kind is the kind where you have something in mind, but it's not likely to happen during the day, and so you invite the child into play, "come and play a game with me." And of course you always look for a time when the child is not super busy with something else, and so you're not interrupting something. And the third kind are games that are seamlessly incorporated into care giving. In fact, the person who wouldn't know much about learning games would hardly be able to notice most of these games. The teacher is doing certain things, but they've done it so seamlessly within the day that it doesn't appear planful, but in fact it is on the teacher's part.

You might have a particular way that you are going to do a little copying of structure. Sometimes you use duplicate blocks. The teacher gets some blocks just like the child and you might just see a teacher sit down by a child and say "oh, I want to build a tower like yours," and you wouldn't even realize that that was a game that she had actually intended to do ahead of time when that opportunity came up.

Sparling – Manitoba (1:51)

Ecology of Childhood – 2.2 Early child development programs

Something interesting is happening right now in Manitoba. This is, as I'm talking, it's March 2012, and one of the centres in Winnipeg, the Lord Selkirk Park Childcare Centre has teamed up with Healthy Child Manitoba and Red River College to implement an Abecedarian Centre. This was one of the four new centres that was in, I'm not sure exactly how the government decided to create four, but they decided to put four centres in needy areas, and this was one of them, and the centre is just brand new; it's only been operating a couple of weeks and I've spent this entire week training the staff on the Abecedarian approach. They had adopted the Abecedarian approach before they had opened and so they have now spent an entire week thinking deeply about this project and they're going to be implementing it and there is a research design with randomization at the beginning and the Healthy Child Manitoba is supporting that, and this is going to be an interesting episode in Canadian early childhood research because its taking a proven model, saying can we put it in practice here in a very needy neighbourhood, and a neighbourhood that's a very high percentage of Aboriginal kids, and can it be successful and will it produce the same results, or better. I think they may be more successful than we were because we're a little bit smarter than we were back at that time, but they're taking all of the same elements and using an updated version of it and I'm very optimistic about that

Sparling – outcomes (2:37)

Ecology of Childhood – 2.2 Early child development programs

The Abecedarian studies have over the years taken IQ as one of the important measures that we did. It's not that we believe that IQ is such an important variable over other variables, but it's known to relate very well, very strongly to school success. If you manage to be a little smarter, you're likely to do a little better, and it's kind of a measure that predicts how kids are going to do in school and in life, and we have been able to see for example in the very first study and in the study I mentioned for you about the low birth weight babies that the IQs of the children in the experimental control group diverge rather quickly and between 18 months and 24 months, somewhere in that period of time, the two groups become significantly different so that one group has an IQ advantage over the other, and by age three, the difference is quiet large, quiet striking. Now in the groups that we have followed for a long period of time, such as the original Abecedarian group, when we measured IQ at age 21, which is the last time we measured it, we still had a significant difference. By that time, it had been about a 15 point IQ difference, it was only about five points by that time. The groups has kind of merged together, but the difference between five IQ points meant the difference in terms of going to university of a 23 per cent graduation rate for the experimental group and a six per cent graduation rate for the control group. In other words, a four fold increase.

Now, what's interesting about this, remember this is a very at risk group. Twenty three per cent University graduation is what Canada has for the general population. It's what the United States has for the general population. It's what Australia happens to have for the general…this is a very at risk group, and that's their graduation rate. It just shows that just because you were disadvantaged; you came from a poor family or poor neighbourhood, you don't have to do worse than the general population, and I think that's very good news. It shows that early childhood can have a lasting effect, not a small and temporary effect.

Stanley – nurturing (3:18)

Brain Development – 1. Early brain development

Well this is where I think it's very exciting because we now know more about brain development and child development than we ever have. Of course we used to have it intuitively. When I talk to some of our Aboriginal researchers and colleagues, the equivalent of your First Nations people, they say, "Why are you researching this? We've know about this for 40,000 years." And my answer to them is: We seem to have forgotten it. We seem to have forgotten how important those early years are to develop the knowledge and capacity to interact with peers, to have a capacity to understand your environment and to be able to be competent within it. And to actually have these wonderful social interactions that enable you to be an intellectually and socially competent person. We have forgotten how important those early times are. When you think about it, it's logical. It's so logical.

But what's been very important and exciting is the neuroscience research, the brain research, which has shown how incredibly important the brain development is, both in utero, in the womb, and in those first three, four, five years of life. While there's obviously quite an important genetic component for the big picture of what a brain looks like, we all have cerebellums, we all have a cortex, we all have an amygdala, we all have a temporal cortex and so on. But how those parts of the brain work together and actually become competent in utero, in those first few years, are due to those social environments around a child. It's that sensory input; it's about how these peers, these parents, these environments around that child; auditory, visual but also the ones that turn on the frontal cortex, particularly the nurturing environments, the appropriate response to crying, the breast feeding, the reading to the child, the talking, the really stupid things you say to a child, which is in fact developing that child's understanding about how social interactions occur. And in fact we know now that that turns on specific neuro-endocrine pathways in the brain. It's wonderful stuff.

So that gives us a very strong message about the importance of these interactions and teaching parents about these interactions. They're not just inconsequential; they are vitally and centrally important to how that child will be at age 10, at age 20, and even at age 50 and 60. And so this now is where the solutions come in. That we have to provide for parents, for communities, for families, for governments, local, state, that's your province, and federal governments, this knowledge. Because the whole future capacity of that child, that family, that community, that nation, is dependent upon how effective it is that we turn on these pathways and make these brains connect properly. Exciting. Simple. Gorgeous.

Stanley – understanding population data (2:33)

Developmental Health – 2. Developmental health research

I think the understanding of population data by people who are working out there with families and children actually is important for several reasons. Firstly, it justifies what they are doing. Because they may think they are just working with one family and focusing on the children of that family, to actually put that child on a trajectory to good health. But in fact what is now coming out is a very powerful reason for doing early child intervention and early child development intervention is the powerful impact this is having not just on this individual family but on whole communities. And if you think about that, when you get whole communities that are performing better because the kinds of things that are enhancing family functioning are enhancing community functioning. Then that's a pathway to national development and prosperity. So it is actually very important that people who are working just one-on-one understand the power of this implementation for the effect on the population.

The other thing that I think is exciting for people who are working at the practice level is that it's from population data that we have actually worked out these pathways to resilience. It's actually by grouping together these population factors, these risk factors, these protective factors, looking at how children and families interact in a population sense that we get enough numbers to say Yes, these are important trends, this isn't just an isolated example of how this works in one family. We've actually got this from thousands and thousands of families and thousands and thousands of children. We've looked at how parenting practices, the kinds of parenting that you do, we've done that in thousands of families.

We've looked at trajectories of thousands of children with mental health problems and we've been able to go forwards by looking at these big large population databases to look at these trajectories in longitudinal data to mental health outcomes. We've been able to take case control studies where you take cases of children with mental health problems and controls of children who don't have those problems and work backwards through the population data to say What were the powerful influences and I think that's very important for people who are working in practice to know that this is very, very rich data that's informed what they're doing. So it isn't something that's not backed up by the strongest of evidence.

Stanley – universal programs (1:58)

Developmental Health – 3.2 Shaping public policies

I know this in Canada and other developed countries and increasingly will be so in developing countries, is this increase in the social gradients, the increase between the haves and the have-nots. In our society, for almost every single of the outcomes that I've talked about, if you look at juvenile crime, you look at educational achievement, you look at mental health problems, you look at some of the complex problems, health problems affecting children, birth weight, everything you can think of. Not only is there a gradient, you know, that there's a lesser amount in the people who are most advantaged and a higher amount in the people who are disadvantaged; that seems to be increasing. Now there are messages from that. One is that this is an unacceptable aspect of any developed country that says its social justice and human rights are important, but it also says that the middle group of kids, that's the most numerous group of kids, this isn't just about disadvantage.

You know so when we look at mental health and income distribution in our children in Australia it's 15 percent in the most advantaged going up to 45 percent mental health problems in the disadvantaged. But it's still 15 percent of children in the most advantaged group in Australian society. So the middle and higher income groups still have these problems. So it's about universal programs rather than: oh this is just a problem of poor kids or marginalized kids. This is a universal problem. So that means that we shouldn't just be providing targeted programs, although there is a place for those with children with special needs that are important. It's about the whole of society and that's also an important point to lobby the politicians about. Because you know it is actually about their kids. It's about everyone's kids.

Suomi – aggression in monkey play (1:37)

Coping & Competence – 2.6 Play, coping and competence

Well, Rhesus monkeys, as they are growing up, as do most primates, engage in a great deal of play behavior during their juvenile years. This behavior takes a variety of forms and there are interesting gender differences that emerge very early, just as, that parallel gender differences that have been reported over and over again in studies of human play. In particular, males tend to engage in rough and tumble play; the monkey version of a wrestling match, if you will. Whereas female monkeys show much less contact in activities in their play and instead prefer chasing games and patterns of affiliation. So if you look at the play patterns, males not only play a little bit more than do females, they play more physically and more roughly.

Also, very quickly on, these monkeys, when they're in mixed-sex groups, begin to segregate themselves by gender in terms of their play partners. Basically it seems to be a consequence of the fact that a male will play with just about anything that moves whereas a female usually will not respond to a rough and tumble play initiate from a male but will readily respond to an initiate from a female. So basically females are choosing partners and males are left with only other males with whom to play. But the developmental course, emergence and developmental trajectory of these gender differences are virtually identical to what you see in human children if you take into account the fact that the monkeys grow up four times faster.

Suomi – alcohol abuse (2:22)

Brain Development – 2.2 Nurturing

This is work done in collaboration with my ex-student and now long-term colleague Dr. J.D. Higley, who's a senior scientist at the National Institute of Alcohol Abuse and Alcoholism, Alcoholism and Alcohol Abuse, it's NIAAA. And Higley and others have devised a technique where they provide monkeys in their familiar social group or sometimes, in some studies, in strange situations, but typically in their own normal social group, and with the opportunity to participate in what you might call a monkey happy hour, where for an hour a day over an extended period of weeks or longer, these monkeys have access, unlimited access to eight or nine percent alcohol solutions sweetened with Nutrasweet or aspartame, a non-alcoholic beverage sweetened with Nutrasweet or aspartame and plain tap water. So these monkeys are not fluid-deprived in any sense. And most monkeys do not, like most humans, don't initially like the taste of alcohol; the sweetness. And under these circumstances some monkeys will consume considerably more alcohol than will others. Again, in exactly the same situation.

And what we found is that there are both genetic factors and early experience factors that predispose some monkeys to consume more alcohol than do others. And we also see interactions between these genetic and environmental effects. So most spectacularly, what we have been able to demonstrate is that monkeys who carry a particular variant of the serotonin transporter gene, what we call the short allele version of that gene, if they are peer-reared, these monkeys drink alcohol to excess. But if they have good mothers, those monkeys with the same short allele, short version of the serotonin transporter gene, actually consume less alcohol than do others in their peer group. So what appears to be a genetic risk factor for excessive alcohol consumption for individuals with poor early environments or less than optimal early environments, may actually be a genetic protective factor for individuals who carry the same gene but who have very good early experiences. And this is a perfect example of what I would call the gene-environment interaction.

Suomi – maternal buffering (2:25)

Brain Development – 2.2 Nurturing

Well, because we're able to determine the genetic background of our monkeys and describe, and indeed, control their environmental histories we are in a position to see whether there are so-called pure genetic effects and whether there are so-called pure environmental effects. And indeed, when we do straight forward analyses like those, yes we find that most, many of the things that we're studying, both behaviorally and physiologically, have highly heritable components and they clearly can be modified. These patterns can clearly be modified by differential early experiences. But when you run analyses that take both into account, what stands out is that pure genetic effects and pure environmental effects are the exception rather than the rule. And instead what we see is interactions between these effects so that individuals who have the same genetic background but grow up in different environments turn out quite differently and individuals who have different genetic backgrounds but are in the same, grow up in the same environments, also have very different outcomes.

And indeed, these fall into some very interesting patterns and perhaps the most interesting pattern is a pattern of what we call maternal buffering. Over and over, for many behavioral and physiological variables, we find that individuals who carry genes that would put them at risk to have less optimal outcomes under relatively poor environmental circumstances; when those same at-risk monkeys grow up with good mothers they turn out perfectly normally or in some cases even better than the so-called normal Rhesus monkey developmental trajectory.

And so we're impressed by the fact that good mothering can allow individuals who carry genes, to carry genes that would otherwise put them at risk to continue to carry those genes and indeed, pass them on to the next generation but with no obvious behavioral problems. On the other hand, if something happens that compromises, in nature, a mother's ability to take care of her kids that have, carry those genes, then a variety of problems will emerge. And so this is why we talk in terms of maternal buffering as one of the primary driving forces behind the gene-environment interactions that we're able to observe and document.

Suomi – NIH primate studies (4:17)

Brain Development – 2.2 Nurturing

Well, the laboratory, the primate laboratory that NICHD helped me build is in rural Maryland about 40 kilometers outside of Washington, D.C., in the countryside, where there's plenty of space. And so we're able to have some of our colony of Rhesus monkeys housed outdoors in multi-acre enclosures that simulate their natural habitat and allow us to have them grow up in social situations that are equivalent to what you find in the wild. We also have monkeys growing up in smaller housing pens but that still allow for relatively normal socialization. And we have a neonatal nursery where we hand rear infants from birth onward and then socialize them with peers or our artificial mothers and peers before integrating them into the larger social group. We have our own self-sufficient breeding colony so that we can basically, through selective breeding, control the genetic background of our animals and we're able to control various aspects of their rearing environment. For example, whether they grow up with their own biological mothers or whether they are foster reared by unrelated adult females or where they grow up with no parents but with access to peers.

And we're able to study these animals longitudinally, essentially throughout their entire lifespan, which for Rhesus monkeys in captivity can go as long as 30 years or more. And we also, because it's essentially a captive colony, we can sample biologically either saliva samples or blood samples or cerebral spinal fluid samples, at any point during development for all individuals. And before and after certain environmental events such as introduction to a new social group, removal from an existing social group, exposure to novel toys or things such as that. So we are able, basically, to control the genetic and backgrounds in environmental histories of our subjects and this gives us an enormous advantage over those who are trying to do parallel work at the human level. Because we can watch these animals essentially every day of their life, rather than only periodically, such as every three or six or nine months that's typical in most human studies, we can actually see developmental changes occur before our very eyes, rather than having to guess what's happening in between sampling periods. This also is an enormous advantage over most human development studies.

And finally the fact that our monkeys grow up four times faster than do humans allows us to see a generation in four or five years instead of having to wait 15 or 20 as would be the case for humans. So these advantages allow us to address directly questions that are of considerable importance at the human level but which for practical and ethical reasons are often difficult to study directly with humans and that's the mission of our laboratory.

We also, I may add, have access to two field sites. That is, sites where Rhesus monkeys are free-ranging in wild or semi-wild conditions. One of them is an island off the coast of Puerto Rico where 50 years ago a group of Rhesus monkeys were brought over from India and their descendents have been thriving ever since. These monkeys are essentially undisturbed except for an annual roundup by the veterinary staff at the Caribbean Primate Centre who runs that operation. It's at that point we can get biological samples from these monkeys

and we can watch them as we do with our own colony throughout the year. And we have access to another semi-free ranging colony that lives on a sea island off the coast of South Carolina.

So we are able, with this range of environments, to study monkeys in natural habitats, in our best efforts to replicate a natural habitat where we have some control over who's in that group, and under somewhat more restricted circumstances in the lab that still are able to provide certain essential components of what a Rhesus monkey's world is normally like.

Suomi – nurturing foster mothers: foster mothers (3:23)

Coping & Competence – 2.2 Family relationships

Well, we have two sets of findings. One that was done some years ago before we knew specific genes that might be involved, taking monkeys that were genetically shy and fearful, and these are monkeys that under normal circumstances develop patterns of behavior that look very much like the behaviorally inhibited children that Jerome Kagan has been studying for the last two decades. These are individuals who, under challenging, under normal circumstances or familiar circumstances show perfectly normal behavioral and physiological patterns, but when they are exposed to model or moderately stressful circumstances, they show excessive amounts of fearful and anxious-like behavior; they show heightened arousal of a variety of physiological systems including the hypothalamic-pituitary-adrenal axis, evidenced by higher levels of cortisol, ACTH and CRF, a high unstable heart rate; greater norepephrine turnover; and some compromising of the immune system. These monkeys, who make up about 20 percent of the population in the wild and in our colony, also are at risk for developing depressive behaviors if the challenge they are exposed to is more extreme, and later in life they show excessive consumption of alcohol.

When we carried out a cross-fostering study, we took these monkeys whose genetic backgrounds suggested that they were going to develop into this bio-behavior phenotype, and we put them with unusually nurturant foster mothers that we call super moms. These were females, multiparous females, whose care of their own previous offspring indicated that they had very, established very firm and secure attachment relationships, they were very supportive of their infants' exploration, they showed very low patterns of punishment, and when we cross-fostered our high-reactive, as we called them, infant monkeys to these foster mothers, we were quite surprised because the up-tight monkeys, as we characterized them, actually showed supernormal development. They were behaviorally precocious, they actually explored more than their counterparts. During the weaning process they showed lower levels of disturbance and distress behavior in reaction to their mother's punishment and they became unusually adept in social situations of seeking out help when they needed it. So they were, became very good at establishing functional social relationships with others in their social group. And ultimately they rose to the top of their group's social dominance hierarchy, whereas high-reactive infants reared with normal mothers or cross-fostered to normal mothers usually end up at the bottom of their group's social dominance hierarchy. And most interesting to us, when the females, high-reactive females who were cross-fostered by the super moms, grew up and started having kids of their own, they showed the same patterns of maternal care that they received when they were infants. Thus they were capable of passing on the advantages that they had accrued from their own foster mothers onto their own offspring.

Szyf – intergenerational epigenetic changes – epidemiological evidence (1:42)

Brain Development – 2.1 A Genes and environments

So absolutely, stressful experiences of a parental generation can pass through such a mechanism to the offspring generation, and maybe down to the grandchildren generation. And there's epidemiological data that suggests that this could happen. I mean interesting examples are the Dutch famine during World War II that now phenotypes are being seen in the third generation of mothers who were exposed to famine when they were pregnant. There are other examples where we have multi-generation transmission of responsiveness to stress. I believe it's also an adaptive response because once environment changes, you want to send that signal down the line, life has changed and therefore we need another kind of genomic response to the environment. So perhaps it's a mechanism by which one generation can send signal to the other generation.

However, when the anticipated environment and the real environment are not the same, that becomes maladaptive, and you can get disease. So stressful behaviour is very useful in a war situation and adversity situation, but becomes useless in a peaceful situation. So when we have a misfit between the programming and the real world, then we have trouble. So we believe that disease is also associated with this process, but when there is a misfit between the adaptation and the real environment.

Szyf – intergenerational epigenetic changes – two mechanisms (1:48)

Brain Development – 2.1 A Genes and environments

There is some evidence that epigenetic marks can pass down the generations. And there are two really mechanisms how it can work. One mechanism is behavioural inheritance. For example, rats that were low licked by their mothers will become low licker mothers, and we know there are epigenetic marks that go with it. These marks are not inherited by the sperm or the egg, they're inherited through the behaviour of the mother. So we believe that certain behaviours are inheritable through the behaviours of the caregivers or the environment. They will stay for generations causing marks not in the germ line but the behaviour of the environment.

There are other kind of marks that don't require the presence of the caretaker but are mediated through the germ line. So it is possible to change not only the DNA methylation marks in the brain, but also DNA methylation marks in sperm. The big question is whether stress can cause changes in methylation marks in sperm. One can think about ways that that can work through hormones that can go from the brain to the sperm, to the testes, and then this is passed to the next generation, and because these marks have a property, they can be propagated, they can be replicated. That can now be passed to different tissues, and remain in different tissues. This is a way by which one generation can send information on experiences to the other generation.

Tomaro – focusing on mothers and children (2:16)

Brain Development – 3.1 Advancing maternal and prenatal health

The major goal of the Aga Khan Foundation's health program is to improve the health status and well-being of mothers and children. And the reason behind that is because mothers of children, particularly young children--those who are under five--suffer a very high burden of vulnerability with respects to the developmental challenges, okay. So, if you're able to reach these two groups in an effective manner, you really have a sense that what you're doing in other spheres is really making a difference. Because if you can see changes in the conditions and well-being of the mother and children, you should be able to see some changes in the conditions of the others in the, in the community.

If you're dealing with adult health, or if you're dealing with the health of adolescents except for young women who are in the fertile age group, it takes a much longer period of time before you're able to see any changes. So by focusing on women of the reproductive age and young children, and by ensuring that they have access to the care, to the information, to the assistance that they need, you can make a substantial difference.

This has been the major focus of work in health over the years. I've been here almost 15 years and during that period of time that goal has remained constant. And the goal has remained constant because the problem, or the challenge—let's put it in those terms—the challenge has remained constant.

Most of the major donors, and most of the G20 countries have just done an assessment of the Millennium Development Goals. And the two goals that have to some extent changed the least, and where these countries are now investing substantially, is in goals four and five. And those are, with respect to infant and child mortality, and to maternal mortality. So the fact that these are so far behind in relation to achieving the MDGs has really begun to motivate the countries to make these investments. And in that respect, ECD, in many ways, crosses the two groups. Crosses between mothers and children and also reaches into the education goal as well.

Tremblay – early onset of aggression; aggression and preschool period (3:20)

Coping & Competence – 2.3 Emotional learning

The Montreal longitudinal study helped us to understand that physical aggression is not something that starts during the elementary school years or during high school. Since they were at their peak in kindergarten and the frequency of behavior was decreasing as they grew older it forced us to start a study at birth to be able to understand the development of aggression during the preschool years. We've been following 2000 children from five months of age and they're now in kindergarten.

What we've been seeing is that from five months to approximately 24 months there is a rapid increase in the frequency of physical aggression; that the peak of physical aggression in terms of frequency is between age two and three, four years of age. And after that it starts decreasing. So that clearly, if there is learning of physical aggression it's starting very early but we believe that what we're seeing is that children do not have to learn to use physical aggression; this is a normal behavior early on and that the environment helps the child learn to use alternatives to physical aggression and this is why there is that early peak and then decrease of use of physical aggression throughout elementary school and adolescence.

We've also learned that there are children, although everybody does it at age two, there are some who use physical aggression more often than others and those are clearly more at risk of not learning alternatives. They need very good environments to be able to learn to put on the brakes. So that it's important for children during the first three, four years of life to have an environment that is helping learning alternatives to using physical aggression.

Tremblay – intervention (2:25)

Coping & Competence – 2.3 Emotional learning

There were two main parts to the intervention. One was parent training, where we were going to the homes of the parents for every three weeks for a period of two years. We were doing a standard parent training intervention where we trained the parents to observe the behavior of their child; observe when they were behaving positively and reinforcing that positive behavior; observe when they were misbehaving and helping them learn to give proper responses to misbehavior. And also training them in sort of general problem resolution skills.

At the same time we were going into the schools and we were getting these children once a week into a social skills training program. And that social skills training program involved being in a group of highly skilled boys that we had identified before. So we had approximately five or six highly skilled boys with two or three boys who had behavior problems so that the highly skilled boys were acting as models for these low performing boys. And we believe that this type of intervention managed to get the boys who tended to be rejected to learn the skills to be accepted by the boys who have less problems.

Tremblay – Montreal longitudinal experimental study: study of aggression (3:47)

Coping & Competence – 2.3 Emotional learning

The Montreal longitudinal experimental study is a study of boys who were in kindergarten in low socio-economic areas of Montreal in the early 1980s. These boys are now 26 years old and we have assessed them almost yearly since they were in kindergarten. It's a sample of approximately 1000 boys. The aim of the study was to understand the development of children who are at risk of having serious problems during adolescence. That's why we chose boys and that's why we chose them in a large city and from low socio-economic areas. The study has focused on a large range of topics, but one of the main focus was how can we prevent children who are at risk when they enter kindergarten from having serious problems in elementary school and then through the adolescent years.

We have shown with this study that probably children are at their worst in terms of aggression, hyperactivity. If we start in kindergarten, they are at their worst in kindergarten and most children as they grow older tend to reduce the frequency of their problem behaviors. But if they don't substantially reduce that level of problem behavior then they get into more problems in terms of the reactions to their behavior because they're growing taller and stronger and people will not put up with an aggressive, physically aggressive 12-year old as they will put up with a five or six-year old aggressive child.

We did a prevention experiment with that study, so we gave parent training and social skills training to the at-risk children and the at-risk were of course those who showed most problems in kindergarten. And we've shown that an intervention, an intensive two-year intervention, with these highly disruptive boys in kindergarten, could reduce their level of problems later on. Those who received the intervention were more successful in school, they had friends who were more positive, less of them abandoned school before the end of high school and less of them had serious delinquency problems.

Tremblay – play fighting; rough and tumble (2:10)

Coping & Competence – 2.3 Emotional learning

Well, one of the most surprising findings that we are getting concerning the development of physical aggression is that play fighting is probably one of the best ways to learn alternatives to physical aggression. Play fighting is play and you can see that children are play fighting when they are laughing and having a lot of fun. You can see that they are not play fighting when they're crying that they've been hurt. So play fighting is a time where you are learning the limit between play and aggression. And if you are not play fighting it's hard to learn where are the differences. One of the best examples of play fighting is tickling. And if you've ever tickled someone, you may hurt that person the first time you do it. So you need to learn where the limit is, where it's fun and where it starts to be hurting the other person. And aggressive behaviors, if they are sort of in-built because we've needed them throughout evolution, there are behaviors that are fun. And that's why we see cats play fighting, and dogs play fight, and children spontaneously want to play fight. So having fun in doing these exercises, in playing, is a good way of learning alternatives to physical aggression.

Tremblay – variations in physical aggression (2:38)

Coping & Competence – 2.3 Emotional learning

Physical aggression in children is present in almost every child early, but there is variation and there's a lot of variation. Some are more peaceful than others at two years of age. I tend to say that some have turbo motors and some don't have turbo motors. And most probably these differences are genetically related. It could also be something that happened in utero, it can be something that happened during the first few years of life. Some children are already more in control than others early on.

And we can see that in the difference between boys and girls. Boys are clearly more physically aggressive very early on than girls. So even if there is a genetic component, it's clear that the environment is playing an important role. But the environment needs to be better in terms of the quality of the environment if you have a turbo motor. Cause if you have a turbo motor you need to learn to put on the brakes. And learning to put on the brakes is something that you learn in your environment. Some children have sort of the brakes are working spontaneously much better and clearly boys have more difficulty learning to put on the brakes. Not all the boys, but in general boys need more support to learn to put on these brakes. So we need to be attentive to this when we have groups of boys and girls. It's clear that boys tend to be more turbulent and they need to have the right support to be able to learn alternatives to aggressive behavior.

Walters – a child's experience with risky play- (1:11)

Coping & competence - 3.3 Valuing play

The girl in the swing this morning, she really likes to go in the swing and spin as fast as she can. Previously another girl had done a similar thing and had thrown up. And that's been a learning moment for all of the children.

This child this morning often speaks about how it feels to her when she's in the swing. And it was a really great connection for me because she says that it tickles her in her tummy. And part of Ellen Sandseter's research and one of her articles is that very quote, "it tickles my tummy". So, actually hearing that come from a child helps in connecting the research to what children are actually experiencing.

Walters – climbing the willow tree- (1:23)

Communicating & Learning - 3. Opportunities for communicating and learning

Originally when we planted this willow tree hut, which has now become a nest, I never imagined that children would climb it. I always thought of it as a place where they would go inside and seek shelter or get away and play. And then one time a few years ago some children began climbing it. And that was a real awakening moment for me, first of all in children's abilities, second in their desires and thirdly in what we were actually doing here. So that space is quite large and there's a few extra branches that we prune off of that living willow every year and we plant them. And our hope is that they will continue to grow and be woven together to be able to create more spaces for climbing. And this morning the children and I were talking about that and they were wondering how they're going to be able to get up and how they're going to be able to get down. And I don't know that yet, which is what we were further discussing is that we'll have to wait and see when it grows and see what happens and go from there.

Walters – environment as teacher (1:13)

Communicating & Learning - 3.2 Planning environments for learning

The environment is a very important part of our practice. And the environment as their teacher is also something that I keep in mind regularly. It's important to have a beautiful, inviting, useable environment whether that be indoors or outdoors.

Creating an environment that is beautiful, inspiring and useable is not an onerous task. I feel that this environment that we get to spend our days in is absolutely amazing and I try and embed that and weave that throughout the space, whether that's indoors, outdoors, outside of the yard. It's a huge part of our program.

Walters - Kittiwake program principles- (5:50)

Communicating & Learning - 2.5 How children learn

So Kittiwake opened in 2009 and it was part of a pilot project looking at mixing age groups of children. Previously licensing standards here in BC had children in the age groups from either zero to 3 or 3 to 5. So the idea was that we would mix the children and have an enhanced ratio. So, we have 24 children between the ages of 16 months and school age; so about 5 and half years, with a ratio of 1 caregiver to 6 children rather than 1 to 4 or 1 to 8. We meet in the middle.

So, for the three overarching principles and my philosophy of care I really think that it's important to listen to children and what their needs, wishes and desires are. And with that we have worked really hard to create democratic spaces for them where they can feel like they have part of that decision making ability here.

A pedagogy of listening is very important within that democratic space and making children feel heard, not just by listening but by taking up the action involved in what it is that they would like to do.

Democracy with children in my view is when a child comes outside and they really want to wear bare feet rather than their shoes. We use natural consequences. So, we would prefer that the children get dirty, have moments or long periods of time, to be in various sensory experiences whether that's sand, water, mud, dirt, the cold. Sometimes the children really just need to and want to feel those things through their senses. So that would be an example.

Another is that we have embarked upon a journey several years ago now but in risky play. And those two ideas are quite related in the sense that when children want to do something that is normally seen as unsafe or outside of typical norms of childcare practices, we don't say no to them. We ask questions about what it is that they're thinking about, what they might like to do. We observe and we try and fulfill those wishes and desires by supporting them in those ideas.

This approach to risky play; it has evolved over time. Originally I would get quite nervous and feel a little bit apprehensive about actually giving the children the right to decide which fundamentally is so important but the actual doing it part was a very difficult internal struggle and my own risk taking because ultimately I'm the license holder and I'm the person responsible.

One of the educators that I hired, she had a lot of experience and I really admired her way of listening to children and that just became the opening for me personally and then for the centre as well to grant children that ability to decide whether or not they wanted to climb a fence or be in a tree.

And the third aspect is that we use responsive curriculum. So, in responding to the children and their daily desires, their-what we see them learning or being interested in and how we can incorporate that into the curriculum. Whether it is painting their bodies or riding their bikes we try and foster those interests.

And then we also create pedagogical narrations as a part of that process so that we can revisit their learning, with the children, with their families, with each other and continue on from there.

A pedagogical narration is a story essentially, so the children's learning, our learning, the family's learning and this; these narrations have many forms. We use a lot of photography. We try to incorporate drawing, painting, artistic ways of documenting as well. And we use a lot of multi-media in the actual narrations themselves. Rather than just photos and a story, we try and have photos that tell a story.

If I had to say I was the most proud about one thing, I think it would be about listening to children and following through on affording them the ability to fulfill their wishes and desires.

Walters – observing and knowing children (1:35)

Coping & Competence – 3.2 Getting along with others

We really keenly observe the children and that's part of when we have in our primary care giving groups we are able to see the children's progressions over time so that we know what they're capable of and we can see the agility and the skills in a child and know when to be closer and when to give more space or when to set a boundary or when to allow for things to happen.

This morning children were up in the tree house and they like to go to that place to get away and to I think feel like they're on their own in the yard. They're up high and they have sort of a bird's eye view of what's going on in the yard but also they're away from the adults.

And I heard something happening up there where I wasn't sure if there might be a bit of a conflict erupting. I so got a little bit closer and I listened, and then just having that proximity lead me to listen to what was happening as well as to see children's faces and then I gave them that space by moving back and retreating and just watching from afar.

Warner – benefits of universal programs (2:28)

Developmental Health – 3.2 Shaping public policies

Traditionally we think of social welfare expenditures as negatives in national income accounts and we think of economic developments as positive: investments are positive, expenditures are negative. What's happening now with the new research on early care and education is a reinterpretation of those expenditures as investments, and this is a radical shift because when government or bus thinks about something as an expenditure, it's just money lost. But when you think of something as an investment, its money that yields a return. And it turns out that both in the short-, medium- and long-terms, early care and education investments yield a positive return.

And this is huge because as governments are stressed in terms of the amount of taxes they can raise and what kind of expenditures they feel they can handle, those things that are thought of as expenditures pure and simple are more likely to be cut. And programs and activities that are considered investment activities are things that you really need to do to for your short- and long term economic health.

So they are investments and we need to start talking about them in that way and thinking about finance vehicles that we use in other physical infrastructures. We don't have to pay for the full cost of a bridge today in order to build it. We know we can't wait and build it brick by brick over the next 20 years but we expect our children to wait. And while we wait in policy trying to figure out what to do they grow up without the care they need. When we need a bridge, we build it immediately: we finance it with long term financing. We build it immediately. We need to start thinking about an investment system in early care and education that acknowledges these highly positive long-term and short-term and medium returns and then goes ahead and builds it today.

Warner – changing economic thinking (1:52)

Developmental Health – 2.2 The socio-economic impact of early childhood education and care

We have traditionally thought of child care as the private responsibility of families. And what's happening now is we're beginning to articulate child care as part of the public responsibility of society. And what makes early care and education a public as opposed to a private responsibility. And the link there is that we all are vested in the outcomes of early care and education. I want your children to be well prepared for school because that's good for me in the long term: it reduces crime, it increases school performance, it improves their labour force performance, and eventually they are going to be supporting my pensions in my old age.

So we've begun to take a longer, intergenerational view on the importance of children and realizing that they are, they have, child development has some public good aspects to it. We've long recognized the importance of kindergarten to 12th grade education. We've recognized the importance of higher education: colleges. And we give substantial subsidies to those pieces of the education framework. But we have not stepped up to the plate and given the kind of resources to early care and education that we need to do. And it turns those early foundational investments out that can yield even greater returns than the investments later in life. And so the societal value to this is in terms of employment, in terms of school readiness, in terms of reduced crime and other social ills. Children who get a good start in life tend to be launched better into adolescence and adulthood and that benefits us all.

Warner – ecological framework (2:00)

Ecology of Childhood – 1.1 Contexts

The ecological framework is really important for looking at the returns from early childhood programs. And my concern with the way economists have come in and looked at the child development studies is that they fail to acknowledge the ecological framework. We need to think of person, place and context. A child is not a biological unit that you insert a little bit of early education and you get these huge results. And that is the way many of the economic are interpreting these investments in formal preschool: 'bad parenting is the problem, formal preschool is the solution. We'll give it three hours a day when you're four years old and voila we'll get returns of 17 to one returns. That's crazy.

A child is a human being. It's born into a family. It's not a biological unit, it's a person. And it's born into a family of parents who most likely work. They have a dual role in society of being caregivers and workers. And they live in a neighbourhood which may not even have any child care facilities. And they work outside their neigh, and they have long commutes and they have high stresses and all those stresses come back on to them, affect their parenting and affect that child's development. Three-hour a day preschool when that baby hits four-years-old is not going to make very much difference.

You need to begin investing early, and you need to think about the child nested in an ecological context. The child as a biological system, a human being, sitting inside a family as a social system, and that family is sitting inside a neighbourhood as a community system, and that neighbourhood is a part of a city, and that city is a part of a policy, a government that decides to care about children and value them as citizens, or to ignore them and treat them as only the private responsibility of their parents.

Warner – economic benefits (2:51)

Developmental Health – 2.2 The socio-economic impact of early childhood education and care

The economic rationale for investing in early child development stems from a number of factors and we like to think of child care, early care and education, as having a three-part impact on the economy. The first and most important impact is the impact on children's development: their social, emotional and cognitive development which makes them ready for school and then develops them to be more productive members of the work force later in life. And there's been a fair amount of research, particularly in the US looking at longitudinal studies that shows very high economic returns for investments in early care and education. That is sort of one-third of the picture; a very important piece.

The second economic rationale for investing in children, in early care and education, is the impact it has on parents. And parents' labour force mobilization, the career choices and career ladders, particularly for women. And in a time of labour shortage there's a lot of interest in the business community on how to motivate and maintain, particularly women in the labour force as they become mothers. It's also important for fathers but the particular issue we've been seeing in the US lately, in the last four or five years, is a slight ticking downwards in women's labour force participation after they have children and this is in part due to the inadequate social infrastructure of child care. So that's the second, and also very important reason, business case, for investing in early care and education.

The third reason, and the one that I focus on mostly in my research is the perspective, from the perspective of the region and the regional economy. And child care as it turns out, is a critical social infrastructure for economic development. And we've always considered physical infrastructures like roads and bridges and water and sewer lines as being important for economic development but we've ignored child care. And the business community is now keenly aware, because of problems with labour shortage and problems with retention of employees, that child care is an infrastructure. It's not something that business wants to have to provide itself. It wants it to be provided as part of the infrastructure that's provided at the community or the regional level.

So we've taken, in our work, we've taken the trillium flower as an example of these three pieces: the children's…the child development piece, the parent piece, and the regional economic piece. And you really need to think about all three together, in the whole picture.

Warner – rights of children (2:08)

Ecology of Childhood – 1.2 Children's rights

I live in the United States which has a very poorly elaborated sense of citizenship for children: they can't vote, they don't get access to social security. They really have very limited citizenship rights. When you hit 18 you get a few more, and when you get old, when you get over 65, you get more citizenship rights than you have at any other time in your life—because of our social security system.

So why do we so under-invest in children? Part of that is part of the ecology of our political system which has defined child as the private responsibility of parents not the public response of society, with the exception of public education. So when you think about these things in the ecological context you figure out that these returns to the child, that children's petal on the trillium flower is only one piece of the picture. Then there is paying attention to the returns to the parent which is another very important piece. And we discover that women particularly pay a very high price for motherhood. They pay a price in lost earnings, lost career trajectories, and in their retirement benefits [which] are also going to be lower for the rest of their lifespan because of these lost earnings and lower wages and career trajectories that come as a result of their investing in caring and reproducing the next generation.

Then you have the broader society that when you begin to realize that child care is a social infrastructure for economic development, that's even giving returns back to the community in the short-term: firms aren't facing labour shortage, turnover employees goes down, the community has a higher quality of life which attracts new creative industries into your local economy. You realize that when you could add up, if you could just look at the kid piece, which is what economists are totally focused on right now, I'm glad they are but they're ignoring the ecological context. When you add to it the parent piece, the employer piece, and then the broader societal piece, you're getting much higher returns than if you just look at the kid piece by itself. And you're also likely to design more relevant and useful policies.

Warner-social benefits of early education (2:05)

Developmental Health - 2.2 The socio-economic impact of early childhood education and care

And this is huge because as governments are stressed in terms of the amount of taxes they can raise and what kind of expenditures they feel they can handle, those things that are thought of as expenditures pure and simple are more likely to be cut. And programs and activities that are considered investment activities are things that you really need to do to for your short- and long term economic health. So they are investments and we need to start talking about them in that way and thinking about finance vehicles that we use in other physical infrastructures. We don't have to pay for the full cost of a bridge today in order to build it. We know we can't wait and build it brick by brick over the next 20 years but we expect our children to wait.

And while we wait in policy trying to figure out what to do they grow up without the care they need. When we need a bridge, we build it immediately: we finance it with long term financing. We build it immediately. We need to start thinking about an investment system in early care and education that acknowledges these highly positive long-term and short-term and medium returns and then goes ahead and builds it today.

Watson - powerful friends (1:49)

Developmental Health - 3.1 Advocating for early child development

Early childhood advocates have been in the trenches for decades, fighting for better recognition and more funding for early childhood, and they continue to be the experts on what the system should look like. But as a colleague of mine once said, "Powerless children need powerful friends." In order to get the dramatic increases in public funding that we want, we need powerful people to use their reputation and their clout to convince policymakers that this is in the best interest of their community, their state, their nation, whatever nation that is.

So we use business leaders, not as a substitute for the advocacy of the early childhood community, but as a supplement to show that this investment helps everybody. So when we say "unexpected champions," we mean leaders, powerful people outside the early childhood field who are willing to say that early childhood is an essential part of improving a country's wellbeing. These can include business leaders, not people in the childcare field, but business leaders from other companies. It can include police officials who are willing to say that early childhood is a wonderful way to reduce crime and violence. It can be athletes, celebrities, doctors, teachers of older children as well. All of these people can say, "Even though we're not in the field of early childhood, we believe that this is an important investment," and those statements carry a lot of weight with policymakers, specifically because those people aren't from the early childhood world.

Watson - ReadyNation (1:32)

Developmental Health - 3.1 Advocating for early child development

ReadyNation is a global business organization of 1400 executives and all of our members want to improve the economy and work force, and they believe that investing in children starting in the earliest ages is the best way to grow the economy and produce a strong workforce.Business leaders can do a wide range of things to support young children. We talk about this in 6 categories of action that I'll describe briefly.

At the most local level, they can donate money and volunteer as an expertise, a traditional corporate social responsibility role. Secondly, they can work through their employees, giving them family friendly practices, as well as educating them on the importance of early childhood. They can use their customer base as a way to educate more people about the importance of early childhood. Fourth, they can develop products, goods, and services that make money but also contribute to the social good. Fifth, they can use their platforms to speak out on the importance of early childhood through the media or other prominent venues. And then perhaps most importantly, we want them to use their clout and their reputation in their power to influence policy change so that we can increase public funding for early childhood investments from the local level, to the national, to the global levels.

Weinberg – animal models (3:33)

Brain Development - 2.1B Prenatal brain development

I work with animal models of prenatal alcohol exposure. And animal models have been very important to this field. When fetal alcohol syndrome was first described in articles that kind of reached the public in 1973, there was tremendous skepticism that alcohol actually could cause this syndrome called Fetal Alcohol Syndrome, which was so severe. The notion was people had been drinking since biblical times and nobody ever described this, and now suddenly in 1973 we have this "new" thing called Fetal Alcohol Syndrome. And people didn't believe it, they said it can't be, alcohol is not doing this, it must be drugs, it must be liver disease, it must be malnutrition, it's got to be something else. And so the animal models were developed very early in this field, really shortly after FAS first came into the literature. And they were critical in showing that alcohol really is the teratogen. A teratogen is something that can cause birth defects, and they cause not only physical defects, but behavioural defects, cognitive defects.

And so that's why animal models are critical. They first of all, work in the animal models; and there were a variety of animal models early on, from miniature swine, and that's one animal that actually likes to drink alcohol. People did some early work with dogs, of course rodents, rats and mice were used the most, and work in primates. And all of that work showed that, really mirrored what was being seen in the human studies, in the clinical literature, that the effects exist on a continuum, on a spectrum from very mild to very severe. That you could directly link whatever you saw to alcohol, because in an animal model you can control for all of the things you can't control for in clinical studies. You can control maternal health, nutrition, the dose of alcohol, the timing of alcohol exposure. You can control the genetics, so you can use animals that are more sensitive to alcohol, or less sensitive to alcohol, and that eliminates some of this genetic variability in the clinical situation. You can control environment. So, under those very controlled conditions the animal models were critical in showing that alcohol really causes the changes that you're seeing in the clinical situation, from the facial dysmorphology, the facial features that are characteristic of FAS, all the way down to behavioural changes, learning and memory, things like that. So that's why animal models have been useful, that's the first reason they've been useful. Really confirming the fact that alcohol is a teratogen.

And then the second issue is that they allow us, the animal models allow us to look at mechanism. How is alcohol having its effects? How does alcohol work on the organism? How does it work on the brain? And then we can take the brains directly from an animal study and examine the brains carefully and understand exactly what alcohol does to the brain.

Weinberg – prenatal alcohol & epigenetics (3:04)

Brain Development - 2.1B Prenatal brain development

One area that has now become a very active area in this field, and an area that we are beginning to work on as well, along with colleagues at UBC, Michael Kobor is our main collaborator; is to look at the field of epigenetics. Epigenetics describes changes in gene expression that occur without changes in the DNA. So DNA is the; are the substances that make up the genes, and we all have heard of the idea of mutations in the genes where the gene itself has actually changed in some structural way. What epigenetics is about is; not changes in the structure of the DNA, the DNA is normal, it's the same in everybody, but what differs is whether genes are turned on or off, and at what level are they turned on or off. Mike Kobor always uses the idea of a rheostat used to regulate lights. Right, so you can turn on the lights and then you can make them brighter, or dimmer. And that's how we can think of changes in how genes are expressed. They're expressed at low levels, or they're expressed at high levels. And what alcohol seems to do, and other early life insults: nutritional insults, other toxic things in the environment, early life stress; prenatal and early postnatal, all seem to have effects on gene expression; whether genes are turned on or off.

So we're beginning to look at that in our work also, and we're of course particularly interested in genes related to the stress system and the immune system. And so those are the areas we're targeting. Initially, rather than focus in on specific genes, we did a more global study looking at changes in gene expression in general, looking at all the genes in the brain. And we found changes specific to our prenatal alcohol exposure in many genes in different parts of the brain. And those genes that we identified are related to stress and immune function, they are related to normal development, they're related to cell signaling; how cells work. And so they; they are genes that you might expect to be altered by a substance like alcohol, or by any insult to the body. And we found a number of genes that are specific to alcohol, and now we're pursuing that further to look at; to try to target more specifically what genes are altered and how they're altered.

Werker – bilingualism advantage (1:56)

Communicating & Learning – 2.2 Bilingualism and multilingualism

So I like to think about what babies are figuring out in infancy as advantaging them for their particular linguistic environment, and if it has other cognitive consequences, I think those will be really interesting to study as well and I'm sure that there are some advantages to bilingualism, as I said they have been demonstrated, but I suspect, and there is evidence, that there are some costs as well, so the rate of processing information is just a little bit slower. The rate of labeling, of responding and pushing a button to which object a word goes with is just a little bit slower in bilinguals because there are two lexicons that have to be consulted, so this is not a surprise. Does that rate difference have any consequences? Maybe not, maybe not at all, and the cognitive advantages may far outweigh, but I still think the most interesting question is how the human mind adapts to the input that its getting in a way that optimizes the environment that the child is going to be living in.

There isn't any good evidence that bilingualism or trilingualism makes one more able to learn yet another language at the perceptual and cognitive processing level there is no good evidence. It's very likely that it has an impact at the willingness to learn level, but perceptually and cognitively there is no good evidence that it facilitates learning of yet another language.

Werker – bilingualism advantage research (4:22)

Communicating & Learning – 2.2 Bilingualism and multilingualism

I'm often asked whether babies growing up bilingual have an advantage or a disadvantage in language acquisition, and I think it's an interesting question but it's not exactly the way that we try and approach this work. There are groups who claim and show some good evidence there are advantages to bilingualism in terms of flexibility and problem solving and perhaps in reserve in aging and there's some nice work from Aggie Kovaks and Jaques Mailer that shows that babies who are growing up bilingual are better able to simultaneously learn or to learn one set of rules then change to another set of rules, but if you think about that in the context of language learning, you can think of that as an advantage or you can think of that as an adaptive developmental achievement. So a baby who's growing up bilingual being able to learn one set of rules then learn another set of rules, you can see how that would be something that they've had experience with growing up bilingual

What our work shows is that there are definitely differences in babies who grow up bilingual versus monolingual and some of those can be, could be imagined, and they might be just overall advantages. So a baby growing up bilingual for example maintains sensitivity to the consonant distinctions used in both of their languages, something they need to do. Even if the da-ta difference is, the categories are different in English and in French, and a baby who is bilingual in English and in French by the time they're a year old they have the d-t distinction in English as well at the d-t distinction in French whereas a mono lingual baby only has one of those. It's an advantage for the bilingual baby because they need two sets of distinctions, it wouldn't be an advantage for the monolingual baby to have two sets of distinctions, it could be seen as a disadvantage if they maintained that. We've looked at a lot of different aspects of bilingual acquisition. One that we've looked at is visual language discrimination, so a young baby can discriminate the change from one language to the other just by watching the face of somebody who's speaking to them. So when shown videos of three French English bilingual speakers just with the sound turned off, so reciting little sentences first in English then in French, babies at four months, monolingual or bilingual can discriminate change from one language to the next. By eight months of age, monolingual babies are not sensitive to that cue anymore, and what we've published in previous work is that French English babies continue to be sensitive so that's certainly an advantage for a bilingual learning baby to be able to continue to use cues just in silent talking faces to distinguish them. The monolingual baby can't do that, so maybe that's a disadvantage, but maybe they're paying attention to something else, we don't know.

Recently we showed that, and this is work with Nuria Sebastian Gallas in Barcelona that even Spanish Catalan bilingual babies can discriminate the change between visual English and visual French, so it does look like, those are two unfamiliar languages to them, so it does look like there is some kind of heightened sensitivity in the perceptual or attentional system in bilingual babies for paying attention to possible cues that will distinguish languages even when they're unfamiliar. Is that a general advantage that has consequences in

other learning domains or is it something that's just specific to the language domain we don't know the answer to that question yet, and we think that's a really interesting question for further research.

Werker – critical period for language acquisition (1:58)

Communicating & Learning – 2.2 Bilingualism and multilingualism

The question of whether there's a critical period for language development, I think is one of the most interesting questions in language acquisition. And if someone had asked me this question five years ago, I would have answered very confidently Yes, that there is a critical period for language acquisition. And there is indeed a lot of evidence that is consistent with the notion of a critical period. And this comes from children who are hard of hearing and are not exposed to any patterned language input until they have the opportunity to see a sign language. And this is the work of Elissa Newport and Rachel Mayberry and others that have shown that children who are exposed to a sign language before the age of seven have a much better chance of fully developing a language than do children who are not. And there's similar work from children's ability to acquire a second language. There the "critical" period looks a little bit later, maybe to age 11.

On the other hand, more recent data suggests that even the sort of sacred notion of a critical period for language acquisition needs to be qualified. That there may be a critical period for acquisition of the first language. You may need to have some kind of patterned input in the first several years of life in order to be able to acquire a language but the idea of a critical period for a second language acquisition may be a little bit more plastic than we once supposed. That if we change the exposure conditions and the training conditions, there may be more adaptability and capacity to acquire a second language, later, than we once thought.

Werker – interpreting the research (5:09)

Brain Development – 2.1B Prenatal brain development

So there were two possible explanations for this pattern of results. One is that SRI exposure just disrupts the circuitry in such a way that it interferes with learning or perception or performance in the tasks that we were looking at, and there is indeed evidence that exposure to SRIs does change tonotopic organization in the primary auditory cortex, so that was one possibility. The other possibility was that exposure to SRIs had moved the whole sort of sensitive period earlier in development and that changes had been taking place even before six months of age, and that had we tested the babies at a younger age, we might have seen discrimination.

So what we had in our data set, we hadn't tested them at four months or two months or even at birth, but what we did have in our data set was we had looked at discrimination of vowels and consonants in utero, at 36 weeks of age by measuring the fetal heart rate deceleration to a change. You get a deceleration if they hear like da da da da da da over and over again and then it changes to ta you get a temporary deceleration in heart rate and previous work has shown that at 36 weeks gestation fetuses discriminate vowels, but there's no evidence that they discriminate very similar consonant sounds that early.

So we tested them on a da ta distinction as well as an ah e distinction and what we found is that we had babies, we had fetuses whose mothers were taking SRI in our sample and fetuses whose mothers were not depressed and were not taking SSRIs. We didn't have a group of non-exposed depressed moms' babies in that sample. What we found is that both groups of babies discriminated the vowel distinction, well both groups of fetuses at 36 weeks, so discrimination was still in place in the SRI babies. They were doing exactly what had been reported in the previous literature for a typical population. Interestingly, we also replicated the inability of 36-week fetuses who had not been exposed to SRIs to discriminate the consonant distinction, but the SRI exposed fetuses did discriminate it.

So the interpretation we have for this whole set of findings then is that SRI exposure accelerates this onset of plasticity and the pathways by which it does so may not be, they may be the typical pathways by which serotonin works, but they may also instead be different pathways that have already been implicated in changing plasticity in gaba pathways that have already been implicated so it may be a different set of pathways so that sensitivity to the properties of native language and then the decline in sensitivity is all pushed earlier.

So we think then that SRI exposure accelerates the onset of plasticity, but the answer for depressed moms is not don't take SRIs because there are also developmental implications of maternal depression that is not treated with SRIs. The take home message that we want to give mothers here is to not beat yourself up if you're depressed, the incidence of depression is very high, people, women in particular, are much too likely to experience a period of depression in their lives. The message is that by doing this kind of research that allows us to understand what the effect is and then we collaborate with, Techau-Hinch does animal model work,

where we can get into the circuits and understand exactly how depression and/or SRI exposure modify development that we're in a position to work with moms and say okay, you're depressed, you had this happen you had that happen, all sort of things happen to our infants and to us while we're pregnant or while we're raising our children that we can't control, but by understanding more mechanistically what the effects are on the process of development we're in a better position to optimize development for children and for their mothers.

In our lab, we haven't so far, looked at how the quality of mother infant interactions can impact and interact with these different sort of trajectories of development but I think that's a really interesting and important area for further research.

Werker – Korean study (2:31)

Communicating & Learning – 2.2 Bilingualism and multilingualism

I think the question of a critical period for language acquisition also needs to be addressed at different levels of language. So vocabulary we can probably continue to acquire throughout our lives. There's no critical period for the acquisition of vocabulary. Syntax, or the grammar of language, becomes more difficult. Phrenology, the sound properties of language becomes more difficult. And there the question of exposure and training conditions I think becomes really important.

There's one recent study that I think is really interesting and makes us all pause when we think about the notion of critical periods. And this is a study that was done in France by Christophe Pallier and others, where they looked at French speakers whose initial language was Korean. They were Korean war orphans who were adopted into French-speaking homes in isolated little villages, up to the ages of eight or nine. And subsequently, at the time of adoption they spoke no French, they spoke only Korean. Subsequently they had virtually no exposure to Korean throughout the rest of their lives. And now as adults, middle-aged adults many of them, their ability to speak French is no different than any other French person. They can't find any differences in their perceptual capabilities for French; they can't find any differences that are really significant in brain-imaging studies of their response to French and conversely there's nothing left of Korean that they can reveal at any level of analysis.

And so this I think is a powerful example of how there is more flexibility after the age at which we thought there wasn't and it's in a circumstance where interference from the first language has been removed. So many of us now are reexamining our assumptions about critical periods. And when we see evidence of something that looks like a critical period in language acquisition, how much of it is based in something that's unchangeable and how much of it is based in sort of an interaction between biological development and the types of learning and listening experiences that the child has had.

Werker – motherese (0:59)

Communicating & Learning – 1.1 Acquiring language

Motherese refers to the way that we speak to infants and young children. Some of us have suggested that maybe it should be called parentese because it's not just mothers who do it. But what it refers to is the fact that we modify our voices as well as the style of speaking and, to some degree, the content of what we say when we're speaking to infants and young children. So for example, speech directed to young infants is usually higher in pitch; the vowels are elongated and it's quite musical in quality. As children get a little bit older, the pitch exaggeration isn't as great. So it's still high in pitch but not as high in pitch, to a little bit older infant or a young child. But the sentences are simplified and the choice of the vocabulary may be a little bit tailored to the developmental age of the child. So that's what motherese is.

Werker – native language sensitivity (2:30)

Communicating & Learning – 2.1 Early language development

Babies are born with perceptual sensitivities that prepare them for, among other things, learning language. And we know now from decades of research really, that when babies are first born they're sensitive to the individual sounds of the world's languages, they're sensitive to the rhythmical properties, to the stress patterns etc. And one of the remarkable changes that happens in the first weeks and months of life is that babies become more attuned to the properties of the native language, so they get better at discriminating the consonants and or vowels that are used in the native language. They get better at parsing, pulling multi work units in the native language in comparison to the unfamiliar language, and they get worse at doing these same things with nonnative speech.

What's interesting is this tuning to the sound properties and visual properties of the native language actually is important for later language acquisition. So as babies begin to learn words, they have to determine, or they have to be able to listen selectively to those sound differences that are going to be important and those that are not. So for example a baby learning English will need to treat different pronunciations of the word doll as all referring to the same object. So whether their mother says do you see this doll, or this is our doll, both of which change the character of that initial d, the English learning child needs to treat those pronunciations of doll as the same word, and hence learn how that refers to a particular object, whereas a baby in a Hindi learning environment, the d that would follow the s in this doll is a little bit different than the d that would follow the r in our doll. One of those is a dental d and one of those is a retroflex d, and those refer to two different words, those are two different words in Hindi, so the Hindi learning child needs to pay attention to that difference because it allows them to learn different words.

Werker – newborn communication (2:46)

Communicating & Learning – 1.1 Acquiring language

Newborn infants are prepared in a number of ways for acquiring language. I wouldn't say that they really speak yet, at birth. They have some vocal repertoire, primarily crying and vegetative sounds. Some people say, and there's some research to suggest, that those ultimately turn into the vowels and consonants of language. But what newborns do have is wonderful skills for listening to language. They seem to have been prepared both by biology and by prenatal experience for listening to the mother's voice and to the sounds and rhythmical characteristics of the native language.

So at birth, newborn infants show a preference for their mother's speech; their mother's voice over other female voices. They show a preference for language samples with the rhythmical properties of their native language versus an unfamiliar language. So for example, an English-exposed newborn will prefer listening to English and German and other languages with that kind of rhythm over languages like Spanish and Japanese that have different timing characteristics.

Newborn infants also show a number of other biases and preferences that are harder to explain on the basis of prenatal experience. They show a preference for listening to speech over non-speech. They show a preference for, or an ability to discriminate words that will ultimately carry meaning versus words that will ultimately carry structure in language. So content versus function words have different characteristics. Nouns, verbs, adjectives–words like dog, run, pretty; they treat as different than words, function words, that will ultimately carry structure like with, the, of. And they discriminate those two classes of words categorically.

So the set of abilities, some of which are probably given, as I said, by biology or an interaction between biology and prenatal experience and some of which are completely tailored from prenatal listening experience, prepare the newborn infant, at birth, to listen to speech over other types of sounds, to listen to their mother's voice, to listen to and pick out members of their linguistic community, and to begin to classify those words that they're hearing into the two big categories that will ultimately be necessary to put together meaning and grammar in acquiring a language. So they're pretty well prepared at birth for acquiring language.

Werker – newborn language abilities (2:22)

Communicating & Learning – 2.1 Early language development

It's really fun to work with newborn infants. And to try to figure out what they know and don't know about language, or what kinds of biases and preferences they have. And researchers who work with newborn infants take advantage of the repertoire of behaviors that a newborn infant has. In my lab, we take advantage of the sucking reflex. So when they're born, newborn infants have a reflex to suck. You put your finger in a baby's mouth and they'll start sucking on it. Many babies are born with a blister from sucking their thumbs in utero. So the sucking reflex is something that's very well developed. And you can change the properties of the sucking reflex by presenting infants with stimuli, sounds or sights that they find interesting. So if you make it that every time a baby gives a strong suck for them that they get to hear a sound, they will change the number of strong sucks that they give per minute. They will give more strong sucks so they can hear more sounds.

You can condition the burst interval in sucking. Babies suck in bursts. They go (sucking sound) and so the strength of the suck, the duration of the suck, and burst, and the interval between bursts; all of those babies will change in order to see or hear interesting stimuli. And so, in my lab, when we test newborn infants on their preferences for different properties of language or on their ability to discriminate one type of sound from another, we use high amplitude sucking. So we present babies with a sound every time they do what is a strong suck for them, a high amplitude suck, and over the course of several minutes they suck quite vigorously to hear sounds. And they will suck more vigorously to sounds that they prefer over sounds that they don't like. So we can count the number of high amplitude sucks per minute to the native language versus an unfamiliar language, for example, or to speech versus non-speech, and newborn babies will show us what their preferences are by the number of times that they choose to suck in order to hear those sounds.

Werker – prenatal tuning (1:27)

Brain Development - 2.1B Prenatal brain development

The tuning to the native language begins even before birth. So when babies are born, they show a preference for listening to their mother's voice. This is old work by DeCasper and Fifer. They also show preference for listening to their native language, and what we've shown; this is work that I did with Krista Barrs-Highnline who's now at Concordia; is that babies who were exposed to two languages in utero show a preference for both of their native languages in comparison to an unfamiliar language, but they none the less keep them apart. So the listening that occurred in utero which is probably to the rhythmical characteristics of the language, allows them to recognize something as familiar so they attend more. Yet at the same time what we think is really fascinating is that it didn't sort of collapse language as language par language when we test them on their ability to discriminate two languages from different rhythmical classes even if they're both familiar languages they heard in utero. They're just as able to do so as a mono-lingual learning infant. So the tuning begins incredibly early, that's evidence there's tuning at birth.

Werker – studying babies of depressed mothers (4:24)

Brain Development – 2.1B Prenatal brain development

Typically one thinks about tuning to the properties of the native language as a kind of self-contained system, that the language input that the child receives or even the more active sort of interaction that the child has with other speakers of their language will provide the system with the information that's required to tune the perceptual system to the properties of the native language and then set all the sequela in motion for language acquisition, so it seems to be in many respects the standard body of evidence would suggest that this is a perceptual tuning that is marching along according to maturation and then the input has an effect at the time that the system or the developing brain or the circuits in the brain are ready to become attuned to that particular input. But we know that in the visual system and other perceptual systems that more extreme environmental differences can change the timing of change so we know that enriched input, very enriched input or pharmacological, like drugs, can accelerate timing, and we know that dark rearing, so not getting enough visual input or not getting any input at all can sort of put critical periods or sensitive periods on hold and so delay timing until a later age.

So in collaboration with Tekau Hinch and Tim Oberlander who studies maternal depression, and Whitney Wycomb, we asked whether exposure to certain pharmacological agents like anti-depressant medication and or exposure to maternal depression that isn't treated with anti-depression medication might have an impact on the timing of developmental change. So we worked with a cohort of mothers who had been depressed throughout their pregnancy and had either been taking or not taking anti-depressant medication, serotonin reuptake inhibitors, and we compared them, We also had a control group, control cohort of mothers who were not depressed during pregnancy and we tested their babies on the timing of tuning to the properties of the native language and what we found is that exposure to maternal depression that had not been treated with SRIs seemed to be like dark rearing in visual development in that it seemed to put the whole developmental sort of trajectory on hold so that at ten months of age the babies were still discriminating the non-native consonant distinctions that are typically not discriminated at that age.

So that seemed to be changing the course of development whether it's for good or bad we don't know yet; we need to test whether there's a later outcome. But in the babies whose mothers had been depressed and had been taking SRIs throughout their pregnancy what we found is that they didn't discriminate the consonant distinctions or the visual language change, I should say this holding pattern for the untreated maternal depression was there for visual language discrimination as well. These monolingual developing infants were still discriminating French from English at ten months so is that a delay, that's a bad thing or is it just a different trajectory. But in the babies who'd been exposed to SRIs in utero, serotonin re-uptake inhibitor anti-depressants, what we found is that they weren't discriminating the consonant change at either six or ten months, or the visual language change at either six or ten months.

Werker – predicting later language and literacy (4:28)

Communicating & Learning – 2.3 Literacy

One of the most important questions in the field of language acquisition is whether we can predict from early language development, later language skill. So can we identify in infancy, toddlerhood or the early school years, the child who's later going to have difficulties speaking, reading, spelling with some more complex use of language. If we could identify, reliably, those children who are developing well, those children who need just a little bit of a push to achieve their potential, and those children who need more specific targeted intervention and just what that intervention is, I think we would all feel that our work on basic language acquisition had been able to make a difference in children who may not be developing so well. And there is an enormous amount of work showing continuity in some realms of language acquisition from early to later years.

So, for example, there are the studies, the Hart and Risley study showing that the richness of the vocabulary input that the child hears in the toddler years predicts the size of their vocabulary. There are a number of studies showing that phonological awareness, so children's ability to rhyme, to show alliteration, and that's recognizing the same sounds at the beginning of words, to count the number of syllables in a word or the number of phonemes, the word cat, for example, has three phonemes c-a-t; those kinds of phonological awareness skills at three and four, predict reading readiness very well. And there are a number of researchers around the world, including in Canada, who have shown that if you go into a kindergarten or grade one classroom and identify the children who do not have good phonological awareness skills, or simply introduce an across-the-board program for all children, with little games to facilitate phonological awareness, that the number of reading problems decreases significantly.

So knowledge of the properties of sound of words is useful in translating between listening and reading. And using, sort of, the orthography to map sounds to letters. There's no question about that. So that's some work that shows a relationship between early language acquisition and later literacy.
There's also work on the pragmatics of interacting with children. Children whose parents read to them, just open a book, turn the pages, those children have a more positive approach to learning how to read and are more successful when they start school.

A focus of my work and the work of a number of other infancy researchers now, is to try and reach down into infancy and to see if some of the pre-language skills that emerge in perception of language, in simple associative word learning and even in things like the quickness with which you can recognize a familiar word in the first couple of years of life; whether those will predict later language skills and later literacy. I can tell you that we're working on these questions and that the results to date look very promising. There are a number of other labs around world, also working on these questions and it's kind of exciting that infants' speech perception and early word learning research has reached the level of maturity where we have stable enough findings about the descriptive aspects of typical language development in the infancy period to be able to use

these milestones we've identified in infancy to see if children who are not achieving these milestones at the same age as other children or as successfully as other children are those children for whom early intervention could be very effective.

Williams – societal solutions (1:58)

Developmental Health – 3. Supporting developmental health

The three Early Years studies, that go back to the mid-nineties, I think have had a terrific impact in Canada and frankly around the world. In terms of all of us understanding the importance of what was then the new neuro-science. And looking at its impact not only on genetics, because of where we were, we thought that what you're given in your DNA was, we came to understand that the importance of the environment and then, the importance of the supports that we could put in place in the environment. So I think it has shone a light across not only for health care workers and early childhood development folk, but much broader. Because it's an all society problem as we look at how successful or not successful Canadian kids are. We need to engage our politicians, our economists, our public sector, our private sector, in the solutions that are societal solutions. And so I think the early years studies have helped us to know and understand, in language that all of us can engage in, and realize that we all have a significant piece in Canada's uh supports to kids.

Sometimes I am disappointed with Canada's track record. You can't read any of the Innocenti Comparative reports that come out that show Canada compared to 29 other nations and their support for early childhood without feeling really discouraged. We are a resource-rich country. And why we can't, uh, garner the attention and the resources that other countries are putting into early childhood… I think we're coming to understand that… But sometimes I feel disappointed that, and how, how can we package it differently to get the energy and the resources that young children and young families need.

Williams-Ridge - outdoor play (1:36)

Communicating & Learning - 3.2 Planning environments for learning

Sometimes in the classroom children may be very reserved, or because of the space might not be as open to different relationships or trying new things, but sometimes outside because of the natural sunlight, or because of them having the sensory experience of the wind and the sound and the smells, they're able to connect, maybe not with another child right away, but they're able to make connections and they can connect with teachers and children. And a lot of children show a different style of leadership when they're outside as opposed to in the classroom. Even in children that you might not expect it to.

So sometimes it's a challenge for teachers to be able to supervise that, especially in a large open space, but it's also a chance for those children to exhibit some of their own leadership skills and work a lot on conflict resolution because they're a little bit further away from a teacher, and so sometimes they have to work on their skills on their own, and a teacher sometimes doesn't know until things have escalated to a certain point and then the teacher can become engaged. But up until then children have been working on solving a problem together, and I think that is an invaluable experience that the outdoors provides, not only for the children who are having the conflict, but for other children who are watching and can say "They're arguing about a shovel, how are they doing it?" and it provides chances for children to almost mentor and role model for each other.

Williams-Ridge - Setting up the classroom (1:54)

Communicating & Learning - 3.2 Planning environments for learning

We try and be intentional with everything we do with children, from setting up the way that the babies look, to having pets in the classroom that children can study and learn more from, and we try and accent everything in the classroom with a touch of something that makes people feel warm and comfortable. Because one of the biggest goals of preschool is the social development of young children and in a calm environment children are much more likely to form relationships with each other and with their teachers.

We also want them to know where to find things. So that they can start to build their ability to: be creative, to be big thinkers, to think 'just because I have these materials on the table, I know where a shelf is where I can get something that I'm really thinking about because I want to make a bigger project'.

Or, we really want children to go with their thoughts and their creative process and keep developing and keep trying new things and experimenting. So, we have things set up in a predictable way, where children and their teachers know where to find things and where teachers have the resources close by to help scaffold children and help them learn a little bit more than maybe they were ready for at that moment, just to keep the learning process going. We do find that children are able to focus longer on, on the material when they're able to come up with something new to try with it. So offering Playdoh or clay one day, but having the tools nearby so when they're ready, and when they've shown some proficiency, either a teacher can point out some of the tools, or they can look to a predictable place to find the tools that they really would like to use to kind of further their development.

Williams-Ridge - understanding through play (0:54)

Coping & competence – 3.3 Valuing play

I came in class one day because there was a child who was having a difficult transition, and he had gone to the doctor earlier in the day, and there was a book on the shelf that talked about, it was actually Berenstain Bears "Trip to the Doctor" and we sat down and we read the book. And he started to ask a lot of questions about, you know "well what is that tool?" (it was a stethoscope), and I said "well there's lots of tools that doctors use in the office to help take care of people", and when we were done with the book we went into the teacher closet and everything was arranged by subject. And we pulled out the doctor bin, and were able, and so I said, "Choose five things that you'd like to take back into the classroom" and took them back in, and he started to use them with the dolls that were in the classroom, and I was able to give him a firm understanding of what the doctor was doing, and even a little bit more about why.

Williams-Ridge-Welcoming environment (2:37)

Ecology of Childhood - 3.2 Strengthening early child development programs

We want to welcome children and families into the classroom, we also want teachers to be able to do things like read a story comfortably to a child or two. And there's something about having soft surfaces that really allows you to relax a little bit more, you can read a longer story and children will have that more home-like feeling and it does help build relationships when you can sit down on something where you and a child can sit comfortably and share in a story.

We do use natural colours, lots of greens and wood tones, and things that aren't too bright. We don't want the environment to be over stimulating, we want it to feel calm and welcoming, but also have some places where things pop like: flowers, that have a little bit of purple on them, or things that have different textures, we want children to be able to feel those things in the classroom as well as outside.

One of the great things about being outside is that children have the ability to touch different textures and smell different. They can use their whole bodies to engage, and we try and reproduce that as much as we can in the classroom with materials that also feel very natural and don't distract children from what we would like them to experience for the day.

The caves are kinds of a side bonus of having observation booths in the classroom, but they offer children a place to be, with, either alone, or just in a cozy space where they can really control all of the sounds and all of the things that they're experiencing. Some children like to use it as a place to just look at a book, but other children also use it as a place to go with a friend to build something special, or a teacher and a child might sit in there and, you know, look at a puzzle, or do something unique. It's nice to have those small places in the classroom, kind of like for an adult where you have something like a hammock or something like a study, where you have a small room that you can focus in on the material and you can kind of, control the variables in the space. So, the caves are a nice bonus, without the caves, the teachers create things underneath lofts, and there are fun places outside, especially once the greenery; there are some willow huts where children can go inside and you know, one, two, maybe three children can fit inside and create a cozy place.

Young - donors' investments (3:07)

Developmental Health – 3.1 Advocating for early child development

I think the science of early development has come progress...evolved over the past 15 some years and that really, that understanding about the synergy of health, nutrition and stimulation, the importance of the synergy on the children's development, that knowledge evolved over time and that has in many way influenced donor communities to address children in a coherent manner, in a holistic manner rather than in a silo approach of just putting health inputs then the nutrition inputs and then education.

That has been tremendously important, the fact that children, brain development continue after birth, prior to, this latest, new thinking has been very much of nature-versus-nurture but not kind of nurture and the interaction of nurture and nature. So definitely that brain, the brain science has kind of, really kind of reframed our understanding and how important it is those early years.

Early child development in the social sector has been considered as a, it's a soft sector as compared to other infrastructure, agriculture, highway, transport projects. So within the bank, or among other donors, having the science of, of early child development importance is not enough. We need, we have to come up with rates of return that's comparable with investing in a highway or cement factory. And indeed that, that's economics of early child development has been done. We have used the results of the positive impact of early child development programs adding on the economics dimension to make a case for why this is beneficial in the economic sense to invest in early child development.

So, a minister of finance, when he's receiving competing pressure from the agriculture, from the cement factory investors, and from minister of health or education, early child development indeed is a positive, has positive rates of return. And we have studies that show that it's in the rate of two-to-one, a two dollar benefit to one dollar investment. With that kind of data, we're able to present a case to minister of finance as they compare what is most beneficial for them to invest. So having this information has helped us to leverage more investment to early child development.

Yousafzai – PEDS background (4:01)

Brain Development – 2.2 Nurturing

This trial was designed because we found there was a real missing gap in addressing childhood interventions for the very young children from birth to two to three years of age. And the reason we found this was important was because there is so much, there is tremendous evidence from the neurosciences which tells us how we can modulate the quality of brain development in those early years and how is good to intervene early; and we know it's the health worker who is the person most likely to be able to support families and very young children.

And in many countries around the world like Pakistan. We also know that the risk factors that we are dealing with that cause poor development like malnutrition they are not only going to affect the physical well-being of the child but, the development of the well-being of the child.

And so, the health worker is ideally placed to integrate all of the interventions to do with better health, better development and to serve that child more holistically. So, that was the rationale for it and we began in July 2009 and the partnership that we have is with the lady health workers who are government based community health workers.

We wanted to implement a realistic intervention for them that they could integrate a child development module that complemented the health and nutrition services they already provided. So, we took the Care for Child Development module design by UNICEF and WHO, we adapted it and we've been training and supporting lady health workers to implement it over the last eighteen months.

So, it's an existing nationwide program in Pakistan. They provide very basic health care to mothers and children in rural communities and in disadvantaged and remote communities throughout the country; and like many other community health workers you find in India, in Bangladesh, in Kenya, they have probably a grade ten level of education. They are from the local community they serve and they have basic health care training and a very large workload.

We give the lady health worker a baseline training of three and a half days, which is not very much and we provide them with an ECD supervisor or an ECD facilitator, who provides on the job, continue on the job training and mentorship; and the lady health worker will deliver this to a group of mothers in her own area once a month.

And then she will do a follow-up home visit to that mother to see well, how the mother is getting on at home and do more individual counseling. So, the advantage of the group meetings is that the social interaction, the mothers get to see how children of different ages develop, see how different mothers work with their children,

learn from each other so there is peer to peer learning and there is the social aspect, there is the… By using the groups I think we've created a demand in the community for early childhood development, so there is the message that's spread; and then the home visit is the opportunity to really build the mother skills on one to one basis; and so the lady health worker is able to follow-up and she integrates that so she does that with health and nutrition.

And now we're beginning to see that mothers see these things linking up so the discussion on the development of the child and the activities is the focus point for talking about everything to do with the child. So, that's how it works on the intervention side.

Yousafzai – PEDS methodology (3:18)

Brain Development – 2.2 Nurturing

On the research side we're following a group of children whose families have participated in the study so we're following them from birth to two years of age. And we're taking measurements of their growth, their nutritional well-being, their health. We're taking measurements of their caregiving environment, their malnutrition status and their functioning: their cognitive development, their language development, their fine and gross motor development, their social emotional development.

We are observing the interaction between mother and child and we are also seeing whether we have any impact at all on maternal stress. Whether if the mother participates in this, if she is focusing on her child, if she is getting that peer-to-peer support. Does that have any benefits for the mother, as a women, not just as a mother with benefits for her child.

So, we are, we have another year to go for the study but our early trends are promising. So we are seeing the ECD children who are exposed to these interventions compared with the controlled children thriving a little better, their development is a little better, their growth is a little better. So, we are slowly starting to see a picture, but we will not be able to tell the final results until next year.

So, it's a cluster randomized control trial and it's implemented in a two by two factorial design, so to put it very simply, there are four groups: one, is receiving the lady health worker standard services, so the basic health care that she already provides to the community. The second group is receiving the early childhood development module plus the lady health worker services. The third group is receiving enhanced nutrition counseling and sprinkles, which is a multi-micro-nutrient sachet which they mix into the complementary food from six to twenty four months of age; and the fourth group is receiving everything so they receive the basic health care services, the ECD interventions plus the nutrition.

And an expectation, as classical work from Jamaica has shown in terms of research, that the children that are exposed to the integrated package whether receiving health, nutritional care and child development interventions, the stimulation, the responsive care for development, those children will benefit the most. And behind that what we really hope to see and over time what we're beginning to see is, that as the mothers start to, as their
capacities, as the quality of the sensitivity in their responsiveness skills begin to develop, that will have a spill over affect not just in how the children develop cognitively, but how the mother responds to early signs of illness, how she responds to feeding care, how she responds to the child's emotional needs as well. So, we hope to see that emerging in our data as well.

Yousafzai – PEDS mothers' sessions (4:02)

Brain Development – 2.2 Nurturing

The package is, it basically works around the concept that if you look at activities, stimulation activities, they could be play activities, they could be communication activities and you can take something very simple: like a child banging on pots and pans; and you can get the lady health worker to introduce that activity to the mother; and while the mother is working with that child, you are teaching her how to read her child. How to see when her child is happy. How to see when her child is, wow I have achieved something I can make these sounds.

She sees her child lighting up and when she sees that she's starting to understand that she is the first teacher and she can get that child to move from here to the next stage of his development and she doesn't need to have a University level of education, she doesn't need expensive toys. But using these very simple activities, she can learn to understand her child and respond to her child's needs. And when she does that the relationship between, mostly we are working with mothers, but the family and the child get stronger, the attachment process starts to develop more strongly; and this is really important because we are working in communities whether are so many challenges, there is poverty, there is twenty-five percent to thirty percent maternal depression or risk of maternal depression, there is malnutrition. And so within all of that you are giving the mother a way of being able to say that despite these challenges she can still give her child so much. So, that's the basis of the intervention.

The effects I have seen on mothers is that they are more knowledgeable now and they pay attention towards the development of children. We give them the skills and tools that allow them to observe the milestones according to the children's age. Therefore, if a child is not developing at a rate that we suggest is normal for a child of that age, the mothers begin to ask questions and wonder what is going on. The other thing is, the children are affected in a way that makes them much more intelligent and active. The mothers enjoy a period of social time during these meetings. The mothers told us in a survey we conducted that they enjoy coming to meetings and perceive it as a healthy activity in which they are allowed to socialize with each other. These meetings allow for positive change and acceptance within the community, as well provide a healthy outlet for competition and social development among the mothers.

And I would say after a year of roll-out what we have learned is, it's feasible to train a lady health worker of an education level of tenth grade perhaps, to deliver and implement an intervention which is complex, but effective supervision. Yes you are able to implement and see some changes in the child, in the mother and community to some extent in one year; and you can, when you see these mothers, you see these children really and their mothers reporting, "Oh my child id so different and I feel so happy now".

One of the mothers had a very beautiful quote: “I like this new way of caregiving”. So their emotions linked to this caregiving are changing which is really wonderful. I think for a mother who used to be stressed or burdened with so many children and now she sees a new way of bringing up her child, she has new hopes then she thinks in a different way now, she has a different attitude for caregiving and for being a mother.

Zelazo – developmental outcomes (1:33)

Coping & Competence – 2.4 Executive function

Executive function is emerging as a very important determinant of key developmental outcomes. Including, for example, academic performance in high school. So executive function measured during the preschool period predicts children's SAT scores in high school. And it predicts other important developmental outcomes. It's a good predictor, for example, of substance abuse problems, and criminal convictions, and so forth, much later in life.

And so there's been an awful lot of research in recent years, aimed at discovering ways to promote the healthy development of executive function. And increasingly, people, I think, are coming to realize that it is indeed something that is quite malleable, and can be trained. It's a skill like other skills. And our research has emphasized the extent to which the key underlying skill is the ability to step back and reflect upon one's own representations.

Not to just act impulsively, or immediately in response to a situation, but instead, to stop, and think, and consider the current context, and consider the long term outcomes of different potential behaviour, behaviours.

Zelazo – infancy (1:34)

Coping & Competence – 2.4 Executive function

Executive function emerges in infancy and may be measured, for example, at the end of infancy by looking at children's ability to solve very simple problems like, an object is hidden very conspicuously at a particular location, and then a delay is imposed, and infants are provided with the opportunity to search for that hidden object. And in order to search successfully, they need to keep the object in mind, and use a representation of that hidden object in order to guide their responding.

And in some versions of this type of task include, for example, Piaget's famous A not B task where an object is first hidden at one location, and the infant is allowed to retrieve it, and then the infant is shown the object being hidden very conspicuously at a new location. And a delay is imposed. And at about nine months of age or so, infants tend to go back to that initial location even though they just saw it being hidden at a new location.

And the ability to search flexibly in that context, to inhibit the tendency simply to go back to the location where the object was found previously, and keep the relevant, current location of the object in mind, and act flexibly in light of that representation, that's a good example of executive function in the infancy period.

Zelazo – introduction to executive functions (2:13)

Coping & Competence – 2.4 Executive function

Well, executive function is a term that overlaps considerably with self-regulation. But it's a neuropsychological term that is used to refer specifically to those psychological processes that are involved in the more deliberate top-down, so to speak, aspects of self-regulation. So, when people use the term executive function, generally speaking they're talking about the processes that are involved in the deliberate self-regulation of behaviour. And more specifically they tend to refer to processes including cognitive flexibility, inhibitory control, and working memory, or keeping something in mind in order to use it in kind of a deliberate fashion to guide your behaviour.

Cognitive flexibility refers to the ability to think flexibly about a particular thing. To view, it for example, from multiple perspectives simultaneously. And it's manifested in interpersonal interactions, for example when understand that I think one way about something but somebody else thinks differently about it. And it's absolutely essential for flexible problem solving to be able to re-imagine, for example, an alternative way of achieving the same goal.

Inhibitory control refers to the ability to suppress a tendency simply to repeat whatever one has done in the past. And one may need to inhibit a particular motor response—a kind of overlearned behavioural routine, but also to inhibit attention to distracting or irrelevant information. And then working memory is typically used, the term is used to typically describe not just keeping something in mind, but also being able to turn it around in your mind, and manipulate it in addition to just maintaining information.

Zelazo – parents (2:15)

Coping & Competence – 2.4 Executive function

Parents, I think, can play an important role in cultivating these kinds of skills. The ability to stop, and pay attention to what you're doing and consider the context. And consider what it is that one is doing in light of a broader range of considerations.

And that, that process of reflection is sometimes referred to as psychological distancing from a situation. So that one doesn't approach it in a more concrete and immediate fashion but considers it in relation to other things. One thing that I think is important for parents to keep in mind, is the, the relatively slow rate at which executive function develops over the course of childhood. It emerges early, in infancy, but it clearly continues to develop until at least early adulthood. And so we've looked at performance on particular measures from three to 85 years of age and you find an age-related increase, peaking at about 25 years of age, and then starting, rather precipitously, to decline over the course of adulthood.

Keeping in mind the relatively slow growth of executive function, parents, I think, might be encouraged to be patient with their children at particular times. Though it's quite a normal developmental phenomenon for children to, for example, be told what to do in a particular situation and you know they heard you, and they can even tell you right back what it is that they're supposed to be doing, but when they're in that situation, keeping the relevant information in mind and bringing it to bear on one's behaviour, in the face of distractions, and habits, and impulses, and so forth, is really challenging for young children. And so, so what looks like willful disobedience, is often just difficulty actually translating what one knows into behaviour.

Zelazo – preschool years (2:23)

Coping & Competence – 2.4 Executive function

Because executive function refers to the deliberate, the processes involved in deliberate, goal-directed problem solving, it's necessary to create more and more difficult problems in order to assess executive function at different ages, as children get older. And so one task that we've investigated quite extensively, is something called the dimensional change card sort which is quite useful for studying executive function during the preschool period, between, for example, about three and five years of age.

And in this task children are shown target cards and then, for example, a red rabbit and a blue boat. And then they're given a series of test cards that would be sorted differently depending on whether you were sorting by shape or by colour. So they match one target on one dimension, and the other target on the other dimension. And children are told to sort the cards, for example, first by shape, and then after they sort a card or two by shape, they're told, "Okay, stop. I want you to play a new game. We're not going to play the shape game anymore. Now we're going to play the colour game."

In the colour game, red ones go over here, blue ones go over here. "Here's a red one, where does it go?" And curiously, three-year-olds typically perseverate in that task. They persist in sorting by that initial dimension even though they've been told the new rules. And you can ask these three-year-olds, you can say to a child who's persisting in sorting by shape, but now being told to sort by colour, you can say, "We're playing the colour game now, right?" And they say, "Right". And you say, "So where do the red ones go in the colour game?" And they point to the right box. And you say, "So what about this red one?" And they turn around and they sort it incorrectly by shape.

So again, that's a situation where you need to think flexibly, you need to keep the relevant rules in mind, you need to inhibit a tendency to persist in sorting according to the old dimension, and younger children have considerable difficulty with all three of those aspects of executive function. Whereas older children tend to behave correctly in that situation.