[MUSIC PLAYING]

BEATRIZ LUNA: I'm really very excited to be able to share with you some of our more recent work that we've been doing, and historically what we've been accumulating, and the insights that we have been getting about brain maturation. And then I also want to spend a little bit of time describing to you a vision of actually starting and strengthening collaborations with Children's Hospital. So first I want reveal I have no conflicts of interest associated with this presentation.

So let me get right to it. I'm showing this here because this is the way that we are starting to really understand development and starting to understand what is the role of adolescence. And it is the following. You're born, you're in infancy, you go through childhood, et cetera. And this is a process of accumulation. You're learning to walk. You're learning to talk. The brain is actually growing. Right?

But by the time that you reach adolescence, everything is already there. And this is very important to keep in mind, especially those who interact with adolescents not just as a parent, but also in the clinic, and so forth. Everything is already there. And what is occurring is that brain maturation is shifting from a process of accumulation to a process of specialization. And this specialization is what is going to determine adult trajectories. And I will revisit this a little bit more as we go through.

So I'm sure that when people think of adolescence we often think of like, oh, my god. What were they thinking of? Oh, why do they act this way? You know? And if we remember the things that we did-- yes, it is true that during the puberty period there is a peak in sensation seeking, that those are behaviors that are meant to gain new experiences. They gravitate towards rewarding contexts and so forth. And we see a lot of that.

Now that can transcend into something that's called risk taking behavior. Those are behaviors that actually undermine our livelihood. And although adolescence is the peak of physical health, there is dramatic increases in mortality rates because of risk taking behaviors. So yes, it is true that during this time we will see the peak of substance uses. And this is a risk for later addiction.

This is the time when we will see the most fatal car crashes due to impulsivity, and so forth, in their driving. And this is when crime also peaks. So we think, oh, my god. Why would the brain have this period of impairment? It is not impairment. I think it's the most amazing period of brain maturation. It is not a sick brain or an injured brain.

In fact, sensation seeking is present across species, even in rodents. It is present across societies. And the way that we're understanding this period of peak sensation seeking is that it is an adaptive manner to obtain the skills needed to survive as an independent adult, and that we need these novel experiences in order to optimally sculpt the brain to fit the demands of that individual's specific environment.

Now that's all great. And there are these unique, very specific to adolescent period changes that are occurring in brain and behavior. And there are great opportunities that I will be talking to you about, because it really speaks to plasticity. But there are some vulnerabilities. So, for example, adolescence is a time when many of the psychiatric disorders that we recognize are starting to emerge.

So there's ADHD and autism, that's occurring early in development. But when you think of schizophrenia or any psychosis spectrum, mood disorders, depression, bipolar disorder, anorexia, even suicide is peaking in adolescence. So that is a piece of the puzzle. That is a clue that something very unique is going on in adolescence that either is breaking down the system or bringing forth an abnormality that was always there. And this is so well appreciated that the National Institutes of Mental Health have continuously funded my work for more than 20 years because there's something going on there that we need to understand.

Another piece of the puzzle is the following-- that across mental illnesses there is always a toll on reward processing, so how motivation and the appreciation of rewards and so forth are processed, and cognitive control. That means deliberated, planned behavior. Not that it characterizes these mental illnesses. Sometimes it does. But it is a recurrent feature across psychiatric illnesses.

So keep that in mind as I go forward to the adolescent brain. Because these are the two primary systems that are undergoing particularly significant maturation and refinement during adolescence. So you see how the pieces are coming together, and why there's a vulnerability for the emergence of mental illness during the adolescent period.

Now we know that there are very specific changes that are occurring during the adolescent period. So what I'm showing you here-- and I'm curious. How many people have seen this slide? Raise your hand. OK. So this is-- in my field it's a famous slide from the NIH. And this is showing how the gray matter surrounding the brain is thinning with development. You're like, oh, we're losing gray matter. No. This is fantastic. This is how the brain is actually specializing.

So blue means that you've reached adult levels. And what this is showing us is that by adolescence parts of the brain-- can you see my-- yeah, good-- including prefrontal cortex but not exclusive to prefrontal cortex, have not reached adult levels in adolescence. So you see that prefrontal cortex, parts of temporal, parts of even occipital visual association areas have not reached adult levels.

If you go within the brain, the striatum, which is needed for motivation and learning, in the hippocampus, which is involved in memory and contextual learning-- those have not read adult levels yet. We know that the white matter connectivity of the brain is continuing to change into adolescence, already reaching adult levels by adolescence. So here we have age-- by the way, most of the things I will show have age in the horizontal axis.

These heat maps here are two showing us that there is significant abundant growth in the white matter of the brain from childhood to adolescence. We also know from animal models predominantly, although we start to study this, as well, is that the neurochemistry of the brain is very unique during the adolescent period when we look at our GABA, glutamate, and dopamine. And I'll talk to you a little bit about that as we go forward.

So the predominant models that think about brain and behavior in adolescence have come to the following view of what is going on. That this is a brain where motivational, affective reward processes are predominating over cognitive control or deliberative processing. Right? Now several models have emerged. This, over here, was the first one. And I think that a lot of people are used to seeing this model, which is incorrect. So I need to correct that. And I want to elucidate that for you.

And predominantly what these models are showing, including ours, with the hatchet line it's showing us that these effective in the big systems predominate doing the adolescent period, which you could imagine is over here in the middle. And that these cognitive systems are not quite there during adolescence. Now our model is, of course, saying there is greater sensitivity to rewards but what characterizes adolescence is, in fact, that now there is access to adult level cognitive control. And this is very different from other models. And I'll show you evidence of why we are thinking this way.

But the implications are large. This was critical for when I informed AMA briefs to the Supreme Court, thinking of extended sentencing in juvenile crime. Because the crimes-- if you think, for example, of Columbine-- are very intricate. They do have prefrontal cortex. In fact, the way that we're thinking about this is that-- I mean, I kind of remember this, waking up one day and going, I'm not a little kid anymore. You know, I have my own way of-- I don't have to ask Mom and Dad.

I have access to these abilities. However, they are in the service of reward and motivation. Because again, the brain is trying to motivate the individual. Go and get me more information about the environment so I can specialize. So if you take anything from this early morning talk, please take the following. When you look at advertisements it's like this-- and there is comic strips and so forth that say ooh, look at teenagers. They don't have prefrontal cortex. That is not the case. Be the one to say no, we're missing the boat this way.

Not only that, but when I presented this to adolescent health groups they have said you have changed the way that we deliver treatment. Because before we were talking down to the teenagers thinking, OK, well, they can't really help us with their care. And now we're thinking, oh, what? If I'm in a room, just the two of us with no peer competition, I can actually access that ability in the adolescent. And, for example, for diabetic care they've told me now we say, you know what? You can participate in your own treatment.

All right. So how do we study this? We look at the quality components of cognitive control. I just want to remind you that behavior comes in two flavors, reactive or reflexive behaviors, which thank goodness we have those. We use it all the time. They're learned and automatic. And then behaviors that are deliberate, that are planned. And those are the ones that I've been referring to when I speak of cognitive control.

And the way that we look at this, is we probe the core components. One of the core components is the ability to stop reflexive, impulsive responses. That is very important. Because most of the time we want to be quick and impulsive. But we need to have a system that stops it so we can follow a planned response. And we also are interested in working memory, so the ability to retain information online to guide our behavior, so when you're keeping a phone number in mind until you write it down or you're playing a game and you're trying to keep your strategy online.

And then we use many different neuroimaging approaches to look at the brain. Now I just want to point out this very handsome 8-year-old boy who is now 28 years old. That is my son. That is how long I've been doing this. [LAUGHS] He's still a cute-- no, well not really.

[LAUGHTER]

So we are using neuroimaging methods that allows us to look at how the brain functions. It allows us to look at the network architecture of the brain, at the white matter connections of the brain. More recently, and I'm still excited although I don't have data to present to you today but just to keep it in mind, we're looking at the neurochemistry of the brain and how that is changing using a 7-Tesla magnet.

We also look at the oscillations of the brain, how two different regions-- what is the type of language that they're using to talk. And we are also very interested in the neurotransmitter dopamine, which underlies learning and motivation and really speaks to the model of enhanced motivational processes during the adolescent period.

So first, let me tell you about what we have found out about this deliberative prefrontal executive process. All right. So this is a demonstration. I'll ask you to look at me. You know, it's just fun. Anyways, so this is how this occurs. We ask people, look at a center light. Another light will appear. You don't know where. Just don't look at it. Look to the other side. So it goes like this. Boom. Super easy. However, what do we see adolescents do often, is the following. Oh, shoot. And then they move the other way.

Now this is very important. It's very compelling because it's letting us know, I know you wanted me to do but I was unable to engage that executive system before the reactive system took over. And you can just imagine when you think of adolescents, this really defines what they are doing. So we have done this in a very elegant way using eye movement metrics. Because that is the fastest movement the human body can make. And it can really-- you can't fake it. It is exactly showing us what we want to understand.

And what we find, and what many laboratories find-- and here again, age. This is how many times that you erroneously looked at the light-- is that you get so much better from childhood even to adolescence. You're so much better. And then you still keep getting better into adulthood. What is responsible for this ability increasingly getting better? Well, I'll tell you what is not helping with this difference in adolescents. And that is the use of prefrontal cortex.

So here's the evidence that I was telling you about. We've written 20 something articles on different aspects in clinical populations using this task. Here I'm showing you a longitudinal study. And what I'm showing you here is that from childhood to adolescence there is a difference in how this part of the brain is being used. Children have a very difficult time doing this task. So they need to engage this important part of the brain, like help, I'm so lost with this.

But by time you reach adolescence, you're using this part of the brain like an adult. So how come they're not doing as well as adults? And that is because there's another frontal part of the brain that's in the middle. It's called the dorsal anterior cingulate cortex. I have a little symbol of an alarm, because that is the way that we perceive this part of the brain. It monitors our performance. And when we mess up, an alarm goes off. And it's like, OK, ding, ding, ding, ding. Engage cognitive systems. Engage cognitive systems. And this has not reached adult levels by adolescence.

When we look at what performance has related to, it is related to-- for inhibitory control, it's directly related to how we use this part of the brain. And when we do mediation analysis it is actually explaining the differences in behavior that we see with inhibitory control. So keep that in mind. The prefrontal cortex is really about the ability to have voluntary, planned behavior. That is there in adolescence. One thing that's not there is the alarm telling you stop, you must stop. And you can imagine that kind of makes sense if we're thinking of the adaptive model of sensation seeking.

Another test that we do, and I'll just do it from here, it's a working memory task. And if you look at me I can show you, or you can see it from there. We're like, look here. Look there. Come back and look here. Remember where that happened. And we can wait all the way up to 10 seconds. Then we remove everything, and the individual has to go into the working memory repository and command their eyes, based solely on the content in working memory, to that location.

So again, it's a very eloquent and powerful way to test working memory. And what do we find? Something similar. There are dramatic improvements in working memory accuracy, and how quickly we can make a working memory response that is accurate. And that persists into the 20s. When we look at the brain, we get a very similar result. It is not due to prefrontal cortex. In fact, in this case it is due to the ability to engage the storage systems that are optimal for this particular task, which in this case was visual association cortex.

So here, these are just a flavor of two studies, although we have many studies that collaborate this in other laboratories, as well. The prefrontal cortex is available. Not that it's used consistently or in a sustained fashion, but it is available by adolescence.

Now another take-home that I want you to take with you is that when we say inhibitory control, working memory, it's not at adult levels, we don't mean that they do not have that ability. So at the trial level, even children can show a response that is just like adults. It's just that the proportion when you look at all the times that they did it, that is lower than adults. So, in fact, when you look at the intrasubject variability, that is dramatically decreasing with age.

That is another important take-home. When you think of adolescents you're like, this is so weird. Just this morning they were acting just like a perfectly nice little adult. And now they're like a beast, or whatever. There's a lot of variability. And we actually explored this. So we did this with a grad student who is now at Wash U. He had come from a single cell monkey laboratory where they looked at variability in neural activation and population level activation, and how that correlates with behavior, which is just amazing. And it's been published in very high tier things.

He's like, let's look at this in humans. So he looked at that working memory data. And he looked at the pattern that the whole brain uses functionally to be able to encode that information, keep it online, and produce a response. And what he found is that when you look at the average of this pattern of what the brain looks like, that is not changing with age. When you're doing encoding, for example, that is what the brain is going to look at.

Now what he did find is how the magnitude of the expression of these patterns-- I know this can be a little bit complex. But the point is, that when you look at the magnitude there is variability. Sometimes the brain is expressing at this level. Sometimes it expresses at this level. And that variability is associated with behavioral variability. And here you can tell. I'm showing you the variability here, how the same pattern can be expressed low or high.

And that variability, just like behavior variability, is decreasing with age. And I love this finding. Because it's telling us about specialization. Just like we know that adolescents are experimenting with different behaviors to see who they're going to be, the brain is doing the same. The brain is going, let me try it this way. OK. Let me try it this way. All right. Let me try it this way.

And then eventually it's going to be, based on a use it or lose it Hebbian process and based on rewards, it's going to say, this is the best way to express for this behavior. And then mechanisms such as myelination will come and say, good. We're going to cement it there. So keep that in mind when we talk about the models of how adolescence is determining adult trajectories.

All right. So that's the PFC function. Let me tell you about the other side, the motivational aspect of development. So I told you this do not look at the light, and how many laboratories, including our own, we always find that adolescents are really bad at it. Well, we have these other experiments we tell them before a trial, we're like, you know what? I know this is hard, whatever. But if you do this right, we're going to give you some money. And in other trials, don't worry. We're not going to give you money. And magically--

[LAUGHTER]

--all of a sudden teenagers can do this task, which is really hard, and almost at adult levels. How can that be possible? We just told you that the brain cannot do it. What we found was the following. And here, this is brain activity in a region of the brain, the ventral striatum, that has to do with reward processing. Red is adolescence, black is adult. And what we found is that when you offer teenagers a reward, that part of the brain goes crazy up high.

It's like, oh, my god. I'm going to get a reward. And at the same time, it is increasing activity in regions of the brain that can help you do this cognitive component of the behavior. So the way that we're looking at it is that there's an enhancement in reward that incentives the teenager to press the gas pedal to the floor. Because they are using this part of the brain at a much higher level than is necessary for adults just so that they can get the rewards.

And this is persisting all the way into the 20s in the college years. It is not surprising, but it really is telling us a story. In the presence of the rewards, they're going to really push themselves. And that can lead to impulsivity and some poor decision making.

So one of our latest result is that-- I've been telling you what the brain does when we show them a reward. But what happens when you're in the rewarded state, which is typically what is happening with adults? They're with peers and everything is great. They're very rewarded. So we've done some very interesting functional connectivity studies looking at what does the brain look like when there are in the rewarded state. So we had them do that rewarded test, and then we had them do absolutely nothing. So no reward was engaged.

And we wanted to get a notion of dopamine. So we looked at the connectivity between the ventral tegmental area, which is at the part of the brain with dopamine is produced, and the nucleus accumbens, which is a part of the ventral striatum, where dopamine is going to and reward and motivation is being processed. And what we found was the following. When there is no reward context, these two parts of the brain speak very nicely. And there are no age differences.

However, within a rewarded state what we find is that during adolescence there is much greater talk, so a real measure that dopamine is working a lot harder during a rewarded state during the adolescent period. And this starts to attenuate as we get older. Now more recently-- and I'm nerdy excitement of some of our dopamine PET findings. And I just wanted to present this with you, because the whole design is so cool. And anyways, so let me just tell you.

So we want to know about dopamine. Right? Now as you might know, PET is great to look at dopamine. But you do have to inject individuals with a little bit of radio activity. I mean, the equivalent of a trip to Europe, actually. But, you know, there are very strict regulations about pediatric populations. So you can, but it's not easy to involve pediatric populations in PET studies. So that's one piece of the puzzle.

So we said, OK, fine. We'll look from 18 to 30, because 18 is still part of the adolescent period. And we should be seeing some refinements all the way to 30. Great. So we looked at presynaptic dopamine, telling us how much dopamine does this system have, and then postsynaptic dopamine, how much dopamine is being used. What are the processes that can tell us that? But we still wanted to know early on.

So we did something that we've already published on before, which is we looked at tissue iron. Not blood iron, tissue iron, ferritin. It turns out-- we know this from Parkinson's and restless legs syndrome and so forth, that tissue iron in the brain is predominantly found in the basal ganglia and where there are dopamine rich areas. Because tissue iron is needed for the production of dopamine. So it is a way of non-invasively starting to look at dopamine.

So we said, great. We will use the molecular MR machine at Presby, which acquires PET and MR simultaneously. And we will study 12 to 30-year-olds. 18 to 30 get PET and everything else, and 12 to 30 get just the MRI aspect of it. So when we look at tissue iron, this is what we're finding. And I have the first draft for me to read, so we should be submitting this not too long in the future.

And here with age what we find is that tissue iron is increasing. And some of you might know, like duh, we know tissue iron is increasing no matter what. But this is beyond the normative age-related increases of tissue iron. And this is within all these aspects of the ventral striatum. Now when we look at the relationship of tissue iron to our direct measures of dopamine, what we see is that tissue iron is particularly well associated to VMAT, which is the vestibular monoamine transmission aspect of dopamine. So it is a measure of dopamine availability. So this tissue iron is particularly associated as a measure of dopamine availability, not so much with our measure of how much dopamine is being used or the separate density.

So when we go and we start to look at what did the PET findings show us, we find that when we look at dopamine availability, it is not changing from 18 to 30. So it's already become established by adolescence. And we can make the inference that early in development it was increasing, and now it is becoming stable. When we look at the measures of dopamine receptor availability, we see a decrease from 18 to 30. And this is, again, that theme of specialization.

It is as if the brain is saying, all right, here's all the dopamine that you have. Go for it. And start to choose what receptors you're going to use. And what you're not going to use, let's get rid of. So it's, again, this period evidence of plasticity. And finally, I'm going to tell you about another set of studies before I tell you about some really cool visionary things that we have in mind.

So we wanted to see how are these two systems talking to one another. So we went and we looked at the white matter of the brain. We went and we looked at these regions in the basal ganglia that have recently been talked about a lot. They're called convergence zones. It's part of the basal ganglia where there are fibers that are coming from cognitive regions, other ones from limbic affective regions. They exchange information in these particular zones to determine action in the basal ganglia.

So we identified that in our individuals. And we were particularly interested in cognitive in blue, and these affective limbic fibers that were coming from the effective limbic systems. And we looked at the ratio. In these convergent zones that are determining action, how much cognitive to affective fibers do we find across development? And what we found, not surprisingly, was that earlier in development these convergence zones have predominantly more white matter fibers that are coming from affective limbic regions over the ones that are coming from cognition.

And with development, this is flipping so that by the time that you're an adult the fibers are predominantly coming from cognitive networks. We went a little bit further and looked at how the white matter integrity in these regions were changing with age. And we found that, in fact, this flip that we see is not due to any changes in the number of fibers that are coming from the cognitive regions, supporting the model that I've been telling you for a while.

What we're finding is that there are actual decreases in the number of fibers that are coming from effective and limbic regions. In fact, we find a similar finding when we look at the connectivity between the amygdala, a part of the brain that has to do with emotion and attention and fear processing that has been associated with mood disorders, et cetera. The connectivity between the amygdala and prefrontal systems, we find, is dramatically decreasing with age.

We looked at both functional and structural connectivity. I need to follow up, because Maria did such a great job. She replicated her findings in big data in this paper. And it was the most highly cited paper in biological psychiatry last year. So I'm very particularly excited about that. So this goes with this model that I've been telling you about, how there is a peak in affective processing with AP frontal system that is new and starting to be used. And that is really telling us a lot about adolescence, really highlighting that during adolescence prefrontal systems are online, and affective systems are predominant influencing that decision making.

And I don't know, there are a lot of young people, but maybe other people know that this is Ferris Bueller from that movie. And that is such a great example of how adolescents actually do have the ability to plan. And it is done just for reward and motivation. But more importantly, it is telling us that this is a period of active specialization that can determine the adult modes of operation. So we think of like ooh, these crazy teenagers, so annoying. But in fact, during this time adult trajectories are being determined.

We had a review paper that I am very, very proud of, led by Bart Larson, who is now doing a postdoc at UPENN, where we scoured the literature, all the postmortem animal studies and so forth, looking at critical-- not sensitive-- critical periods of plasticity. Akin to what we know is occurring in visual cortex early in development, those markers are there in prefrontal cortex, and possibly in other association cortices. So the evidence is that during adolescence there is this door that's opening and saying, OK, do very significant specialization in prefrontal cortex. And then we're going to not completely, but significantly close this window so that you can be an adult.

Now that becomes extremely important. So overall, the way that we're thinking about development is the following. You are born with a neurobiological predisposition, defined by genes. Right? And you have an environment. And these are actually interacting. It biases how you interact and how the environment influences you.

And all the development is doing including adolescence, it's not trying to make a good brain or a bad brain. It is just saying, OK, you gave me that genetics. Ooh, I see that you are using these parts of the brain a lot. Oh, you're not using those other ones. All right. OK. This is who you're going to be. And if you're really lucky, you--

[LAUGHTER]

--end up being an exceptional person. Right? However, we're not all that lucky. [LAUGHS] And some people will end up having a mental disorder. So predominantly what we think is that the machinery that establishes trajectory is not necessarily what is broken. It is just doing what you gave it. Oh, so OK. You have a lot of experiences of adversity, so the amygdala has to be predominant in your brain. So, OK, we're going to make it so that now for-- your adult trajectory is going to be that fear and negative mood come forth first, before anything else, is some of the ideas.

So, all right. We have reached a lot of understanding, not just in my laboratory but in the field. I know that I've kind of hogged the field now, because I'm the president of the society and the editor in chief of our journal. But we know a lot. We know a lot about how cognition is changing, and how this is associated with different brain systems. So we're proposing the following.

You know when you take your kid to their well visit and they get weighed and they get measured? And they tell you oh, you know, Donnie is 60 percentile for his age. Fantastic. He shows growth. Or there are sometimes when the clinician is like, wait a minute. There has been a lack of growth. We need to investigate this further. And this is fantastic, because it's like, an indirect measure of something that might be specific that can be cut in a timely fashion.

We're thinking of doing the same to probe neural cognition by looking at core cognitive components. And the idea is the following, that we would follow at every healthy visit how is the cognition proceeding for their age. And we can say, oh, great. Everything is proceeding fine. But we would want to have the sensitivity to pick up when cognition is showing an impairment. Because, as I told you before, something that is core across psychiatric illnesses and behavioral impairments is cognition.

And the idea is, can we pick this up before you get the young adult level lifetime diagnosis of a mental illness. Let's get the markers before, agnostic as to is it depression, is it-- no. And really not because we care about how great you are at inhibiting your responses, but because looking at response inhibition and working memory is actually telling us how well-- what is the integrity of the complex brain systems that allows us to produce these behaviors.

So the idea would be like, hmm, this is not going well. Let's do a greater assessment of this individual. And what we want to then be able to do is to provide tailored interventions to bring that individual back into the normative range, be it that we've given them compensatory mechanisms or strengthened cognitive control so that they don't have to collapse into that mental illness diagnosis.

So we've been working with the Innovation Center. I've been talking a lot to the Children's Foundation. Hello, everyone. I know you've seen this talk too many times. And we have programmers. We have engineers who are trying to help us come up with a really fun way for healthy visits to proceed in this fashion. We are also starting to think how can we apply the interventions. There is a lot of cognitive training. There's CBT that could immediately start to be targeted for different aspects of correcting trajectories.

But we're also thinking what about brain stimulation, psychopharmacology because we're starting to understand the neurochemistry, different apps, et cetera. So here are some examples of what could be happening. You have Jane. She's 17 years old. She's starting to show a diagnosis of depression. What if we were to caught this way earlier before we thought it was depression. Yeah, she's a little moody, whatever. But we're seeing that the cognition has gone down.

And now we've identified that there is a particular cognitive process that speaks to a particular aspect of brain processing. And we have tailored and strengthened this so that now when she gets to 17, she is not crossing the threshold of diagnosis. Another way that this could be of help is we have Bobby. He's playing football, gets hit in the head, has a traumatic brain injury.

And now we're like, oh, my god. Look. His behavior has changed. How do we-- And there's a lot of great effort that's being done, admittedly. But what if we knew how Bobby was behaving beforehand, before the lesion? We could really, really tailor into what has been impaired, how can we tailor the intervention, and if the intervention is actually working.

So I want to finish by saying that these are big ideas that I have. [LAUGHS] And we have been talking to at many levels, with the foundation, with the administration, with the chairs, et cetera, is that you know what? We have powerhouse researchers at Children's Hospital and at Western Psychiatric Hospital. I mean, really amazing people who are committed to understanding development, either because they're interested in depression or they're interested in the effects of epilepsy.

We have a common goal. What if we start to bring all of these people to start to talk to one another? Now I see a lot of you who I talked to. There is Deb Bogen. We've started to talk about collaboration. I talk to Ashok a lot. And the wealth is amazing how much farther we can go, if we start to talk to one another. So the idea is to bring these two hospitals together through a program that would provide incentives for collaboration, pilot funding, et cetera, so that we can be a first in the nation brain cognitive developmental program.

Sometimes when I present people this vision, they're like, what? This doesn't exist? This doesn't make sense. How could it not exist? No, it does not exist. As you may know, prevention is not usually at the top of the list. But if we're thinking about development, catching things earlier, wow. What if we can prevent these mental illnesses? Not just in matters of cost, but in matter of life satisfaction for the family and for the community.

So what we're thinking is that we really are working very hard to find support so we can have intellectual capital and ways to incentivize collaborations. We are also looking to find the latest technology. And I just put this because most recently we've been using-- typically MRI is at the level of 3-Tesla. We are lucky to have a 7-Tesla magnet. That magnet, we do a lot of the neurochemical studies. That's the only place that you can do it for development. And my colleague's are doing it for aging and looking at psychosis. That scanner is starting to fail. And it's an expensive piece of equipment.

So I just want to tell you that I'm inviting people to come and let's play together. It can be so amazing that in our lifetime we might be able to make an impact in life trajectories. And going forward, you might hear more about me. Or maybe you won't, because we weren't able to garner the interest in the funding. But I think that we will.

Anyways, a couple of things. If you are really interested in this type of work, the Flux Society holds a yearly conference that is amazing, the best neuroscience that you will see that is related to development. This year, it's in New York. I also wanted to tell you, our study is actively recruiting individuals. We are particularly interested in finding kids, 10 to 17-year-olds. We desperately need these kids. Please, please tell people to come and participate in our studies.

Or if you know of a way that I can collaborate with people for recruitment, please, I beg you to please get in touch with me. If you know anybody, you can take a picture of this slide, they can directly contact us and be part of our studies. Of course, we pay money and we get to look at their brains. Or you can always Google Luna Brain and I should be coming up. So thank you very much. I want to thank the NIH. I want to thank the Staunton Farm Foundation, which supports me as chair, but also so much more in our research, and so forth. And to all the people in my laboratory, thank you.

[APPLAUSE]