Alan Hu Foundation Mental Health Lecture Series

Age of Opportunity: Lessons from the New Science of Adolescence

Webinar by Laurence Steinberg, PhD
Distinguished University Professor and Laura H. Carnell Professor of
Psychology and Neuroscience at Temple University
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[0:00]
CHIH-CHING HU: Welcome everyone to Alan Hu Foundation Mental Health Lecture Series. I'm Chih-Ching Hu, cofoun der of Alan Hu Foundation and host for your webinar. Today, Dr. Laurence Steinberg will present "Age of Opportunity: Lessons from the New Science of Adolescence".

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We'd like to thank the City of Pleasanton Community Youth Grant to fund this webinar. We'd also like to than k the Mental Health Association for Chinese Communities for providing simultaneous Chinese interpretation. And than k you to Ida Shaw for Chinese interpretation. Alan Hu Foundation's mission is to promote mental health, ra ise awareness and remove stigma surrounding psychiatric disorders, and support fun damental research for cures. Please consider making a gift to Alan Hu Foundation by using the donation link in the chat box. Thank you for supporting our programs.

[1:00]
Today it is our great honor and privilege to introduce Dr. Laurence Steinberg. Dr. Steinberg is a distinguished University Professor and Laura H. Carnell Professor of Psychology and Neuroscience at Temple University. He is the author or co- a uthor of approximately 500 articles and essays on development during the teenage years; the author of many books for parents, including "Age of Opportunity: Lessons From the New Science of Adolescence", "You and Your Adolescent", and "The 10 Basic Principles of Good Parenting"; and the leading college textbook, "Adolescence". His latest book is "You and Your Adult Child: How to Grow Together in Challenging Times". Dr. Steinberg has written for The New York Times, The W all Street Journal, and The Washington Post, and is a frequent guest on NPR.

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In this lecture, Dr. Steinberg will discuss the teenage brain's potential for change, the elongation of adolescence as a developmental stage, and the implications of each for how we parent, educate, and understand young people. This webi nar is being recorded. The recordings will be available on the Alan Hu Foundation website and Alan Hu Foundation YouT ube channel in about 1-2 weeks. Please subscribe to Alan Hu Foundation YouTube channel. Following the presentation, there will be a Q&A session. Please use the Zoom Q&A function to submit your questions. The presentation is for educational purposes only and is not intended for medical diagnoses. If you have any persistent symptoms, please seek professional help. With that, I'm turning to Dr. Steinberg. Welcome, Dr. Steinberg. Thank you for being here.

[3:01]
DR. LAURENCE STEINBERG: Thank you, everyone, for attending the webinar. I hope you find it interesting and education al. What I'd like to do tonight is to change how you think about adolescence. I've been in the field of adolescent psychology for almost 50 years now, doing research and writing, and teaching on this developmental period. I served on the National Academy's panel on the science of adolescence and chaired that panel for several years, and have been i nvolved in research on young people from all ethnic groups and all socioeconomic backgrounds around the world. I'm currently involved in a study that is collecting data in Asia, Europe, North and South America, and Africa. I'm also a parent, and our son is grown now, but I have experienced the parenting of an adolescent firsthand. What I want to say is that I have a very good sense of what the science of adolescent says, but there's a big disconnect between what the science tells us and what is available in popular books and articles.

[4:18]
If you go to a bookstore—either a virtual bookstore or a real physical bookstore—and you look in the section where there are books for parents of teenagers, you will see a lot of survival guides. If you go on Amazon and look, yo u see that there are many, many titles and see the word "survive" or "survival" in it. This stands in contrast to the titles of books for parents of infants. It's very common to see a book called "How to S urvive a Child's Adolescence," but I've never seen a

book called “How to Survive Your Child's Infancy”. I think it's wrong to think of adolescence as a period that demands that parents survive it. Or teenagers survive it. I want to convince you tonight that this attitude about adolescence is not working in the United States. As you probably know, we're in the midst of a mental health crisis among teenagers and young adults in America. We are seeing very high levels of depression, anxiety, and suicidal ideation. Now, the causes of this increase in mental health problems during adolescence that has taken place over the past 15 or 20 years are debated, and they're controversial. And I'm going to come back to this later in my lecture, but I think you'll be surprised when I tell you what the science actually says about why these incidences of mental health problems have been increasing over time.

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But that's not the only signal that we're doing something wrong. Our students have performed poorly on tests of achievement—standardized tests of achievement. You may have seen new stories that came out in the last week or so. Performance on tests of math and reading dropped considerably during the COVID pandemic, but they have not returned to their prior levels. We lead the world in dropping out in developed countries. We lead the world in truancy, and there is a huge truancy problem in the United States right now. When the pandemic ended and students were permitted to return back to school, we discovered that many of them did not want to go back and they don't want to go back because for many American teenagers, school is an unpleasant place, and I'll talk about that later as well. We also see our failures in rates of sexually transmitted diseases, teen pregnancy, and teen abortion. We lead the developed world in all of those indicators. And we also are a world leader in adolescent obesity, alcohol use, and marijuana use.

[7:18]
So I think you'll agree with me that we can do a lot better than we're doing in how we raise our young people. And we have an important stake in that. Whether you are a parent or a professional who works with young people, you know that we will be dependent on the next generation to take care of adults in this country when they reach that age. And so all of us have a huge stake in making sure that adolescence is a time when young people are developing in healthy ways. And it turns out that adolescence as a development period is much longer than it's ever been before.

[8:05]
In fact, I think it's too long to approach it as something that you're just going to survive. As if you're just going to hold your breath until it's over. The period of adolescence has been elongated at both ends. It starts earlier and it continues later. And we know this by looking at data on the age at which young people go through puberty, which is usually taken as the beginning of adolescence, and the rates at which young people enter into the roles of adulthood. And so the age of puberty has dropped considerably over the last 150 years, and it continues to decline. And that's especially true among girls. So at the turn of the century, the average American adolescent went through puberty at around 14 years of age. And now it's dropped to about 12 years of age on average. And as I will explain in a moment, puberty is important not only because it changes us physically, but it has a tremendous impact on the brain. And children are going through these brain changes earlier because the age of puberty is declining. Why has it been declining? I don't have a lot of time to go into the details, but there are three main contributors to the drop in the age of puberty.

[9:35]
The first is obesity. So, as I mentioned before, we lead the developed world in adolescent obesity. But we are a world leader in childhood obesity as well. And obese children go through puberty earlier than children who are more lean. And so, as obesity has increased, that has contributed to average drop in the age of puberty. A second contributor are man-made chemicals that disrupt the endocrine system. In fact, they're referred to as endocrine disruptors. And they provoke earlier puberty in young people. A lot of us automatically think that these endocrine disruptors are in food, and some of them are, but they're also in everyday products. And many of them are in plastic furniture that we sit on and expose ourselves to, so they get into the body through many, many different pathways. A third contributor is the increase in exposure to light. And so we know that young people who grow up near the equator go through puberty earlier than those who grow up further from the equator because if you grow up near the equator you're exposed to more sunlight and sunlight has an effect on brain that is associated with earlier puberty by interfering with the production of melatonin. But it turns out that the same impact of light on earlier puberty is seen in light from screens, and you've all seen the shocking and alarming statistics on how much time our young people spend in front of laptops, tablets, phones, and computer monitors. This increase in young people's exposure to light—and you've probably heard that it can be disruptive to sleep—but it turns out to also affect the brain in ways that trigger the onset of puberty at an earlier age. And so there is no question at all that the age of puberty has declined, and we understand why it's happening.

[11:54]
At the same time, the age at which people become adults has become later—and by that I mean the age at which they finish their formal education, enter the labor force, get married, become parents, and establish financial independence. Most young people don't make those transitions until their mid or late 20s. This has become a big issue, and it's one of the reasons why I wrote the book *You and Your Adult Child*. I'm not going to have time to talk about it tonight, but the delayed transition from adolescence into adulthood has surprised parents and has caused families to enter into new territory that they don't know how to handle.

[12:43]
A much higher percentage of Americans in their mid and late 20s are financially dependent on their parents today than has ever been the case before. And similarly to that, a much greater proportion of young people in their mid-20s and late 20s are living at home with their parents. In fact, living at home with your parents is now the most common living arrangement for Americans in their 20s. And this has really thrown families for a loop, too, because they don't know how to manage this. Now, it isn't necessarily all bad that adulthood is being delayed. A lot of it depends on how you spend the adult years. And so there are ways to keep the brain stimulated in adulthood that will keep the brain plastic—as I'll discuss in a moment—and allow young people to continue learning and developing.

[13:43]
What we've learned from the science should make us think of adolescence not as something to be survived but as an opportunity. But we're not taking advantage of the opportunity. And the opportunity stems from how the brain is developing during this period of time. So I want you to take a moment and think back about your own adolescence. And if you're like most people, you will have very vivid and detailed memories of that period of time. I know that when I think of my adolescence—and I'm 72, so that was quite some time ago —I can remember very, very small details of events and experiences and people and what people's voices sounded like and so on.

[14:33]
And it turns out that in psychological experiments, this experience is common among people. So, if you do studies to ask people to recall memories from different periods of time, people recall adolescence better than any other period of time. And this is referred to as a reminiscence bump because if you draw a graph of how much people are accurate in their reminiscences, you see a big increase in details for memories from the adolescent years. Now, there have been lots of explanations for this, but the dominant one has to do with the fact that the brain is increasingly sensitive during adolescence to the environment. And we refer to this as brain plasticity.

[15:24]
Brain plasticity is the ability of the brain to change in response to experience. We've known for a long time that the brain is very plastic early in life, and this is why we've spent so much energy and money trying to improve the state of early childhood education and daycare, and prenatal care because the brain is very, very plastic during the first few years of life. But a more recent discovery is that the brain goes through a second period of plasticity. A second period of sensitivity to the environment during adolescence. And during this time, what this means is that the environment in which we raise young people matters tremendously because their brains are super sensitive to experiences. And significantly, this is the last period of development where the brain is going to be this plastic.

[16:37]
Your brain is still plastic now, even if you're an adult. That is, when you go home—or you're probably at home—but when this lecture is finished and you think about it later this evening or tomorrow, the fact that you're able to remember some of it indicates that there has been some change in your brain or else there wouldn't be any way that you could recall it. So the brain is always somewhat plastic. But as I said, it's more plastic during adolescence and very early in childhood than at any other time in development. And that is what gives us an opportunity that I think we're not taking advantage of, because when the brain is plastic or malleable, it can be more easily influenced by experiences. It is more sensitive to the environment.

[17:27]
Now I want to talk a little bit about what we've learned about adolescent brain development, which is very important to understanding the nature of the developmental period and why it is a time of mental health problems for young people.

And I want to think about three different regions of the brain and brain systems that change dramatically during adolescence. And these are a regulation region, a reward region, and a relationship region, and I want to say a few things about each of these parts of the brain and how they're changing during the adolescent years.

[18:13]
And I want to start with the regulation system of the brain. Many of you have probably heard of a brain area called the prefrontal cortex. That's the part of the brain that's directly behind your forehead. The prefrontal cortex is really the last region of the brain to be changing with development. It is the last part of the brain to mature. The prefrontal cortex serves a lot of functions, but two of its most important are advanced thinking abilities like reasoning about challenging problems or balancing risk and reward, and making a decision. But the prefrontal cortex is also the main region of the brain that is responsible for the development of self-control. Of self-regulation. And we know that as the prefrontal cortex develops during the adolescent years, people on average become much better at exercising control over their emotions, and their thoughts, and their behavior.

[19:26]
This is very important because studies show that probably the single best predictor of success in life, in school, at work, in relationships, that success in life is better predicted by self-control than by any other trait. If you look at the predictors of success in school, for example, what you find is that self-control is a better predictor of grades in school and school performance than IQ is. It's more important than intelligence. And so, because the prefrontal cortex is still developing and therefore is still very plastic during adolescence and is important for the development of probably the single most important trait that there is for success in life, we need to take advantage of this tremendous opportunity.

[20:23]
And you've probably heard a lot about the importance of things like grit and perseverance. And perhaps if you're a parent or teacher, you've seen this in your own children or the students that you work with. It’s that it's not always the smartest ones who succeed in class. It's the ones who are most determined and most persistent. And that determination and persistence, and grit come from the maturation of the prefrontal cortex. What do we know about what contributes to that? What do we know about the way in which parenting influences the development of this regulation system?

[21:03]
Well, the research here is very, very consistent. There is a style of parenting that we psychologists call authoritative parenting. And that is parenting that is both strict, but warm. You need to do both of them in order for it to be effective. To be strict—that is firm. To have rules and expectations, but to be warm and loving and affectionate toward your child. And this combination has been shown to contribute to self-regulation, which in turn contributes to success in school and in work and in your social life. But it's important to help our young people develop self-regulation, not just for purposes of achievement, because adolescence it turns out, is the peak period in life for risky and reckless behavior. And one of the best protective factors from children getting into risky situations and engaging in reckless behavior is a strong sense of self-control.

[22:14]
So by helping your child develop a more mature prefrontal cortex—develop better self-control—you're not only helping your child in school. You're helping a child develop the abilities to resist temptations to get involved in risky and reckless Behavior. Why is this so important? Well, adolescence, generally speaking, is a very healthy time in human development, a very low rates of disease and illness during adolescence compared to other stages. And the major causes of morbidity and mortality during adolescence are behaviors that young people engage in, and a lot of these behaviors are risky behaviors. So if we can do something to diminish adolescent tendencies to engage in risky behavior, we can really improve the health of our children and teenagers.

[23:10]
Now, this is the same time that the self-regulation system is developing. There's also a change in the brain in the reward region, and the brain becomes much more sensitive to reward during adolescence than before or after. And we understand this to be due to the impact active puberty on the brain. And so adolescents, compared to children and adults, are more likely to seek what they think are rewarding experiences, and they have more difficulty stopping themselves from doing this because their self-regulation is still immature. It's still developing. One way to think about it is that adolescence is the time when the accelerator is pressed down to the floor, but there isn't yet a good braking

system in place. And this imbalance between the pursuit of rewards and the ability to control our impulses is what leads adolescents to engage in so much risky and reckless behavior. Things like reckless driving, or binge drinking, or unsafe sex. These are all higher during adolescence than before or after. And I mentioned earlier that I've been involved in international studies. And in one of our studies that took place around the world, we looked at the development of the reward-seeking behavior and self-control in a large sample of young people from all over the world. And what we found was that the patterns of development were very, very similar across countries that are very, very different.

[24:52]
So why, from an evolutionary point of view, would adolescence be a time when people are more likely to engage in risky behavior? You would think that that would be too dangerous. And if you understand adolescence in other species, you have a clue to answering this question. Because in most species of mammals, the juveniles in a family group leave home shortly after puberty. And they go out into the world to explore and to mate, and to learn skills that are going to help them be successful adults and to have children of their own. But this is a risky behavior because when young juveniles go out into the world and don't have their parents to protect them, they encounter stronger, and bigger, and smarter adults in the environment. And this is a huge risk in terms of their own survival and health. And so we now believe that adolescence has been genetically programmed as a time in which people are more willing to and more inclined to engage in risks because this risk-taking during adolescence is what allowed our species to survive.

[26:18]
Now, I mentioned before, there are three main systems that change during adolescence: The regulation system, the reward system, and the relationship system. So we've talked about regulation and reward, let me say a few words about the relationship system. There is a huge increase in adolescent attentiveness and concerns about their peers during adolescence that is very familiar to all of us who've raised or worked with young people. And so susceptibility to peer pressure is higher during adolescence than it is before or after. And in our research lab at Temple University, we have been doing research on the impact of peers on adolescent decision-making. And what we have found over and over again is that young people are more likely to take risks when they're with their friends than they are when they're by themselves. And this isn't simply because their friends are encouraging them to behave in risky ways. Simply being near other adolescents seems to increase adolescent risk-taking behavior. And it does this by activating and strengthening the reward system in ways that make adolescents who are already interested in rewards even more so. And that leads them to engage in more risky behavior.

[27:46]
I don't want you to come away from this lecture thinking that all risk-taking is bad. We've been doing research on what we call positive risk taking because there are times when we want our adolescents to take risks to take harder classes or to try out for leading parts in the school play, or to ask somebody out that they're nervous about talking to. So all risk-taking isn't bad, but there is a lot of bad risk-taking that exposes adolescents to some very serious harms.

[28:18]
Now I want to come back to this idea that the brain is plastic and malleable, and that therefore it provides an opportunity. Especially an opportunity to help kids develop self-regulation. But the same malleability, the same plasticity that makes adolescents and opportunity, also makes them more vulnerable because the plasticity of the brain allows the brain to be more responsive to both good experiences and bad experiences. To both healthy experiences and toxic experiences. And this heightened vulnerability of the brain is important in understanding why adolescence is a very significant time for the emergence of mental health problems, because the brain can be harmed by exposure to toxic experiences. It helps to explain why adolescence is a very important time for the development of substance use and abuse because the parts of the brain that respond to recreational drugs are more sensitive during adolescence to the effects of these drugs than in other periods of time.

[29:33]
And so, just as a concrete example of this, we know that if a young person doesn't use tobacco or alcohol or marijuana until age 21 or later, then they're protected against addiction and dependence. And someone who starts using these recreational drugs during the early part of adolescence is 10 times more likely to develop a drug use problem than somebody who delays it until they're entering into their 20s. And puberty—by affecting the reward system the way that it does—leads adolescents to engage in risky behavior. It leads adolescents to try recreational drugs. And it makes adolescence especially susceptible to the effects of trauma.

[30:27]
And so this means—taken together— that we need to be very careful to make sure that the environments of adolescence are those that facilitate healthy development, that take advantage of the opportunity that adolescence is. And that protects adolescents, given the fact that they're more vulnerable to bad experiences in the environment.

[30:52]
Now I think it's fair to say when you look at the experiences of high school students in the United States that our high schools are squandering the opportunity to take advantage of this brain plastic. Now, this may not be the case in the schools that you go to if you're a student here—or the schools that your children go to if you're a parent—but national surveys tell us that a huge percentage of adolescents say that school is boring and say that school is uninteresting. Now, a lot of them work very hard in school, as I'll explain in a moment. They have to work so hard, not because the work is so challenging, but because there's so much of it. And we have managed to create an educational system in the United States in which we're stressing children without challenging them, and the difference between the two is important to keep in mind.

[32:01]
Challenge is the situation in which you're asked to perform a harder task or a more advanced task than you have been able to perform before, but that is something that you can master. It's just the next rung up on the ladder that you can reach and pull yourself onto. And when we challenge young people by asking them to do a little bit more than they've done before intellectually, we help build the prefrontal cortex and that system of the brain.

[32:38]
But challenge is not the same as stress. Stress, we know, is bad for the brain. Stress produces an excess of a hormone called cortisol. Cortisol in high levels eats away at important material in the brain. So stress—unlike challenge—is when we demand something from our young people that they can't accomplish. And I think it's fair to say that in communities like yours, we are not only expecting our adolescents to have a perfect GPA. We're expecting them to be perfect on the athletic field, in extracurricular activities, in volunteer activities, and we're asking them to be this perfect person in a way that's nonchalant. That suggests that they're not even trying all that hard. And adolescents are under a tremendous amount of stress because these demands that we're putting on young people exceed their abilities to master them. And we need to rethink how we are handling this aspect of adolescence, and I'll talk about this a little bit in a moment.

[33:56]
The deficiencies in self-regulation that are caused by our inadequate challenge in schools show up when young people begin college. A lot of young people in America are encouraged to go to college, and that's more or less a good thing to do. And the United States has one of the highest college enrollment rates in the developed world. But the United States also has the highest college dropout rate in the developed world. And so a lot of young people are encouraged to go to college, and once they get there, they can't do the work that they're asked to do. And they can't do the work because they haven't been adequately prepared in high school. And a lot of them leave college after their freshman year or during their sophomore year. And this, of course, is very expensive for the young person and his or her family. And it's also very expensive for colleges and universities because if you look at the impact of college on your success in the labor force, what we find is that it's getting a degree that matters. It's not going to college for a certain number of years. And so if you start college but you don't get a degree, you have almost no advantage over people that just went right to work after high school. And given the high cost of college and university in the United States, to start college and not finish it is a huge waste of money for families and for universities.

[35:39]
Now I want to come back to something that I'm sure you are all very curious about. I mentioned at the beginning of my lecture that there have been important increases in mental health problems, especially depression and anxiety, among American teenagers and young adults during the last 15 years or so. And I mentioned that the causes of this increase have been debated and continue to be debated. And I'm sure that you have been told and you have read that the primary contributor to the increased depression and anxiety that American adolescents are experiencing is social media. And I want you to know something that most people don't know. And I know what I'm about to say is correct because I've studied the science that has looked at social media and its impact on teenage mental health. And there is no evidence that using social media causes adolescents to become anxious or depressed. No evidence that they're related

in a causal way. Adolescent depression is correlated in a very small way with social media use. But it looks like a lot of depressed adolescents turn to social media rather than social media making them depressed. We just don't have good enough evidence that social media use causes adolescents to become depressed to make the kind of sweeping policy changes that have been promoted.

[37:15]
Now I want to conclude with some practical advice for parents and for young people about how to protect the adolescent brain and how to cope with the academic pressure that young people report—and they do report it. A study out of Harvard University last year asked young people— a representative sample of young people in the United States—what the main threats to their mental health were. And at the top of the list was academic pressure. And social media barely made the top 20 factors identified by adolescents as causing stress and mental health problems in their lives.

[37:59]
And so that is consistent with what the scientific evidence says, which is that the impact of social media on adolescent mental health has been greatly exaggerated in the popular press. Now, the stresses that come on during adolescence—especially academic stress—are not going to go away. There are some things we can do to make school less stressful without making it less challenging, but it's going to be very hard to do. And there are a lot of stressors that adolescents are sensitive to that aren't in school. When we look at surveys of what adolescents say is stressful, they mention, as I said, academic pressure. But they mentioned climate change, and they mentioned worries about school shootings. And they mentioned concerns about how the labor force is changing and whether they'll be successful in it. They don't mention whether they're getting enough likes on Instagram. So there are legitimate stresses in young people's lives, and I don't want to minimize them. But if we can't make those stresses go away, what we need to do is to help adolescents develop coping skills that allow them to protect themselves against the toxic effects of these stressors.

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And there are five things that we need to do. And some of these are things that adolescents can do for themselves. And some of these are things that parents and teachers need to do. But let me go through the most important ones —there are five of them. The first is sleep. We know that sleep has a protective impact on the brain, and we know that a huge proportion of adolescents are sleep deprived. So adolescents need to get seven or eight hours of sleep a night at a minimum in order to protect their brain development. A second protective exercise is physical exercise. So we know that having aerobic activity exercise every single day is not only helpful for our physical well-being, but it's helpful for our mental well-being. And it's helpful for brain development.

[40:20]
Unfortunately, a lot of schools have gotten rid of their physical education programs. And so in some school districts, the only kids that get daily physical exercise are the ones who play school sports: varsity or junior varsity sports. But all adolescents— not just competitive athletes—need daily exercise. A third activity—that turns out protects against stress—is mindfulness development. So mindfulness training can be found in things like meditation, or yoga, or tai chi. But we know that those activities are very good for helping us cope with stress. And so adolescents need to be encouraged to engage in those activities because it will help them develop better coping abilities to manage the stresses that they're exposed to. And I should say that these factors that I'm mentioning are really good for you as adults as well. To get adequate sleep. To get adequate exercise. To engage in activities that promote mindfulness. These will help you cope with stress in your life. The fourth thing that's important to helping adolescents develop coping skills is the kind of parenting they're exposed to. And I mentioned before that there is a style of parenting called authoritative parenting, which combines being firm and being warm. And adolescents who are raised in this kind of family environment cope better with stress and have fewer mental health problems and fewer physical health problems than adolescents who are raised in households that are too permissive or not warm enough. And so parents can help kids develop in this realm as well. And finally, it's important that adolescents are challenged without being stressed in school. And if you believe that your adolescent is bored by school and is not being challenged you should bring this up as a concern to your school's teachers and principals. Because adolescents need challenge—appropriate challenge—to develop a stronger prefrontal cortex and self-regulation system.

[42:46]
And so I want to conclude tonight before I take questions from you with what I hope is a message that you've gotten from me. We have to stop thinking about adolescence as something to be survived. We need to think about it as a time

when young people can thrive. And if we do that, we can improve not only the long-term development of young people, but we can improve their day-to-day life while they're living it as teenagers. And so we have to stop thinking about adolescence as a problem to be solved. And to start thinking about it as an opportunity that we need to seize.

[43:36]
So, thank you for your attention. I hope I've changed the way that you think about adolescence, and I'm happy to take your questions.

[43:45]
CHIH-CHING HU: Thank you so much, Dr. Steinber,g for the wonderful presentation. So now we will open up to the Q&A. The first question is from a high school health teacher: "I teach Health at Foothill High School. We studied the teenage brain. Please discuss synaptic pruning and its relevance to teenagers. Thank you".

[44:08]
DR. LAURENCE STEINBERG: Sure, great question. So the brain is basically an electrical system. The brain cells—what are neurons— are connected to each other because neurons have arms or tendrils like an octopus that reach out. And they come very close to the tendrils of adjacent neurons. And when an electrical impulse is generated in the brain, it travels along these circuits that are composed of neurons and the tendrils that connect with other neurons. Now, when these tendrils connect with each other, they almost touch, but they don't touch. And that little gap in there is called a synapse. And synaptic pruning is a process through which the brain eliminates unnecessary synapses. So, one way to think about it is that when we're born and during childhood, our brain is like a network of small unpaved dirt pathways. And by the time we become adults, that network has been made more efficient by becoming one that is composed mainly of a smaller number of superhighways. And synaptic pruning is the process through which the wiring of the brain is changed by eliminating unnecessary synapses.

[45:43]
CHIH-CHING HU: Okay, next question from our audience: "How is sunshine affecting adolescent brain development? What do you think of light therapy?".

[45:53]
DR. LAURENCE STEINBERG: Well, as I mentioned before, exposure to too much light—especially indoor light, as we now know today, blue light— seems to accelerate the onset of puberty, and that is not good for kids to go through puberty at such a young age. But exposure to sunlight is also—in appropriate amounts—is an important contributor to mental health. And it's been shown that when individuals who live in environments in which there is inadequate sunlight undergo light therapy, that for many of them their mental health improves. And so it's good for—and you know I mentioned before—that it's really important for kids to get enough physical exercise. And so it would be especially good, especially for those of you who live in such a pleasant part of the country, to encourage kids to get physical exercise outdoors where they're getting exposure to sunlight as well as aerobic activity.

[46:57]
CHIH-CHING HU: Okay, so next question: "Does authoritative parenting still work when teens are more argumentative and testing parents? What is the best way to maintain the approach at that time?".

[47:13]
DR. LAURENCE STEINBERG: Great question. A lot of parents believe that their kids become more argumentative as adolescents. But really, what's happening is that they're becoming better arguers. And that makes you more frustrated as a parent. Now, the fact that your adolescent is challenging your opinions about things—it's hard for you to deal with—but it's actually a sign that their cognitive development is proceeding in a healthy way. Because you want your teenager to challenge people when they're being asked to do something that they don't want to do. And you can't raise a teenager who's going to stand up for them themselves outside the home if you don't allow them to do that sometimes inside the home. Now, where does authoritative parenting fit in? It fits in because being an authoritative parent not only means that you are strict, and have rules, and expectations. It also means that you're loving and affectionate, and warm. And part of authoritative parenting that contributes to healthy development is when parents take the time to explain their thinking to their adolescent rather than acting in a do-it-because-I-said-so way. And if you take the time to explain your

rules and your expectations in a calm and loving way—as an authoritative parent does—you will find that your child will become less argumentative. It won't stop them from asking you questions, but you don't want them to stop asking questions. But it may stop them from challenging you and fighting you when they have a better understanding of your own reasoning and your perspective.

[49:12]
CHIH-CHING HU: Okay, thank you. Next question: "How do neurodevelopmental conditions—neurodivergence like ADHD and ASD, and arguably giftedness—affect the science of adolescence?

[49:29]
DR. LAURENCE STEINBERG: That's a great question, and I wish I had a good answer for you, but I don't think that we know. That is, most of the studies of adolescent brain development of the sort that I talked about today have not been done with neurodivergent populations. And so we don't know how the brain development of children with attention deficit hyperactivity disorder or who are on the spectrum differs developmentally from other young people. Now, obviously, all psychological states, including ADHD and autism spectrum disorders, have some component that can be seen in the brain. But I don't know, and I don't think we know yet how the process of adolescent brain development differs for neurodivergent young people.

[50:30]
CHIH-CHING HU: Okay, the next question: "I've read that the development of the prefrontal cortex is often delayed in ADHD, which affects the inhibitory system as well as executive functioning and doesn't fully develop until the late 20s or even early 30s. Is this accurate? And what other impacts are there beyond just being delayed?"

[50:58]
DR. LAURENCE STEINBERG: Well, certainly if a child has a disorder which is making them have difficulty controlling themselves—have difficulty engaging in self-regulation—it's going to have manifestations like deficits in attention or difficulties in controlling one's behavior, which may lead to them being hyperactive or being perceived as hyperactive. We do know that some young people show a slower trajectory of brain maturation in the prefrontal regions. And some of these young people have psychological and behavioral problems as a consequence of that. I think that we don't know yet how much of things like ADHD are caused by slower development, where individuals catch up later, or whether they're caused by immaturity that doesn't resolve itself. And we know that there are adults who have ADHD. And so there's reason to think that some of the problems in the functioning of the prefrontal cortex that existed when these adults were children have not gone away. Now we also do know that ADHD is a very treatable condition, usually with a combination of medication and psychotherapy. So there's no reason that a child has to suffer with it because it can be effectively managed in a lot of cases.

[52::42]
CHIH-CHING HU: Okay, thank you. We have a comment from a retired teacher: "Thank you for pointing out the students' need for intellectually stimulating school work rather than just more busy work. "

[52:56]
DR. LAURENCE STEINBERG: Well, I'm glad that you agree with me. I know that the audience is on mute, so I couldn't hear reactions to that, but when I've given this presentation to audiences that contain high school and middle school students, they clap very vigorously when I say that they don't need all this make-work. What they need is more challenging teaching and assignments.

[53:23]
CHIH-CHING HU: Right, right. Next question: "How much does genetics affect mental health relative to environment?"

[53:33]
DR. LAURENCE STEINBERG: Well, that's, of course, an age-old question. It's difficult to say because genetic influences and environmental influences work together. And so in some sense it's a good question, but it's the wrong question. We know that all mental health problems have some genetic component. And all of them also have an environmental component. And so in depression, for example—which is probably the most studied— we know that individuals with certain genes are more likely to develop depression. But we also know that there are lots of people with those genes

who don't develop depression. And the reason is that they don't grow up in an environment that is stressful. So it's the combination of stress and a genetic tendency that leads to the mental health problem. And that's true for most mental health disorders. And so, just because someone has inherited a set of genes that is associated with a mental health problem, does not mean it's inevitable that this person is going to develop it. It may mean that they need to be extra careful about the kinds of environmental experiences that they're exposed to. That they need extra protection than individuals who don't have a genetic tendency toward that mental health problem. But I think in the field we've moved away from the "how much" question: how much is genes, and how much is environment. And I think the question that we're asking now isn't "how much" but "how". How do genetic and environmental factors interact with each other to produce a problem in mental health?

[55.23]
CHIH-CHING HU: Right, okay. We have a couple of questions related to sleep. One type of question is the amount of sleep needed for a teenager. The other question is that they always go to bed very late, until 2 AM. Any recommendations?

[55:50]
DR. LAURENCE STEINBERG: Right, so I think the evidence is that adolescents need a minimum of seven hours of sleep every night. More is better when it comes to sleep. But a minimum of seven. And what should a parent do when their child just stays up so late, till let's say 2 o'clock in the morning? And then has to wake up so early to get to school that they don't get seven hours of sleep? What the key is—I think there are two things that parents can do that will help. The first is removing the stimulation in their bedroom that's allowing them to stay awake longer. And some colleagues of mine—who are clinical psychologists—who work with families who have asked this question, say that one approach is for everybody in the family to leave their smartphone out of the bedroom when they go to sleep at night. And parents do it as well as the children. The second thing that really helps is to get up at the same time every morning. And so I would not fight my teenager about what time they go to sleep at night. But I would fight them about when they get up in the morning. And a big mistake that families make is that when the weekend comes, they allow their child to sleep in very, very late in the morning. And then as the week progresses, they find it very hard to get up on Monday. Hard but not quite as hard on Tuesday. Hard but not quite as hard on Wednesday. And by the time Friday rolls around, they're not having difficulty getting up for school even though they're still staying up late. But it's a mistake at that point to say Saturday mornings and Sunday mornings you can sleep as late as you want, because that undoes all the progress that you've made during the weekdays.

[57:54]
CHIH-CHING HU: Okay, the next question: "For parents with kids younger than 10: Is there anything we can do now to prepare our children's minds before they approach teenage years of puberty?"

[58:11]
DR. LAURENCE STEINBERG: Absolutely, and as I describe in my book *The Ten Basic Principles of Good Parenting*, authoritative parenting has been shown to work among younger children and elementary school age children as well. And so the best thing to do as a parent from the time your child is in preschool and through the elementary school years is to be an authoritative parent. And that will help give them the skills and strengths that they need to be a successful adolescent.

[58:47]
CHIH-CHING HU: Okay, so we're about time. Maybe we will ask the last question: "For kids in colleges, especially junior and senior years, parenting seems out of the picture. How do parents help young adults at this period of time?"

[59:03]
DR. LAURENCE STEINBERG: Great question, and that's partly what my book *You and Your Adult Child* is about. I think that the main thing that you can do for your child is to be supportive without being directive. In other words, if your child comes to you and asks for assistance —whether it's financial or emotional, or instrumental—you should be there. But you should focus on—when your child is having a problem—you should focus on helping your child find help for that problem. In other words, saying "Okay, I think there are people on campus who can help with this," and "have you tried to find those resources," rather than stepping in yourself and solving the problem for your child.

[59:47]
CHIH-CHING HU: Okay, great. Thank you so much, Dr. Steinberg, for sharing your knowledge with us today. And thank you to everyone for joining in our webinar. We hope to see you again in the next webinar. This webinar is being recorded. The recordings will be available on the Alan Hu Foundation website and Alan Hu Foundation YouTube channel in about one to two weeks. Please subscribe to the Alan Hu Foundation YouTube channel. And please take a moment to fill out a short survey. Your input is critical to us in order to improve the program. And I will leave the donation QR code for a few more minutes. And thank you for donating to support our programs. With that, I'm closing the webinar. Thank you, Dr. Steinberg, and thanks everyone. Take care and stay well.