Building a Dynamic Brain: The Influences of Movement, Nutrition, and Music

The Second Webinar in the "Little Voices for Healthy Choices" Series

Laura Annunziata: Good afternoon everyone. My name is Laura Annunziata, and I am a senior training specialist at the Early Head Start National Resource Center at Zero to Three. I'm very pleased to welcome you to this afternoon's webinar entitled "Building a Dynamic Brain: The Influences of Music, Movement, and Nutrition"...the second webinar in the "Little Voices for Healthy Choices" series. "Little Voices for Healthy Choices," sponsored by the Office of Head Start, is an initiative focused on issues in nutrition, music, and movement, particularly, as they relate to infants, very young children, their families, caregivers, and communities.

We're very pleased to have all of you joining us today as we spend the next hour or so exploring concepts in early brain and neurologic development, looking particularly at the prenatal period and children between birth and 3 years of age. We have three wonderful presenters joining us. Donna Britt, senior program manager, distance learning and senior training specialist, and with the Early Head Start National Resource Center at Zero to Three, and Valerie Bayne Carroll and Maria Tripodi, teaching artists with the Wolf Trap Center for the Performing Arts. In the audience, today, we are joined by staff from programs throughout the country, both those that are participating in the yearlong "Little Voices for Healthy Choices" initiative as well as federal staff, technical assistants, consultants, and others interested in the "Little Voices for Healthy Choices" content.

Today's presentation will include some interactive arts activities, a PowerPoint presentation, and an opportunity to ask questions of our presenters. We will also be sharing some short videos with you. If, for some reason, your computer has difficulty processing the video in this live format, don't worry. You'll have a chance to view it again later when this presentation is archived for you. Now, I'd like to introduce you to Valerie Bayne Carroll and Maria Tripodi. Both Valerie and Maria are arts educators with many years of experience working with infants and very young children in a variety of settings. They will begin by sharing a music and movement activity with you called "Dance Like Raindrops." If you've brought scarves with you, please take them out now so that you can use them as you follow along with them in this experience. Maria, Valerie?

Valerie Bayne Carroll: Thank you Laura. This is a simple song that uses scarves with rhythmic movement.

Maria Tripodi: Esta una canción simple que utiliza pañuelos con movimiento rítmicos.

Valerie: It focuses on crossing multiple midlines.

Maria: Su enfoque es cruzar las líneas del cuerpo.

Valerie: Causing information to be transmitted from the right and left sides of the brain.

Maria: Que causa que la información se transmita de una parte del cerebro al otro.

Valerie: So to join in, stand up in a place that gives you some space to move.

Maria: Si quiere participar, levántese y encuentre un espacio donde se pueda mover.

Valerie: First. I'll describe the movement, and then we'll add the singing.

Maria: Primero voy a describir el movimiento y después vamos a agregar el canto.

Valerie: So with a scarf in each hand, extend your arms up over your head.

Maria: Empiece con los pañuelos en cada mano y sus brazos extendidos arriba de la cabeza.

Valerie: Then slowly sweep the scarves down in front of you to the ground, swishing them from side to side.

Maria: Lentamente vamos a bajar los pañuelos hacia el piso, moviendo de un lado al otro como una serpiente.

Valerie: And when you finish, the scarves will be touching the ground.

Maria: Cuando terminemos, los pañuelos estarán tocando el piso.

Valerie: and you'll be bent over at the waist, crossing the first midline.

Maria: y estaríamos doblados hacia abajo, cruzando el primer “midline”.

Valerie: Next, you'll uncurl into a standing position with your arms stretched out from side to side.

Maria: Lentamente volvemos a pararnos en una posición recta con los brazos hacia los lados.

Valerie: Then, you'll twist from side to side, crossing the midline that runs up through the belly button.

Maria: Luego, girar media vuelta de lado a lado, cruzando el “midline” del centro del cuerpo.

Valerie: For the third movement, hold your scarves out in front of you.

Maria: Para el tercer movimiento, sostenga los pañuelos en frente suyo.

Valerie: and wave them up and down, alternating hands, as if you're splashing water.

Maria: con los brazos extendidos, comience a mover los brazos en dirección contraria hacia arriba y hacia abajo como si estuviera chapoteando sobre el agua.

Valerie: And you can also add your feet, as if you're splashing through a puddle.

Maria: También puede agregar los pies, como si estuviera chapoteando el barro.

Valerie: Now, we're not crossing a midline with this.

Maria: No estamos cruzando una línea con esto.

Valerie: But by alternating hands, we're still stimulating both sides of the brain.

Maria: Pero haciendo la dirección contraria, todavía estamos estimulando las dos partes del cerebro.

Valerie: Finally, for the last midline, keep your arms extended in front of you.

Maria: Finalmente, para la ultima línea, mantenga sus brazos extendidos en frente suyo.

Valerie: Open your arms until they're extended behind you, and then close them again.

Maria: Y luego comience a abrir los brazos hasta que se extiendan hacia atrás.

Valerie: And with that we've crossed the midlines that run up both sides of the body.

Maria: Y con eso hemos cruzado las líneas que corren por los lados de nuestros cuerpos.

Valerie: Now, we'll add the singing to the movement.

Maria: Ahora vamos a agregar el canto al movimiento.

Valerie: So start again with the scarves over your head, sweeping them down to the floor as we sing.

Maria: Comencemos de nuevo con los pañuelos con los brazos extendidos arriba de nuestra cabeza.

Valerie: Here we go. ♪ Dance like raindrops, dance like raindrops.

Maria: ♪[in Spanish] Empecemos, baila lluvia, baila lluvia.

Valerie: Now uncurl to standing, arms stretched out at your sides and get ready to twist.

Maria: Volviendo a una posición recta, con nuestros brazos a cada lado nos preparamos para girar, cantamos.

Valerie: Here we go. ♪ Through the air, through the air.

Maria: ♪ [in Spanish] Fresca sí, fresca sí.

Valerie: Now arms in front for the splashing motion.

Maria: Brazos extendidos en frente de su cuerpo para la agitación.

Valerie: ♪ Splishy-splashy, raindrops, splishy-splashy raindrops.

Maria: ♪ [in Spanish] Plis-plas, la lluvia; plis-plas la lluvia.

Valerie: Keep your arms extended in front of you, then open them up till they're behind you then close them again.

Maria: Mantenga sus brazos extendidos en frente suyo, ábralos hasta que estén detrás suyo.

Valerie: ♪ Here and there.

Maria: ♪ [in Spanish] Aquí y allá.

Valerie: ♪ Here and there.

Maria: ♪ [in Spanish] Aquí y allá.

Valerie: Now let's move through the whole sequence with just the singing.

Maria: Ahora vamos a hacerlo todo de vuelta simplemente cantando.

Valerie: And we're going to open the lines so please sing along! Here we go. ♪Dance like raindrops, dance like raindrops. ♪Through the air, through the air. Splashy-splashy raindrops, ♪splashy-splashy raindrops. ♪Here and there, here and there. Thank you! Now close the lines again. This next experience deals with quality of touch. I like to call it "Kneading the Bread."

Maria: Esta próxima experiencia es con la calidad de tacto. A mi me gusta llamarlo amasando el pan.

Valerie: This experience is a collaboration between you and your child.

Maria: Esta experiencia es una colaboración entre usted y su niño.

Valerie: The physical cues that the child is giving you will dictate how much of this experience you will be able to do at one time.

Maria: Las pistas físicas que el niño le esta dando va a determiner cuánto de esta experiencia se va poder hacer a la vez.

Valerie: It is a great way of incorporating imagery into the tactile experience, even if the image is more for the adult than the child.

Maria: Es una forma excelente para incorporar la imaginación con la experiencia del tacto, aunque la imagen es más para el adulto que el niño.

Valerie: For this webinar, let's practice on ourselves.

Maria: Para este webinar, vamos a practicar con nuestros cuerpos.

Valerie: I like to imagine...the image I like to use is of kneading bread. Having said that, take your child and lay her on her back in front of you with her feet toward you.

Maria: La imagen que me gusta usar es el de amasar pan. Con eso dicho, acueste a su niño enfrente suyo con sus pies hacia su cuerpo.

Valerie: Using your fingertips, gently begin to sprinkle some imaginary flour so it feels like gentle rain. Start at the head and work your way gently down the body.

Maria: Usando las puntitas de sus dedos, suavemente espolvore un poco de harina imaginaria como si fuera lluvia. Empiece con la cabeza y muévase hacia abajo por todo el cuerpo.

Valerie: Incorporate the shoulders and the arms, the torso, legs, down to the bottoms of the feet.

Maria: Incorporando los hombros y los brazos, el torso, las piernas, hasta que llegue a la planta de los pies.

Valerie: You can even describe what you're doing to the child as you go: "Here comes the flour. I'm sprinkling it on your head! Now it's on your shoulders. And whose arms are these?" Etcetera.

Maria: Incluso, se puede describir los movimientos mientras se hacen. Por ejemplo, "Acá viene la harina. Estoy espolvoreando la harina sobre tu cabeza. Ahora está sobre tus hombros y ¿de quién son estos brazos?" Etcetera.

Valerie: If the baby seems comfortable, this is a great opportunity to cross some of those midlines.

Maria: Si el bebé se siente cómodo, esta es una buena oportunidad para cruzar esas líneas del cuerpo.

Valerie: For example, take both arms and lift them over the head or cross one arm at a time over the belly, reaching toward the opposite side.

Maria: Por ejemplo, levante sus brazos arriba de la cabeza o cruce los brazos en diagonal a la altura del ombligo uno a la vez.

Valerie: Another thing you can do is lift the legs toward the chest so that you cross the midline at the waist.

Maria: Otra cosa que se puede hacer es levantar las piernas hacia el pecho, cruzando la línea que se encuentra en la cintura.

Valerie: Next, we're going to knead the dough. Starting at the head, we're going to gently squeeze all the same body parts we just sprinkled.

Maria: Luego vamos amasar la masa. Empezando con la cabeza, vamos a apretar las mismas partes del cuerpo que espolvoramos.

Valerie: Finally, we're going to wipe off the excess flour with a sweeping motion, adding a bit of pressure so that the quality of touch feels different from the first two experiences.

Maria: Finalmente, vamos a cepillar el resto de la harina, agregando un poco de presión para que la calidad del tacto se sienta diferente de las primeras dos experiencias.

Valerie: Remember to incorporate all the body parts as before, starting from head to the bottoms of the feet.

Maria: No se olvide de incorporar todas las mismas partes del cuerpo que antes, empezando con la cabeza hasta llegar a la planta de los pies.

Laura Annunziata: Thanks Valerie. Thanks Maria. And thanks to all of you out there for joining in with us! At this point in our webinar we'd like to welcome Dr. Donna Britt. Donna is an experienced trainer and educator who many of you may know from trainings throughout the country. She has prepared a lively and information-packed presentation to share with you, and we're very pleased to have her here with us today. Donna?

Donna Britt: Hello, everyone. I may be an experienced trainer, but this is the first time I've talked to a microphone and not seen faces to respond to me. So, this is a new experience for me too. Today, we are going to talk about the most complex job in the world: The formation and development of the human brain. How and when the brain grows is something scientists are learning more about almost every day. As early care professionals, we don't need to know everything about brain growth. But knowing a little bit about what happens at each stage of brain development helps us understand this dynamic, interactive process and helps us support healthy brain development. Our goal today is to explore the relationship between the developing brain, nutrition and motor, movement, and music development of infants and toddlers. We will review the brain's developing structure and functions, then conclude by looking at what we can do to promote and support healthy brain development.

To begin with, imagine a brain. What color do you think the brain is? What is the texture? What is the size? The brain's outer cover is a light gray. Immediately underneath the light gray is a whitish layer. The texture is that of pudding or tofu. It is made up of water, fats, and proteins. A newborn baby's brain weighs about 12 ounces to 1 pound, while an adult brain weighs about 3 pounds. You can see the size difference in this picture. The wrapped peanuts weigh one pound; the melon is three pounds. The adult brain makes up only about two percent of your total body weight. A baby's brain is about 16 percent of that total body weight. So, if you were 100 pounds, it would be like you carrying around 16 pounds above your shoulders, day in, day out. That's a lot of weight for a little guy. Then by two years of age baby's brain will have doubled to about two pounds.

The information about brain development is available, in part, due to the new methods of studying the brain in living persons. You may have had personal experiences with the use of some of these technologies: the MRI [magnetic resonance imagery], the PET scan [positron emission tomography], and the ultrasound or sonogram. I think that Jackie Ward, a past SETA Health Coordinator, said it best when she said, "First of all we need to recognize that before most are aware that they are pregnant, the baby is developing. The brain is the center of everything else that happens in our body. If we don't have a good start with the brain, then we're going to have a problem with everything else. The brain begins to develop about two weeks after conception and there is so much happening, we will only hit some of the highlights during our time together. When the brain begins to form, the embryo is not much larger than a grain of rice. And you can see the size of a grain of rice in comparison to this dime. During prenatal development all the structures of the brain are formed, but the internal components need time to

develop. Nature has ensured that the neural circuits responsible for the most vital bodily functions-breathing, heartbeat, circulation, sleeping, sucking, and swallowing-are up and running by the time a baby emerges from the protective womb. The brain stem controls these bodily functions, the reflexes, and the senses of taste and smell. Much of the newborn's behavior is linked to brain stem maturation. The sense of taste begins to develop at about 11-13 weeks after conception. Research shows that prenatal experiences with taste affect what babies can taste and what they prefer to taste after birth.

The sense of smell develops very early, but it's not known exactly when. Newborns remember and prefer smells from their prenatal experiences. The newborn's ability to recognize the mother by smell is an example of the remarkable ability of the brain to store memories from prenatal development. The cerebellum is located at the back of the brain and is divided into two peach-size mounds: the right and left hemispheres. The motor and movement of the body, including posture, balance, body awareness, and coordination, are the responsibilities of the cerebellum. About half of the brain's neurons reside there. This allows for fine motor control of the fingers and toes, as well as the movements of the lips, tongue, and larynx needed for speech.

The cerebellum begins maturing shortly after birth and continues throughout the elementary years. Deep inside the recesses of the brain is the limbic system, and it's the center of human emotions, motivation, memory, and body regulation. The lower limbic system is mature at birth. It generates the basic emotions of fear, anger, and joy and controls the body's responses associated with those emotions. The upper limbic system is responsible for regulating the emotions. The total experience of our emotional memories is responsible, in part, for the emotional tone of our mind. The more stable, positive experiences, the more positive we are likely to feel. The more trauma in our lives, the more emotionally set we become in a negative way. The top, wrinkled layer of the brain is called the cortex. The cortex is only about the thickness of a quarter. This thick outer covering of the brain resembles the peel of an orange and, if unfolded, equals the size of a single page from a daily newspaper. This layer of the brain consists of bumps called gyri and grooves called sulci. As brain cells multiply and grow, the gyri and sulci help squeeze the mass of the cortex into the very small space of the skull. Most of the gyri and sulci are formed before birth or during the first year of life. Within the cortex are four lobes: the occipital, temporal, parietal, and frontal lobes. These lobes are associated with the senses of hearing, vision, touch, smell, and taste. The occipital lobe, located in the back of the brain, so you really do have eyes in the back of your head, serves as the home for the sense of vision. The sense of vision is the last sense to develop before birth, beginning about 26 weeks after conception. The fetus can sometimes see its own limbs, the shadows of its own body, and mother's organs. As the abdominal wall stretches, more light enters the womb. You can see the fetus react to light by shining a flashlight on the stomach of a pregnant woman. Usually the fetus turns away from the light. The amniotic sac provides a predominantly dark environment to aid typical development. Early exposure to light slows auditory learning and development, while bright light is stressful to the fetus. The development of sight is one of those critical periods. Exposure to light is required for the sense of vision to develop properly. Any problems such as congenital cataracts or crossed eyes should be promptly corrected so that the visual

cortex is properly wired. At birth and for the first two to four months the neonate's focus is about eight inches, which is about the normal distance from your face to the crook of your elbow. That just happens to be the distance away that we hold infants when we look at them and feed them.

The development of sight directly influences the infant's developing motor and movement skills. Our second is the temporal lobes and they are located on both sides of the head, just above the ears and house the sense of hearing. The ability to hear begins to develop before birth at about 21 weeks after conception. The prenatal environment is full of sound. The fetus hears the mother's heartbeat, the sound of blood moving through her veins, and her breathing and digestive sounds. The fetus can hear mother's voice and other sounds from outside, but the volume of these sounds decreases as they pass through the maternal tissue and amniotic fluid surrounding the fetus. Research shows that the newborn prefers the speech of the mother's language over other languages; the theme songs from the daytime dramas that mother watched while pregnant over other songs; and stories mother repeatedly read aloud. Researchers believe that newborns are probably responding to the familiar intonation, rhythm, and stress rather than to the particular words and songs in the songs or stories.

The temporal lobes are also associated with memory, meaning, and language. They work with the deep limbic system, remember way down in the center of your brain, to store highly charged emotional memories, whether positive or negative. Without auditory input, this part of the brain is taken over by the sense of vision; so, from my understanding of the research that means the vision becomes more acute if the baby is not able to hear, is exposed to sound to develop that particular sense. The parietal lobe has many responsibilities. One area of the parietal lobe processes information from the skin including touch, pain, and temperature. The sense of touch is the first sense to develop, and it does so at about 7½ weeks after conception.

The mouth is the first region to become sensitive to touch and continues to be highly sensitive after birth. Infants use their highly sensitive mouths to help them learn about the objects in their environment. At about 14 weeks after conception, the fetus begins to sense its own movements and changes in position within the womb as the vestibular system in the inner ear begins to develop. When mother's movement is not sufficient to stimulate the vestibular system of the fetus, the fetus becomes active, moving about within the confines of the amniotic sac. And I think women who have been pregnant would validate that by saying it usually happens when they are trying to rest. The parietal lobe also controls and directs voluntary movements. The motor area of the brain gains control of the body gradually, from the top down and the inside out.

The fine motor skills and sequencing actions are still developing during the preschool years. Still another responsibility of the parietal lobe is that of linking all the information being processed in the brain, then

directing appropriate actions. Maturity of this area often takes a while and may not occur until the '20s. That leaves us with the frontal lobe, which is behind the forehead, and it's responsible for deciding what to do with the information received from all parts of the brain.

Some of these functions include problem solving, planning, initiating, organizing, judgment, short-term memory, motivation, creativity, and impulse control. This is the last area to develop, often not mature until the late '20s or early '30s. The slow development of this area is why children have trouble controlling their impulses, making good decisions, following multiple instructions, and having a hard time sitting still and paying attention for extended time. Major development in the areas of cognitive growth, social-emotional functioning, and behavior directly relate to the development of specific areas of the cortex. For example, for a child to follow rules and control behaviors, maturation in the frontal lobe must be occurring.

The cerebral cortex is divided by lengthwise fissures that are connected by bundles of nerve fibers. The largest is composed of about 250 million nerve fibers and serves as the connector for the exchange of information between the right and left sides of the brain, kind of like the Golden Gate Bridge serves as the connector of hundreds of commuters in San Francisco. The two hemispheres are very similar in structure but have different purposes; although there is no known ability that uses only one hemisphere at a time. For example, we now know that the left hemisphere is more active when we experience positive emotions, while the right hemisphere is faster at recognizing negative emotions. Although all of the neurons in the cortex are produced before birth, they are poorly connected. The lower brain is therefore largely in control of a newborn's behavior: All of that kicking, grasping, crying, sleeping, rooting, and feeding are functions of the brain stem and spinal cord. Even the striking visual behavior of newborns -- their ability to track a bold moving object, like a red ball of string, or to orient to Mom's or Dad's face -- is thought to be controlled by visual circuits in the brain stem. The cerebral cortex produces most of its synaptic connections after birth. At its peak, the cortex creates an astonishing two million new synapses every second. Although, this "hardware" is laid out during pregnancy, the connections within the brain are unique to an individual and to the physical, cognitive, social, and cultural environment that that individual experienced.

The building of these connections is dependent on the experiences available in our environment. Although the brain has already undergone an amazing amount of development, the brain of a newborn baby is still very much a work in progress. At birth, about 100 billion neurons, or brain cells are produced with about 15,000 connections for each brain cell. Not only are most of the brain cells formed, they have spent time traveling to the right sections of the brain and connecting to one another. Additional connections form after a baby's birth, some existing connections are strengthened, and others are removed. By age 3, 80 percent of the connections are made, forming neural networks.

During "Little Voices," Dr. Carson described the neuron's communication system. Let's review by watching a short video of that, of her communication system. Feel free to follow along with the activity with others at your site. Remember this video may download slowly at some of your sites.

[Video begins] Linda Carson: Say, this word: "Neuron."

Audience: Neuron.

Linda: Hold out your hand like this and look at your palm. Look at your palm and say: "neuron."

Audience: Neuron.

Linda: Think of your palm as that cell body; think of your palm as the neuron. And the neuron is going to be...that's where...That's Grand Central Station, right there. Say, this word: "neuron."

Audience: Neuron.

Linda: Alright. So, the neuron is going to be where the messages are coming from. Now, what I want you to do is to look at your arm...look at your arm and say: "Axon."

Audience: "Axon."

Linda: Say it again.

Audience: "Axon."

Linda: OK, look at your palm and say: "Neuron."

Audience: "Neuron."

Linda: Look at your arm and say: "Axon."

Audience: "Axon."

Linda: The axon is this long extension cord; sometimes it can be three, four, five, six feet long. It's a long extension cord, and it connects neurons together. So, it's a long extension cord. And the reason I call it an extension cord is because the message that's coming from the brain down here to the muscles, or in an infant's case, the messages that are coming from the limbs, as we passively move them through a range of motion, the messages that are going back to baby's brain to help say to the baby's brain: "I'm here; I can bend; I can do this; I have two." The messages that we send back up are really electrical messages. All of our messages in our nervous system are electrical messages, So, we need an extension cord; we need electrical wire to handle those messages. Say: "Axon."

Audience: "Axon."

Linda: Alright, that's your arm. Now, look at your neuron and wiggle your fingers and say: "Dendrite."

Audience: "Dendrite."

Linda: Dendrites. Dendrite is, they're like little extensions coming off of the neuron, and the dendrites are the real messengers because what they do is they connect with other dendrites from other neurons. And, so, let's do this: Put one hand out like this, palm down, palm down and then put your other hand right here. Wiggle your fingers; wiggle your fingers; and now, you've already made a connection here; you have two dendrites on either end of your axon. What I want you to do at your table is stand up. Stand up. We're going to start forming some neural networks. Listen. Listen. Dendrites don't actually touch other dendrites; they chat; ok, they chat. And, so, a dendrite comes over here and does this, and there's a little tiny divide in between there, and they're chatting across this divide through some chemical substance because the electrical message from here goes across and it becomes chemical. And, then, when it gets over there, it's back to being electrical and it goes on; so, this is called a synapse. You've probably heard that word: "Synapse." This is the synapse and they don't actually touch; but they chat, chat, chat, chat, chat. So, what I want you to do now, is I want you to try to find some other dendrites that you can match up with, and you're going to build networks right now. I would build networks with your own program first. Yes, yes, you're building networks. [Video ends]

Donna Britt: As Dr. Carson stated, when the current reaches the end of the axon, the axon releases chemicals called neurotransmitters into the synaptic gap. Just as a baseball mitt, the dendrites catch the chemicals. Certain chemicals fit into certain dendrites; some activate the cell, some stop the cell from firing. Whether the neuron fires or not depends on all the signals received. Both the environment and experience influence the production of these chemicals before and after birth. To begin with, this communication between cells is not very fast, much like the dial-up, Internet connection, many of you are using. It takes a while to pass the information along. But for cells to react to all the sensory input one is exposed to in the environment, communication between cells must be quick. Nature's way of speeding up communication is through a process known as myelination. Myelin is a white, fatty substance that coats the axons. It's produced by certain kinds of glial cells. Remember Dr. Carson's idea of an extension cord: Think of the myelin as the rubberized covering surrounding the wires.

The process of myelination begins in the third trimester of pregnancy or about the sixth month. The majority of the process occurs after birth into adulthood. Babies, preschoolers, and even older children perform tasks slower than adults because their axons are either not myelinated or not sufficiently coated to allow for rapid transmissions through the neurological network. The early development of myelin can be disrupted by malnutrition, infection, and brain injury. So, let's talk a few minutes about the importance of nutrition. Good nutrition is important for both the pregnant mother and the infant. A baby's birth weight and brain size depend on the quality of mom's nutrition during pregnancy. Remember, the brain begins to develop at two weeks after conception. By the fourth week of development, or one month of pregnancy, the neural tube that holds the spinal cord seals. But sometimes the groove doesn't completely seal, causing spinal bifida. Most cases are the result of a lack of folic acid, a B vitamin.

According to Klein, Gilkerson, and Davis, 70 percent of neural tube defects are preventable by taking a multivitamin beginning before conception and continuing in the first month of pregnancy. After birth, brain growth depends critically on the quality of a baby's nutrition. Breast milk offers the best mix of nutrients for promoting brain growth, provided the breastfed infants receive some form of iron supplement beginning after six months of age. Iron deficiency has been clearly linked to cognitive deficits in young children. Iron is critical for maintaining an adequate number of oxygen-carrying red blood cells that are necessary to fuel brain growth. Learning changes the brain because with each new experience, behavior, or stimulation the brain wires and rewires itself. To do this, the brain needs eight gallons of blood every hour or 198 gallons per day. The blood provides the brain with nutrients like glucose, protein, and oxygen that fuel the brain. Because of the rapid pace of myelination in early life, children need a high level of fat in their diets, some 50 percent of their total calories until about two years of age. Babies should receive most of this fat from breast milk or formula in the first year of life and can continue to be an excellent source of liquid nutrition in the toddler years. However, depending on doctor's advice, whole cow's milk may become a part of a toddler's diet after the first birthday. Low

fat milk of one or two percent is not recommended until after two years of age or upon doctor's recommendation. The brain must remain hydrated for optimal learning. Breastfed and formula-fed infants usually do not need additional water. However, infants and toddlers are particularly susceptible to dehydration because they have more water in their bodies than adults. They also have less ability to tell you that they are thirsty. For toddlers, water is an appropriate choice for quenching thirst because it does not contribute to excess caloric and energy intake. Depending on how much water is included in the foods eaten at meals or snacks, fruits, vegetables, soups, etc.; older toddlers and twos may need about a half gallon of water a day. One-half gallon of water, in toddler-size servings equals about 32 two-ounce cups, the number shown in this slide. Think about how often you offer water to the older toddlers and twos in your care. Ensuring that toddlers and older children have enough water to keep the brain and body hydrated is essential to learning. In summary, poor nutrition can cause smaller than normal brains because of reduced dendritic growth, reduced myelination, and the production of fewer glial cells. Inadequate brain growth explains why children who were malnourished as fetuses and infants suffer, often, lasting behavioral and cognitive deficits, including slower language and fine motor development, lower IQ, and poorer school performance.

Next, let's look at motor development and movement, by reviewing the principles of physical development. The principle of directional growth is that the body develops from head to tail and from the center to the extremities, or from the midline out. Most control develops from the reflexive reactions to specific coordinated responses. Once connections are made, in the brain, the brain must identify and remember what parts of the body do specific actions, then develop wiring that allows for the movements in different parts of the body to be coordinated. Once motor and movement skills are accomplished, they become stored memories like riding a bike and tying shoes. Movements that are new or novel, something that hasn't been tried or accomplished, shifts the focus in the brain and cause a flurry of nerve impulses to the muscles involved in the movement, creating new networks. Strick's research found that the part of the brain that processes learning is also the same part of the brain that processes movement. The development of gross and fine motor skills follows the same pattern with all children, although the age at which each develops depends on many genetic and environmental influences. Knowing or having access to the milestones of development for gross and fine motor skills and locomotor development, allow you to identify the skills baby is building and look ahead to prepare the environment for the skills that are next to come. Infants deprived of stimulation from touch and physical activities have fewer neural connections between the cerebellum and the brain's pleasure centers. Scientists associated with the longitudinal studies of the children from the Romanian orphanages showed that children who were deprived of positive, nurturing relationships and restricted from exploring and moving about continued to have some delays in sensory motor development, poor balance and difficulty integrating movement of the right and left sides of the body. And these difficulties extended well into their school-age years. These children also had difficulty listening to words, remembering a task, and responding quickly.

The picture that you should see on your screen is the confined infant from a Roumanian orphanage. And you can see how they were tied to their beds. And actually got no movement whatsoever, other than what they could do moving around their bed.

At this time, let's watch a video. And it's a really short one, so hopefully those of you who couldn't see the last one will be able to see this one: And this is Mary, an Early Head Start teacher, and Awja, with one of her babies in care. As we watch the clip think about what motor skills Awja is developing and what strategies Mary uses to encourage 3-month-old Awja to development these skills.

[Video begins] Mary: Are your arms getting tired? Huh? Oooh look it there. Can you feel it? How does it feel? Is it soft? Is it soft?

Narrator: Three-month-old Awja is spending her ninth day at Early Head Start. Her primary caregiver, Mary Butler, promotes brain development by engaging Awja. [Video ends]

Donna: During this clip, Awja appears to be working on controlling the muscles of her arms-moving from reflexive reactions to specific coordinated responses. Awja's ability to reach and grasp has not developed yet. Her arm movements seem erratic and uncontrolled. These seemingly purposeless movements contain identifiable rhythms and patterns that may be seen through time-lapse photography. Scientists believe that these rhythms and patterns lay a foundation for deliberate action. Individual babies show differences in their activity levels, responses, and personalities, but cultural practices and racial background also affect how much a baby moves. Think about cultures that swaddle their infants or use cradle boards for infant sleep. Awja is also working to coordinate her eyes with the object as well as with her hand and arm. Hand preference is hard to identify in this clip. Research studies show that before birth, about 70 percent of the fetuses studied were right-handed. Strategies that you may have seen Mary used might have included soft language, describing actions and objects, identifying feelings, positive relationship, stopping to allow Awja to touch the toy, verbal interaction, the use of "parentese," and encouraging reaching and eye-hand coordination. I'm sure you probably had many others, but those are the ones I came up with and thought that I would share with you. One of the most highly developed abilities of newborn infants is the response to sound. Newborns move their bodies in synchrony to adult speech. They are programmed to respond to human speech, moving in rhythm to mother's voice in a kind of subtle dance. Babies can distinguish minute differences in spoken sounds, in pitch, and in rhythms. They prefer soft, melodious speech to sharp, strong, abrupt, angry speech. Between birth and three or four months of age, babies manipulate sounds of crying, varying rhythm, pitch, and loudness. They experiment with music, like sounds of cooing, gurgling, and babbling, followed by babbling in response to parents and teachers who are talking or singing to them. Between six to nine months of age infants make speech sounds of various pitches, known as musical babbling. They follow

this musical babbling with explorations of voice sounds during interactions between nine and 18 months of age. Then, somewhere around 18 months they are speaking and singing.

Bayless and Ramsey state that infants need to be musically nurtured from birth by hearing mom or teacher sing lullabies, hum spontaneous melodies, sing, and chant. Some research shows that the musical skill of "perfect pitch," or ability to identify a musical note without referencing a tuning note, seems to develop only in musicians who began their training before seven years of age. Coulter calls movement, songs, and music, brilliant neurological exercises vital to cognitive development. Infants respond to music with their "whole body." Toddlers and twos deserve the same opportunities to listen, sing, play, create, and move. The benefits of music to the brain continue to be a focus of study. They have found that music helps manage feelings through the release of endorphins and that it fosters cognitive, physical, and motor development. It is thought that music increases an appreciation of one's cultural heritage, creativity, and self-expression. Music and movement cannot be thought of as separate entities. The developmental stages of musical experiences are equally as important to the continuing wiring of the brain in many areas, including those controlling coordination, balance, body awareness, vocalization, language, math, and organization. Including music and movement opportunities during daily routines can occur in many ways.

As you watch the next clip, think about the toddler's play with the tambourine. What movement, motor, and music skill is Xariah developing? What additional skills do you hear developing in the background? What are the strategies teacher uses to support and promote healthy brain development?

[Video begins] Narrator: When Xariah was introduced to a new tambourine toy she continued to show her growing interest by going back to it frequently. [Video ends]

Donna Britt: Xariah is developing so many skills, it's hard to record them all without seeing the video multiple times. I'm sure you found some of these as well as many others. Some of the Xariah's skills that I saw were eye-hand coordination, beat, rhythm, listening, grasping, shaking, focused attention, and arm control and coordination, using the shakers to hit the tambourine. The young man in the background created his own music complete with accompaniment of song, which I thought was really cute. Some of the teacher's strategies included encouraging independent play. I don't know if you saw the times scrolling across there, but Xariah spent an extremely long amount of time focused on playing with this musical toy. The teacher showed patience in allowing the toddler to play until she was no longer interested, and I thought the teacher showed a lot of patience listening to all of the music noise that was going on in her classroom. The teacher also allowed the freedom to explore the tambourine in the way that the child chose to do so, encouraging independence and further exploration. Movement, motor,

and music provide opportunities for the brain to both build and strengthen the connections while offering great opportunities for enjoyment as well as learning.

Remember that at birth, about 100 billion neurons, or brain cells, have been produced. The process of pruning streamlines the functioning of the brain based on experiences that occur throughout life. Neural pathways that are used are maintained. We help infants and toddlers build and maintain neural networks by our positive, nurturing relationships with both the baby and the parents. Through exploration and practice, the connections strengthen, skills develop, and new skills are attempted. Our brain is a wonderfully adaptable organ. It changes based on new experiences, and those changes are called plasticity, which, in turn, keep reorganizing our neural networks. Although brain connector density is at its highest level in the first three years of life, that doesn't mean that the brain has its greatest brain power at that time. The first three years are important for laying the foundation for learning, the groundwork for healthy brain development. The brain continues to grow and mature well into adulthood based on the experiences or lack of them. The brain is adaptable and flexible, with the exception of some language sounds and sight, although the ability to adapt changes with age and situation. Just because the brain is flexible doesn't mean that change is easy. Just as a stroke or accident victim works to regain their skill, or an adult tries to learn a second language for the first time. It's an incredibly difficult challenge.

Although difficult, the brain is capable of rewiring, to accommodate for loss, trauma, and accident, but it is most adaptive in early childhood. Research tells us that the child's successful learning and progress through the developmental milestones is dependent on the formation of an emotional bond and relationship between the baby and their parents. To promote and support healthy brain development, we must form an emotional bond or relationship, both with the child and the parents. For that reason, relationships become the key, the foundation or base for healthy, successful development and learning. To develop and maintain a positive relationship, we must accurately respond to the baby's cues, recognize and respect the family's culture and customs, and follow routines that allow the infant and toddler to repeat their experiences over and over until they're ready to move onto the next set of skills.

I've summarized a little bit about what research tells us, and as you can see relationships are one of the most important pieces for development of brain. And I'd like to leave you with this thought: "What the brain does is what the brain becomes" and this is Gunnar from 1997. And I thank you for your attendance.

Laura: Thank you, very much Donna. This is such an important topic. I'm sure that people in our audience are going to have some questions for you. For those of you who are listening who would like to

send us questions, please feel free to type them in now. Jose, could you prompt attendees regarding how to engage with us around questions, please?

Jose: Not a problem. To ask a question, use the Q-and-A panel. You can ask questions via the Q-and-A panel; type your question in the box and click on send. We'll see your question. And we'll address it as we go. If you are on the phone, the lines will be unmuted in a couple of...a few seconds. And just jump in. If you have any questions, submit them via the Q-and-A panel. Thanks.

[Phone sounds]

Joes: Hi, sir. Now, unmute it.

[Phone sounds]

Female: What is the echoing? Where's the echoing?

Laura: One comment just for Dr. Britt. Thank you; this information was extremely useful. You'll let us know if you have any questions, too. Thank you, for that comment. We know this is a lot of information, as it relates to your work.

[Silence]

Jose: There are no questions. I have muted all the lines.

We have a few more minutes to share today, and we're going to end today's event with another interactive experience. This one is called "Airplane." If you've brought baby dolls or stuffed animals with you today please take them out now so you can join in with Maria as she shares this experience with you. Maria?

Maria: Thank you Laura. This experience incorporates imagery, movement, and singing. We're going to take the baby on an airplane ride, incorporating directional movement.

Maria: Esta experiencia incorpora imaginación, canto y movimiento, llevando el bebé en un viaje de avión, agregando direcciones.

Begin by picking up the child and cradling her in your arms. Depending on the comfort of the child, she can be looking up at you or down to the ground.

Empiece con el bebé en sus brazos. Depende del bebé, esta posición puede ser mirando hacia al piso o mirando hacia usted.

You can open the lines now please. We're going to begin by swaying side to side while we sing: ♪ Airplane, airplane, wings so wide, airplane, airplane, side to side.

Muévase de un lado al otro cantando esta canción, ♪ Avión, avión, con alas extendidas, avión, avión lado a lado.

Any bilingual folks out there help me sing. Let's begin moving through the space. Move any way you want as long as you're not bumping into anyone or anything. Help me sing! ♪ Airplane, airplane, wings so wide, airplane, airplane, side to side.

Ahora empecemos a mover por el espacio. Muévase como quiera mientras no choque con nada o nadie. ¡A ver, ayúdenme a cantar!

You can sing in English or in Spanish, whichever one you're getting.

♪ Avión, avión, con alas extendidas, avión, avión lado a lado.

This time we'll add a dip at the end of the song, meaning bend your knees to bring the baby down and up. Here we go. In English. ♪ Airplane, airplane, wings so wide, airplane, airplane, side to side. And dip.

Esta vez vamos a agregar un sube y un baja al final de la canción, agachándose subiendo y bajando el bebé. Acá vamos. [In Spanish] ♪Avión, avión, con alas extendidas, avión, avión lado a lado. Y dip.

Let's do it again, this time adding a dip and a turn. Help me sing. ♪ Airplane, airplane, wings so wide, airplane, airplane, side to side. And dip and turn.

Vamos a hacerlo de vuelta agregando el sube y baja y dar vuelta en un círculo. Ayúdenme cantar. ♪ Avión, avión, con alas extendidas, ♪avión, avión lado a lado. Y dip y la vuelta.

Finally, we're going to add a bounce after the dip and the turn. Here we go. Help me sing. ♪ Airplane, airplane, wings so wide, airplane, airplane, side to side. And dip, and turn, and bounce.

Finalmente vamos agregar un brinco después del dip y la vuelta. Acá vamos. ♪ Avión, avión, con alas extendidas, ♪avión, avión lado a lado. Brinca, dip, y la vuelta.

This time, as I sing, make the dip, turn and bounce any time you wish during the song. You don't have to wait until the end of the song to incorporate the sequence. One last time, here we go; help me sing ♪ Airplane, airplane, wings so wide, airplane, airplane, side to side.

Esta vez mientras cantamos, haga el dip, la vuelta y el brinco cuando usted quiera, no tiene que esperar hasta el final de la canción para incorporar la secuencia. Una vez más. Ayúdenme a cantar. ♪ Avión, avión, con alas extendidas, avión, avión moviendo lado a lado.

These are movements that we like to use; you can move any way you like as long as you and the baby feel safe. [Inaudible] The important thing is to make these experiences your own.

[Inaudible] Estos son movimientos que nos gusta usar a nosotras [Inaudible] pero usted puede moverse como quiera mientras usted...La cosa importante es hacer estas experiencias personales. Muchas gracias.

Laura: Thank you Maria! That was wonderful, and we could hear you out there too. We are reaching the end of today's webinar. I want to take this opportunity to thank all of our presenters: Dr. Donna Britt, Valerie Bayne Carroll, and Maria Tripodi and everyone else who participated in bringing this webinar together today and for you in the audience, as well, for your participation today, as well as your ongoing dedication to infants, young children, their families, and our communities. We're very pleased to have these opportunities to share information together.

I also wanted to remind you that this webinar will be followed by a call in Spanish, en Español, on January 29 at 3 p.m. Eastern Standard Time. We hope that many of you will join us on that date. The next webinar in the series is scheduled for March 17, at 3 p.m. Eastern Standard Time. We look forward to it, as we continue to explore this exciting content together, as part of the "Little Voices for Health Choices" Initiative. Thank you, very much.