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Thank you, Mr. Chairman and members of the committee, for this invitation to testify today.

My name is Ross A. Thompson, and I am a Professor of Psychology at the University of California, Davis, where I study early social, emotional, and personality development. I was a member of the National Academy of Sciences Committee on Integrating the Science of Early Childhood Development that produced the report, *From Neurons to Neighborhoods: The Science of Early Childhood Development*[i], and I have been actively involved in conducting original research on early psychological development and examining the applications of developmental science to public policy problems. I am grateful for the interest of the Subcommittee in the science of early childhood development and its relevance to the services provided by Early Head Start.

As described in *From Neurons to Neighborhoods*, today we know much more about the determinants of development throughout the life course, and especially the importance of early experiences for life-long competency. Contemporary research in human development has been supplemented by work in developmental neuroscience whose conclusions about brain development complement and expand the conclusions from behavioral studies. As a consequence, research from a range of scientific disciplines now provides a clear and convincing case for the critical importance of the early years to later success in school and in life. Remarkably, findings using a variety of methodologies and approaches converge on a set of fundamental conclusions[ii]. The early years are important. Early relationships matter. Healthy development involves building strong minds, bodies, and persons. The early years are a period of considerable opportunity for growth, and vulnerability to harm. Developing competence involves cognitive and noncognitive capabilities. It is much better to prevent developmental problems from emerging than to try to remediate them later.

In these remarks, I will focus on some of the central conclusions of the science of early childhood development, especially as it concerns the influence of early experiences and their potentially enduring effects. I will conclude with some recommendations concerning the implications of the science for Early Head Start.

The early years matter

One of the central conclusions of developmental science is the importance of development early in life. Quite simply, early growth lays the foundation for all that follows. More precisely, ***the development of essential human competencies is at its most accelerated pace in the early years, and is based on processes of brain development.***

We see the importance of the early years most clearly in brain development, which begins not at birth but prenatally, when the nerve cells that will last a lifetime begin to be created[iii]. In a manner that reflects the ongoing interaction of nature and nurture,

brain development is guided by a maturational timetable that incorporates early experiences to create a brain that is efficient and well-suited to the requirements of everyday life. How the brain becomes wired in the early years provides a foundation for the development of more advanced capacities in the years that follow.

The following points reflect some of the central conclusions of developmental neuroscience[iv].

- First, as noted earlier, brain growth begins very early. Indeed, some of the most formative aspects of brain development occur prenatally, when healthy brain growth is supported by good maternal nutrition but can be undermined by maternal exposure to hazardous substances such as alcohol (resulting in fetal alcohol syndrome), environmental neurotoxins (such as in lead-based paint or mercury in fish), controlled substances (such as cocaine), and other harms[v]. This means that some children are born with brains that have already been damaged, sometimes for life.

- Second, brain development lasts a lifetime. Important developmental processes, some associated with the growth of new neurons, subtly shape the brain during adolescence and adulthood. The brain is continuing to grow and change throughout life.

- Third, the early years of childhood witness some of the most significant growth in the brain's developing architecture. This includes the "blooming and pruning" of neural connections in different regions of the brain governing seeing and hearing, language, and higher cognitive functions. These processes are substantially completed, or well underway, within the first five years of life.

Taken together, developmental neuroscience confirms that the early years establish the foundation on which later development is built, much as a house is structurally firm or weak based on the foundation on which it is built. Neural circuits that process basic information are wired earlier than those that process more complex information[vi]. This means that the development of more advanced capabilities is based on the quality of early development. With respect to the brain, higher capacities are more difficult to develop if lower-level capacities have not developed appropriately. With respect to the mind, advanced skills build on basic skills throughout development.

For this reason, ***the growth of these basic, early competencies is directly linked to the emergence of school readiness and adult skills that are important to success.*** In many, many areas of development, from language ability and communication skills to problem-solving and categorization to capacities for focusing attention and exercising self-control, later skills are based on the foundational skills established earlier in life[viiviii]. For example, experiences during the preschool years in letter recognition, letter-to-sound mappings, rhyming, listening to stories, and access to literacy materials predicts higher language and reading achievement in elementary school[ixx]. Likewise, preschool exposure to basic concepts about numbers, counting, comparing amounts, pattern recognition, and categorizing enables children to more

quickly absorb and understand math concepts taught in school[xi]. In each case, early-developing abilities are a foundation for the preliteracy, language, and number skills required for school readiness, and for adult skills important to workplace success as children build further on these skills in school.

Early learning is based on both cognitive and noncognitive skills.

At a time when we are concerned with promoting children's school readiness and preparing them for contributing to an increasingly technological and information-rich society, it is natural that the development of cognitive skills would be the focus of our concern with early learning. But developmental science and developmental neuroscience together tell us that early learning is based on both cognitive and "noncognitive skills" – such as a child's curiosity, motivation to learn, self-confidence, excitement about new discovery, and the capacities to focus attention, control behavior, and get along with others.

This is true from very early. Infants learn through discovery in their everyday explorations, shared by a sensitive, attentive caregiver[xii]. Even the most casual observer of young children notices how much early learning is driven by young children's curiosity and enthusiasm for new understanding as they are ably assisted by parents and teachers. As young children enter into group learning activities, their capacities to pay attention, ask questions if they do not understand, cooperate with peers and adults, control their emotions, and approach learning opportunities self-confidently and with enthusiasm are major contributors to their conceptual growth. These qualities are also essential to school readiness and school success. Developmental studies have found that classroom achievement in kindergarten and the primary grades are associated with young children's noncognitive skills such as motivation, self-regulation, cooperation, behavioral self-control, and even the quality of their peer relationships and emotional understanding[xiii].

This is consistent also with scientific understanding of brain development[xiv]. Contrary to the natural tendency to divide the brain into areas devoted to language, memory, reasoning, emotions, and the like, the human brain is actually a highly complex, integrated organ. There is not one brain area devoted to memory or language, but rather several[xv]. Furthermore, brain regions have overlapping functions related to thinking, feeling, or self-control. For example, areas of the frontal cortex are involved in both attentional focusing and emotional self-control[xvi]. In short, the brain is not neatly divided into cognitive and noncognitive areas. Rather, brain processes influence each, and cognitive and noncognitive capacities are mutually influential.

Early experiences are influential

Much of the story of early experience and brain development has focused on encouraging parents to talk, read, and sing with their young children. This is worthwhile, and it further illustrates the integration of cognitive and noncognitive

influences because of how parent-child interaction captures the child's attention, provokes preliteracy skills, and instills enthusiasm for learning. Over time, experiences of this kind at home and outside the home can strengthen brain areas related to early thinking and reasoning.

But the influence of early experience is a double-edged sword because the experiences that shape brain architecture can be either positive or negative, nurturant or stressful. Each is incorporated into developing brain architecture. Unfortunately, for many young children in the United States, experiences of chronic stress, neglect, or deprivation are major architects of their brain development, and helps to account for some of the difficulties they face. This is because of how the brain responds neurobiologically to stress[xvii]. Chronic experiences of severe stress, especially early in life, can alter the functioning of brain-based stress systems – potentially causing the person to become hyperresponsive even to mild stressors – and can have important effects on physical health, immunological capacity, and psychological well-being for this reason. Chronic stress can also influence cognitive functioning because, over time, the release of stress hormones can damage brain structures (such as the hippocampus) involved in learning and memory. These are some of the reasons that early deprivation and stress can have enduring, detrimental consequences for brain development, psychological growth, and physical health. Children in socioeconomic hardship are especially vulnerable to these stresses, and to the hazards they pose.

Early experiences are important for another reason. ***As brain circuits consolidate over time, the brain's plasticity decreases.*** The brain's "plasticity" is the basis for its flexibility and adaptability, and this flexibility naturally declines as brain architecture develops and consolidates. For many young children, however, this means that the brain is being built around early experiences of stress and trauma whose effects become more difficult to remediate over time if they are not addressed early in life.

For this reason, it is biologically wiser to prevent later difficulties from emerging than to later try to remediate problems that have already developed[xviii]. Early interventions benefit from the greater plasticity in the immature brain, and the flexibility of the brain to adapt positively to helpful interventions. By contrast, it is often more difficult to try to remedy problems after they have already developed, after brain development has consolidated around early vulnerabilities. Indeed, the interventions that are necessary to remediate later problems are often much more costly and prolonged than are early preventive interventions. Furthermore, even when later interventions are partially successful, individuals may experience continuing vulnerability, especially when they are under stress. Early prevention is, therefore, both biologically and economically a better course than later remediation.

Early relationships are important

A large research literature documents how much early psychological development relies on the quality of early relationships. In the words of the National Academy of Sciences committee that wrote *From Neurons to Neighborhoods*, "Parents and other regular

caregivers in children's lives are the 'active ingredients' of environmental influence during the early childhood period. Children grow and thrive in the context of close and dependable relationship that provide love and nurturance, security, responsive interaction, and encouragement for exploration."[xix] Relationships within and outside the family are important as catalysts for learning, sources of security, and supports for developing self-confidence.

The quality of early relationships is also important for brain development for several reasons.[xx] First, early social interaction provides infants and toddlers with a wealth of simultaneous and integrated stimulation – sights, sounds (including language), emotional arousal, touch, social signaling – that is well-calibrated to their capacities for understanding and responding. It is difficult to imagine a toy, DVD, or other manufactured product that can come close to matching everyday, sensitive parent-child interaction for the qualities of stimulation that are optimal for fostering brain development. Moreover, because parents and other caregivers adjust their interaction to the child's developing capabilities, they provide a continuing catalyst for the developing brain.

In addition, supportive early relationships can buffer the effects of stress on young children. In one study, for example, temperamentally fearful children who were faced with mildly stressful events exhibited lower physiological stress responses when they were accompanied by mothers to whom they were securely attached in comparison with fearful children who were in insecure attachment relationships[xxi]. Studies like these are consistent with the findings of many other studies with primates and rats that attest to the stress-buffering functions of early close relationships[xxii]. Taken together, they indicate that one of the important ways that relationships matter to young children is that they provide support in difficult circumstances, with the absence of such supportive relationships a significant added risk for children growing up in difficult circumstances.

Early interventions can be effective

There is now a significant science of early intervention that shows, in carefully-designed studies involved randomized controls, the long-term benefits to young children from their participation in high-quality early intervention programs. These studies collectively indicate that ***early intervention programs can improve developmental outcomes for children who are at risk of long-term difficulty – especially if the programs are carefully-designed and thoughtfully implemented***[xxiii]. Taken together, evaluation studies in this literature support the conclusions reported in *From Neurons to Neighborhoods*:

> Model early childhood programs that deliver carefully designed interventions with well-defined objectives and that include well-designed evaluations have been shown to influence the developmental trajectories of children whose life course is threatened by socioeconomic disadvantage, family disruption, and diagnosed disabilities. Programs that combine child-focused educational activities with explicit attention to parent-child interaction patterns and

> relationship building appear to have the greatest impacts. In contrast, services that are based on generic family support, often without a clear delineation of intervention strategies matched directly to measurable objectives, and that are funded by more modest budgets, appear to be less effective[xxiv].

Implications for Early Head Start

The science of early childhood development suggests that investing early in young children makes sense, both biologically and economically. This research has three further implications for our thinking about Early Head Start:

-- **The most effective programs to support early brain growth and psychological development attend to intellectual, social, and emotional development, and support families and parenting, beginning early in life.** This follows from what we know about the importance of both cognitive and noncognitive skills, and the significance of early relationships, to children's learning. It is also consistent with what we know about the conditions of young children in socioeconomic hardship, who not only fall behind in letter and number skills but are also often lacking in physical health, the motivation to succeed, and supportive relationships at home. Early intervention programs to support young children in socioeconomic difficulty must begin early to benefit from the plasticity of early brain development and their early beginning in learning, and ideally should involve sustained assistance to ensure that early gains are built upon, rather than lost.

-- **The results of rigorous research document the benefits of Early Head Start for enhancing children's progress in school readiness, supportive parent-child relationships, and improved family functioning.** The Congressionally-mandated randomized control trial of Early Head Start, studying more than 3,000 families, has documented significant positive impacts on standardized measures of children's cognitive and language development, as well as measures of supportive family relationships and increased family self-sufficiency[xxv]. Early Head Start produced statistically significant, positive impacts on standardized measures of children's cognitive and language development. Children in Early Head Start had more positive interactions with their parents. And Early Head Start parents were more involved and provided more support for learning, and were making greater progress toward self-sufficiency.

-- **In relation to the number of young children at risk, and the science of early childhood development, significant expansion of Early Head Start is warranted.** Developmentally appropriate early childhood education looks a lot different than developmentally appropriate education for older children, and Early Head Start is a developmentally appropriate program for young children. The enhanced participation of eligible young children in a well-designed program like this one respects our growing awareness of the importance of the early years for brain development and psychological growth.

I very much appreciate this opportunity to testify, and I welcome the opportunity to work with Subcommittee staff to provide any further information that you may need.

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