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Panel on the Science of Early Childhood Development

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Permit me to join my colleagues in thanking you, Speaker Pelosi, for your invitation and Representatives Miller, De Lauro, and Fattah in inviting me to speak at this timely and important forum.

The construction of the brain is a protracted process that begins just a few weeks after conception and is not complete until the late teens or early 20s. As you heard from both Dr. Norton and Dr. Levitt, the first few years are perhaps the most critical in terms of laying a strong foundation for later development. It is during this time that the wiring of the brain begins in earnest, a process that makes possible the extraordinary and endearing changes in behavior that any of us who have spent time with children eagerly observe. In this context, I would like to underscore two additional points made by Dr. Levitt. The first is that experience exerts an especially powerful roll in sculpting and guiding brain development after birth. The second is that a number of fundamental abilities – our capacities for seeing and hearing; language abilities; and many aspects of our

mental and emotional functioning – all depend on children being exposed to *typical*, everyday experiences during a rather narrow time window. We refer to this concept as a *sensitive period*, which simply means that for development to proceed normally, a child must be exposed to normal experience during a particular interval of time.

Now, the process by which the structure of experience weaves its way into the structure of the brain is referred to as **neural plasticity**. Advances in neuroscience tell us that, although brain development benefits from good experiences, it can also be disadvantaged by bad ones. To make matters worse, if these bad experiences occur during a sensitive period, there is a measurable risk that a child's subsequent development may be derailed – in some cases, permanently. And, the longer these bad experiences continue, the more difficult it becomes to redirect development back toward a normal trajectory. Not impossible, just more difficult...and more costly. The simple reason for this is that, as brain development progresses, the neural pathways and basic architecture of the brain becomes established, making them increasingly difficult to alter.

Two simple and familiar examples are our ability to see and our ability to acquire language. For example, if a child is deprived of vision for the first several months or years of life - perhaps because the eyes are crossed or have a cataract - and is not treated during this time frame, there is a substantial likelihood that the child's vision will never be normal. Similarly, if a child is

deprived of hearing normal speech during the first few years of life – by way of hearing impairment or impoverished parent-child communication—the child is then at a substantially greater risk for failing to develop normal language ability. In essence, when considering how deprivation influences brain development, we must consider four factors: What the child was deprived of, the degree of deprivation, for how long the deprivation occurred, and when in the course of development the deprivation occurred.

I would like now to turn my attention to the consequences of rearing a child under conditions of serious deprivation, such as occurs in many parts of our country and throughout the world. Sadly, it is from studies of extreme deprivation that we have learned the most about the importance of experience in brain development.

That story begins with the tragic observation that an extraordinarily large number of children throughout the world begin their lives in psychologically and materially adverse circumstances. In some cases, these children are born into profound poverty and have limited access to essential resources, such as adequate nutrition, or they have caregivers who are overburdened and under-educated. Others are born into families that will abuse or neglect them; for example, in 2005, in the United States alone, there were 900,000 documented cases of child maltreatment or neglect. Finally, in many parts of the world, large numbers of children are orphaned or abandoned shortly after birth. Current estimates from UNICEF, for example, place the number of orphaned children in

Afghanistan at 1.6 million; in sub Saharan Africa, there are nearly 50 million children who have lost 1 parent and over 9 million who have lost both parents. Many of these children live lives of profound psychosocial neglect, including the absence of any primary adult caregiver.

In the context of our present conversation, these sobering statistics beg the question – *how exactly is psychosocial deprivation bad for the brain?*

There is evidence, dating back many years, that has consistently demonstrated that children experiencing serious early deprivation are at great risk for developmental delays and disorders. For example, among children abandoned at birth and then reared in orphanages (such as the 10,000 currently living in orphanages in Afghanistan and the more than 100,000 that once lived in orphanages in Romania) , there is a high prevalence of attention deficit hyperactivity disorder , non-optimal, impaired intellectual development, and mental health disorders. Clearly, the developmental deficits and delays that result from institutional rearing have their origins in compromised brain development. Why is this?

Again, as I have already alluded to, brain development depends to a large degree on the child being exposed to features of the environment that are (or at least, should be) common to all humans. Although it would be difficult and possibly presumptuous to offer an exhaustive list of what a *normal expected* environment would look like for children, a short list might include:

- a) sensory stimulation;

- b) access to a caregiver who is responsive *to* and consistently cares *for* the child; and
- c) adequate nutrition.

It would also include

- a) an environment that is low in so-called “toxic” stress
- b) provides the building blocks to cope with stress (as you will hear shortly from Dr. Gunnar); and
- c) Of course, if mental and language development are to be facilitated, it requires a variety of learning opportunities.

Again, this list is far from exhaustive, but by inference, it illustrates a key point: that many children around the world, including the United States, lack some or all of these elemental requirements for development.

Why *specifically* is such deprivation bad for the brain? One reason is that the young nervous system, which actively awaits and seeks out positive environmental stimulation, is robbed of such input. This paucity of input leads to under-specification of some brain circuits and the mis-wiring of others. We should therefore not be surprised that such children experience a range of problems due to “errors” in brain development.

There is also another potential consequence of early psychosocial deprivation of which we must be mindful. As you heard from Dr. Levitt, typical brain development is characterized by an initial overproduction of both neurons

and synapses, followed by a pruning process that eventually leads to adult numbers. The process of overproducing neurons and synapses is largely guided by a genetic program that begins in earnest the last trimester of pregnancy and is complete by the first 1-2 postnatal years, whereas the pruning process is more heavily influenced by experience, and in some regions of the brain, continues well into puberty. In this light, then, it may be that living in a deprived environment leads to errors in the normal process of reducing the number of neurons and synapses. Importantly, because most regions of the brain do not make new neurons after birth, it is possible that early psychosocial deprivation may exert permanent effects on cell and synapse numbers.

But, can this adverse process be reversed? In work my colleagues and I are conducting in Romania, the answer appears to be yes – if done early enough. Thus, young children who were abandoned at birth and placed in orphanages and are then, early in life, moved to very high quality foster care homes show remarkable ability to recover. With excellent care, they can develop IQs and brain function that resemble children who never experienced deprivation. However, children who received the intervention at a later age may show some improvement but they typically continue to have developmental problems.

The take home message here is that even children experiencing profound early deprivation can return to a normal developmental trajectory *if* intervention occurs sooner rather than later.

In summary, we must all be mindful of the environment in which we rear our children, and the experiences we provide for them. Neuroscientists have learned that *plasticity cuts both ways* – illustrating both the adaptability and the vulnerability of a young brain. Because plasticity is greater early in life, when the brain is being built, rather than after its basic architecture has been established, the best way to ensure healthy brain development is to invest in the early years....a point Dr. Heckman will underscore in his remarks later today. Although it is never too late to intervene in the life of a child, it becomes increasingly more difficult to intervene *successfully* if we wait until a considerable amount of brain circuitry has already been built.

Thank you.