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1

David A. Hamburg, M.D.
The White House Conference on
Early Childhood Development and Learning
April 17, 1997

OPENING REMARKS OF SESSION ONE

This month is a historic one in the annals of disease prevention. Remember "infantile paralysis?" In April 1955 the Salk polio vaccine first became available. The late Jonas Salk was a member of the *Starting Points* task force and wrote this statement.

"The relief that was felt in April 1955 following the Francis report that it would be possible to prevent infantile paralysis by immunization should be recalled today. The encouraging news in the Carnegie Report that there is a way to prevent the crippling of the minds of infants and children may be a similar historic opportunity."

Today's White House conference does indeed signify a historic opportunity — the nation coming together on behalf of our most precious assets.

Our nation's infants and toddlers and their families are in trouble. Compared with most other established democracies, the United States has more casualties and serious risk factors — e.g., a higher infant mortality rate, a higher proportion of low-birthweight babies, a smaller proportion of toddlers immunized against childhood diseases, and a much higher rate of babies born to adolescent mothers.

If a poor start leaves an enduring legacy of impairment, then high costs follow. They may show up in various systems: health, education, justice. We call them by many names: disease, disability, ignorance, incompetence, hatred, violence. By

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2

whatever name, these outcomes involve severe economic and social penalties for the entire society.

Early childhood is the most dramatic period of development. It is characterized by rapid growth, specific environmental needs, maximal dependence on caretakers, and great vulnerability. First, the nine months of pregnancy -- from a single cell to a very complex organism. Next, the critical transition from living inside the mother's body to the world outside. Then, the period of forming the initial human attachments that shape so powerfully the possibilities for human relationships and social skills -- and the infant's beginnings of discovery, the building blocks of learning skills. So this initial phase has a strong bearing on a child's entire life. The risks of permanent -- and largely preventable -- damage are formidable.

During the 1980s and 90s, an important consensus has emerged within the scientific and professional communities on ways that parents and others can cooperate in meeting the developmental needs of very young children. Our aim at this meeting is to clarify that scientific and professional consensus and make it widely understood throughout the country. We hope this will illuminate the essential requirements for healthy child development in the first few years and their implications for lifelong learning, health, and decency. We will call attention to a set of frontline institutions -- starting with the family -- that have a daily opportunity to help meet these essential requirements. Beyond this, we will explore the help that might come from government, media, business, scientific community, and relevant professions.

H:\pres\hrc\braindev.wh

3

To meet the essential requirements for healthy child development, it is crucial to start early with family-strengthening functions. The pivotal institutions are schools, churches, community organizations, and the health care system -- all augmented by educational functions of the media. A developmental sequence of valuable services starts with prenatal care and goes on to preventive pediatric care, parent education, social supports for young families, high quality child care and early childhood education.

The Carnegie report, *Starting Points*, published in 1994, spelled out these needs and formulated four main approaches to preventing damage to the youngest children: 1) Preparation for responsible and competent parenthood; 2) Health care; 3) Child care; and 4) Community mobilization.

When *Starting Points* was released, much of the extensive media attention focused on new highly persuasive evidence from research on brain development that how individuals function from the preschool years all the way through adolescence and even adulthood hinges, to an important extent, on their experiences in the first three years of life.

But *Starting Points* also made it clear that there is a very wide gap between scientific research and public knowledge -- between what is known and what is done. Today's meeting is a major step toward filling that dangerous gap.

In this morning's session, we will first hear from three distinguished scientists about highlights of basic research from biological and behavioral sciences. These are important samples of emerging knowledge. In the brief time available, they cannot be comprehensive; but they will be sufficient to suggest the profound importance of early development. Then we will hear from three highly respected scholars on professional

H:\pres\hrc\braindev.wh

4

services. How can the fundamental knowledge be put to work for the well-being of all our children?

Dr. Donald J. Cohen -- Donald J. Cohen, M.D., is the Director of the Yale Child Study Center and Irving B. Harris Professor of Child Psychiatry, Pediatrics and Psychology, at the Yale University School of Medicine, New Haven. The Center is internationally recognized for its multidisciplinary programs of clinical and basic research, professional education, and clinical services and advocacy for children and families. Dr. Cohen's clinical and research activities focus on developmental psychopathology of the serious neuropsychiatric disorders of childhood. He is deeply involved in urban child development and approaches to intervention, as well as studies of the impact of violence and trauma on children and families.

Dr. Carla J. Shatz -- Dr. Carla Shatz received a Ph.D. in Neurobiology from Harvard Medical School, where she studied with David Hubel and Torsten Wiesel. She is current Class of 1943 Professor of Neurobiology. Her ongoing studies of how the orderly sets of connections present in the adult brain are wired up during development have gained her numerous honors. Dr. Shatz is (1995-96) the immediate past president of the 24,000 member Society for Neuroscience. Research in Dr. Shatz's lab is directed at elucidating the mechanisms that guide the formation of precise connections in the mammalian visual system. The results of these studies have broad implications for our understanding of the normal development of the human brain including the processes of learning and memory, of neurological birth defects such as cerebral palsy and dyslexia, and of epilepsy.

H:\pres\hrc\braindev.wh

5

Dr. Patricia K. Kuhl -- Dr. Patricia Kuhl is the current chair of Speech and Hearing Sciences at the University of Washington. Her research interests focus on the study of language and speech, particularly its development, and on how language information is stored in the brain. Her research has played a major role in demonstrating how early exposure to language alters the mechanisms of perception, changing a person's abilities to hear certain distinctions in speech. The results of her studies have illustrated how infants' early auditory experience plays a critical role in the acquisition of language in the first year of life. The work has broad implications for its identification of critical periods in development and its applicability to bilingual education as well as for brain mapping of complex information.

Dr. Ezra C. Davidson, Jr. -- Dr. Ezra Davidson, Jr. is Professor (and past chairman), Department of Obstetrics and Gynecology, The Charles R. Drew University of Medicine and Science. Currently, he also holds professorships in Obstetrics and Gynecology at UCLA and Dartmouth Schools of Medicine. He was chief-of-service, Department of Obstetrics and Gynecology at King/Drew Medical Center in Los Angeles (1971-96). In this position in 1971, he developed a new and subsequently nationally recognized full service academic department of Obstetrics and Gynecology. By 1990, the deliveries reached 9,000 per year becoming one of the ten largest obstetrical services in the country. Dr. Davidson has led an active career in research, education, and clinical and public services. He was an early contributor to the development of the technology of fetoscopy and fetal blood sampling. Because of his interest in affecting maternal and child health issues, his efforts turned increasingly to public policy.

H:\pres\hrc\braindev.wh

6

Dr. T. Berry Brazelton -- Dr. Brazelton is one of the best known child health specialists in the world, a distinguished scholar and tireless advocate for children. One of Dr. Brazelton's foremost achievements in pediatrics is his National Behavioral Assessment Scale (NBAS), published in 1973 and revised in 1984 and in 1996. Known as "the Brazelton," this evaluation tool is used worldwide, clinically and in research, to assess not only the physical and neurological responses of newborns but also their emotional well-being and individual differences. Since 1988, Dr. Brazelton has held appointments as Clinical Professor of Pediatrics Emeritus at Harvard Medical School, where he still teaches and conducts research, and Professor of Psychiatry and Human Development at Brown University. In 1995, Harvard University Medical School established the T. Berry Brazelton Chair in Pediatrics. The Touchpoints Project at Children's Hospital formulates curricula for use in outreach programs around the country to capture high-risk, undervalued populations (40 percent of U.S. children) for the primary preventative health care system.

Dr. Deborah Phillips -- Dr. Deborah Phillips is a distinguished child development psychologist. She is Executive Director of the Board on Children, Youth and Families of the National Research Council, National Academy of Sciences. This is a vital focus of integrative work on the sciences pertinent to child development. She has done highly illuminating research and analysis on child care, most recently serving on the group responsible for the NICHD longitudinal study of child care outcomes that reported its important findings early this month at the SRCD. She was a valuable member of the task force that prepared *Starting Points*.

Mr. President and Mrs. Clinton,

We are very grateful for your focusing national attention on children's development, and on what research means for children and families. Research reveals that babies are born with remarkable abilities and broad potential. Their experiences during the first months and years of life will either facilitate this potential or blunt it. These early experiences have an enduring impact on children's behavior and also on the maturation of their brains. While there is far more to learn about young children, scientific knowledge already can and should be used to help assure that children receive the care that will move them forward. Available knowledge can also help families, teachers, and clinicians recognize when a child is first starting to have problems and to provide effective treatment to help move development back on course.

Much that scientists have learned confirms the truths of what our grandparents took for granted -- that babies need devoted care of adults who love them, protection from harm, a chance to play, to feel proud of their achievements, and to be comforted when they are upset. Our grandparents also knew that children need to be treated fairly and provided with moral examples to develop their own inner sense of values.

Science has confirmed these beliefs. But we have also learned things about the first years of life that would have surprised our parents. Researchers have discovered that the minds of infants are active from the time they are born and are shaped by what they experience; infants see, hear and taste; they try to make sense of their sensations; they recognize patterns and are interested in shapes; and they remember what they have felt and heard. Babies, in short, are smarter and more curious and eager to learn than was ever suspected.

Most importantly, we have learned that social relations are central to every aspect of a child's development. Active, engaged care is essential for children's brain maturation and for their social, emotional, and intellectual growth. Ordinary, devoted parents are what makes development go forward because their care provides the basic ingredients for brain maturation.

It is artificial to distinguish brain and behavior. Everything the baby thinks, feels, or does is the result of brain activity. In turn, the baby's experiences actually change the way the brain works. As the child looks at the mobile above his head in the crib, or later, as the child and father play with blocks and talk about what they are doing, specific groups of brain cells are activated and connections between parts of the brain are formed and strengthened.

The baby comes into the world ready to adapt. On the first day of life, a baby can search the room with his eyes, visually trace the edges of a triangle, and look intently at his mother's face during feeding. When he is a few days old, the baby calms down and his heart rate becomes more regular when he is nursed or given a pacifier to suck. During nursing, a baby exercises every sensory modality -- vision, touch, taste, temperature, smell -- and organizes his perceptions as he learns about his mother's appearance and style. When parents and other caregivers take care of a child, they are doing a lot more than just feeding or bathing or comforting. They are helping the child's brain develop, shaping his temperament, and teaching the child about the world.

These social interactions become the building blocks for the young child's mental and emotional abilities. When the child plays or finger paints with his parents or caregivers, or listens to them talk and babbles back, he learns to focus and concentrate, to recognize the familiar and study

the unfamiliar, to remember and to take pleasure and pride in learning. These same processes later allow a first grader to focus on a book, quiet down, filter out the buzz of classroom noises, and feel good about learning to read.

Children provided with warm care and attention become attached to their parents and then to one or two other adults who take care of them on a regular basis. They build up an internal, emotional portrait of their parents. When the parent is not there --- when she is at work or busy with something else --- or when the child is upset, the baby remembers the internal portrait and comforts himself. The more securely a child is attached, the more easily she can cope with new experiences, including going to day care or recovering from illnesses and separations

The experiences during the first years of life -- at home, in daycare, in the community --- are especially important because they lay down the patterns for all future development. A fortunate child who has been loved, stimulated, talked with, comforted and given predictable care will see the world as basically safe and secure, will feel valued and effective, will have trust in himself and others, and will be able to use his intellectual potential to its limits. Children who have had difficult experiences are likely to have problems in one area or another.

In subsequent years, there may be opportunities for earlier brain and behavior patterns to be reshaped. A child with low self esteem from repeated failures and neglect can blossom with a mentor and success, and an anxious child can be helped with therapy and emotional support. Overactive children can learn how to calm down in kindergarten. No child's potential for recovery and achievement should ever be written off. But we cannot count on the success of such renovation when maladaptive processes have gone too long or too badly.

There are important lessons from research on early care and stimulation for the lives of the most vulnerable young children, such as those who are abused, neglected and move from one foster home to another. Mrs. Clinton, your teacher and mine, Sally Provence, was among the very first researchers to show that children who are deprived of the continuity of individualized, active attention and care are at great risk to fail to thrive emotionally and physically. They are at jeopardy of ever forming secure, stable attachments and trust in others. Dr. Provence used these insights to create one of the first early intervention programs for infants and parents. She demonstrated that sensitive day care and family support can lead to long term gains in children's development. We need to make advanced, developmental knowledge, training and resources available to those providing care and security for the most vulnerable, traumatized children.

Scientific research also provides exciting new information about children from loving devoted families who are born with constitutional vulnerabilities, such as autistic children. These children are unable to communicate or participate in social relations because of inborn dysfunctions in brain maturation that no amount of loving will reverse. They benefit from education and treatment, but their ultimate hope lies with the type of behavioral and brain research you are encouraging today.

Scientific research on healthy and vulnerable children casts new light on the many factors that go into normal development and the ways development may become derailed. This research helps define what children and families need to develop their fullest potential. We thank you, Mr. President and Mrs. Clinton, for your making the future of children a shared national concern.

SHATZ LAB

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NOTES:

Draft of Dr. Carla J. Shatz's talk for White House Conference on Early Childhood Development.

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C. 15 min.*

How the Brain Develops - C. J. Shatz

Thanks to President and First Lady for invite to talk about how the brain is assembled during development.

The human brain is the most incredible computational machine imaginable. Our ability to function, to see, to move and to think depends directly on the precision and detail of our underlying brain circuits - how are these circuits assembled during development? The last 25 years of research by many neuroscientists have yielded great insights into process.

The Problem:

First, I want to give you an idea of the magnitude of the problem. The adult brain consists of about 1 trillion (10^{12}) nerve cells - neuroscientists argue about the exact number. Each neuron makes a very stereotyped set of connections with others. Just to remind you - nerve cells are kind of like telephones, using a mixture of chemical and electrical signals to send and receive phone calls. Each nerve cell sends a long process - an axon - kind of like a phone line - to connect itself to other cells that can be located the equivalent of hundreds of miles away - For example, nerve cells up in your brain connect many feet away with nerve cells way down in the spinal cord.

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The connections that nerve cells make with each other are called "synapses", and each cell can form anywhere from 10 to 10,000 synapses depending on the function and specific circuit. So, the brain contains well over 1000 trillion connections and none of them are random! So, you can see the magnitude of the problem of brain construction.

Even more incredible is that during brain development, all these connections have to be formed from scratch - nerve cells are made in different places in the brain by undergoing many successive cell divisions, and then each cell has to spin out its long process - the axon - and grow it towards the appropriate target neurons. For instance, the million or so nerve cells in the eye have to grow their axons long distances to connect up with the "visual" part of the brain; those in the ear with the "auditory" part of the brain; and so on. And then, once the growing axons reach their targets, they must select, from the millions of possible neurons, just the right few with which to form synapses. The process is much like stringing phone lines from New York to DC.: First, trunk lines between the 2 cities must be laid down. Then, phones at specific addresses within each city need to be wired so when you dial your grandmother in DC., only her phone rings and not also phones at the White House, NIH or the Kennedy Center.

The Solution - not like a computer:

How does the brain solve this incredible wiring task during development? One possible idea is that the solution is like wiring up a

computer: take all the thousands of component parts (the neurons), solder together all the connections according to the adult circuit diagram, flip a switch and voila, it works!

But research has shown that the brain's solution is much more elegant and adaptive than this. The brain actually lays down a basic framework of circuits - the trunk lines - according to strict circuit diagrams set by a genetic blueprint. Then, way before the adult precise circuits are formed, the "switch" is turned on: Brain function itself completes the wiring process by running test patterns on the circuits and selecting correct connections and eliminating errors. It's as if, once the trunk lines are strung between NY and DC, at first placing a phone call to your grandmother will cause many phones to ring in DC. because many connections are formed initially. Then, the process of phoning itself eliminates that pesky phone that rings in the White House.

2 Phases to Wiring:

So, there are really 2 broad phases to brain wiring: an early phase that lays down basic brain circuits that does not require brain activity, and a later phase that refines circuits into their adult precision that does. Neuroscientists actually are beginning to learn a great deal about the molecular rules that govern these 2 major phases. Early on, growing axons follow roadsigns and highways of specific molecules, like netrins, semaphorins, CAMs, and SAMs. Then, in the phoning process itself, the frequent use of connections strengthens them by rewards with special growth factors and signaling molecules. It's in this second phase where experience of the world can make a huge difference to brain wiring.

Experience Places the Phone Calls After Birth:

Let me give you a specific and famous example. Here's a question for you: your grandmother gets a cataract as an adult. She can't see out of her right eye for 5 years. Then, after cataract surgery, she's fine again. In contrast, a child is born with a congenital cataract in the right eye. At 5 years of age, it is operated and the optics of the eye are restored to normal. Yet, unlike grandma, tragically, the child remains permanently blind in the eye! What's the difference between these 2 cases?

To find out, David Hubel and Torsten Wiesel, Nobel Laureates in 1981, made an animal model of adult versus childhood cataracts. What they found was striking! They found that a childhood cataract actually caused that eye to lose so many connections with the visual cortex that blindness resulted! Here is a graphic demonstration of "use it or lose it" - literally.

But why the difference between the child and grandma? Well, neuroscientists also discovered that for a long period after birth, the visual system is still wiring itself up. That is, at birth the trunk lines between eye and brain are all present but the detailed patterns of connections within visual structures are still in an immature pattern. The phone process is still

going on to correct errors and select appropriate connections. Visual experience is needed to place the phone calls and if an eye is blocked by a cataract, calls can't be placed effectively, so connections wither away: use it or lose it. Grandma is fine, though, because once connections are formed in this system, lack of use does not cause them to be lost.

A Critical Period for Vision Development:

This early requirement for visual experience occurs when brain wiring is still happening - and during this period, normal experience is crucial for normal brain wiring. So, there is a critical period, or window of opportunity, in the visual system when experience is necessary for wiring. Neuroscientists know absolutely in the case of the visual system that during this time, abnormal experience leads to abnormal brain wiring. This is the classic model of critical periods for brain development. And because different parts of the brain mature at different rates and times, neuroscientists believe there are different critical periods for different functions. Indeed, we are going to hear about another important example from Dr. Kuhl regarding language development.

How early do these windows or critical periods open? Well, in the case of vision, we know from animal models that the phoning process actually begins even before birth - in utero! In utero, of course, vision itself can't place the phone calls. Instead, nerve cells in the eye actually undergo a spontaneous auto-dialing process, sending "test patterns" to the visual centers of the brain to get the process of fine-tuning of connections going. Then, after birth the phoning continues as visual experience replaces auto-dialing. So, the baby doesn't wait until birth to start the second activity-dependent phase of brain wiring. It starts even earlier - almost as if the brain were in training for experience after birth. Thus, proper brain functioning even in utero is thought to be essential for proper brain wiring.

An Elegant Solution to the Problem of Brain Wiring:

X Today I've told you about brain wiring development and the 2 step process that occurs - an initial activity-dependent step in which the basic framework of connections is constructed strictly according to the genetic blueprint, followed by a step in which brain function selects and refines from a wealth of connections. This second step is prolonged in humans, beginning prenatally and lasting to puberty postnatally. It is during this second period that experience can profoundly influence the important details of brain circuitry. You can see that a baby's brain is not simply a miniature version of the adult's. It is a dynamically changing structure that records its experience in wiring.

Why does the brain use this seemingly risky strategy to wire itself? Well, there are at least 2 good reasons. The first relates to the numbers problem I posed in the beginning of my talk - there are just not enough genes

in the genome (only about 100,000) to account for the incredibly precision of connectivity present in the adult brain (> 1000 trillion connections). An elegant solution is to "hand wire" the trunk lines with specific molecular guidance clues, but then flip the switch early and let neural function make the final decisions. And this flexibility in final decision-making, after all, is what let's us adapt to our environment.

For example, the brain doesn't know if it is going to have to learn English, Spanish, or Japanese after birth, an elegant solution to the wiring problem is to establish the fundamental framework of language circuitry using strict molecular mechanisms and then sculpt out the details depending on specific experience after birth. Without this superb flexibility, we could not learn or remember or adapt to our environment - in short, those properties that make us human.

Fax Transmittal Cover Sheet

To: Early Learning Nicole Radner, - White House

From: Patricia Kuhl

Fax Number: 206-543-5771

Date: Tue, Apr 15, 1997 • 9:05 AM

Pages, including cover: 12

Born to Learn: Language and the Brain of the Baby

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Paper presented at the White House Conference:

**"Early Childhood Development and Learning: What New Research
on the Brain Tells Us About Our Youngest Children"**

April 17, 1997

The research described here is supported by grants to Patricia K. Kuhl from the National Institutes of Health

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 2

Born to Learn: Language and the Brain of the Baby

- I want to thank Mrs. Clinton and the President for convening this Conference. It calls attention to the country's most precious resource, our children.
- Today I want to talk to you about language acquisition and the results of new studies on infants. They show two things: first, infants are born to learn. One of the most striking characteristics of human beings is their passion for learning. Signs of language learning occur in the first months while the infant is still in the crib. Second, the first sign of language learning that occurs does not involve words or grammar, but the phonetic units of language, the consonants and vowels that make up words. We think the process uncovered at this level may mirror learning at higher levels of language.
- Language is one of the most complex mental activities we engage in, one that makes humans unique. No other animal on the planet has a communicative system even approaching the complexity of human language. Yet, as you listen to me speak you decode my message effortlessly. No computer in the world

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 3

can accomplish what you are now doing, though many computer companies are interested in creating computers that communicate through language.

- If computers can't master language, how is it that children the world over do it so well? If brilliant computer scientists haven't cracked the language code, how do babies crack the code? This is one of the most interesting puzzles in modern developmental psychology, and one I want to talk about today.

- Most of you have witnessed your own children passing through the well-established timetable for typical language milestones. Whether an child is born in Tokyo, Zimbabwe, Paris, Moscow, or Washington, at about 3 months the baby will coo, producing vowel-like sounds. At about 7 months the baby will babble, producing the /bababa/ or /mamama/ that constitutes the universal sign that the child has heard language and is beginning to master it. At about 1 year, normal infants will begin to produce their first words. At 18 months, their first 2-word utterances. And by 3 years of age, infants the world over will speak in sentences and can talk your leg off.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 4

- What makes this happen? Both nature and nurture are critical. First, we know that newborn infants are born with the ability to distinguish the sounds used to communicate meaning in the world's languages, like the 'p' in "pat" and the "b" in "bat." These are very subtle acoustic differences and infants can hear them at birth. In studies conducted on infants in the first few months of life in many countries of the world, research has shown that there isn't a single speech sound contrast used in the world's languages that infants can't distinguish at birth. They come prepared. I like to refer to infants as "Citizens of the World" at birth. Newborns are ready to acquire any of the world's languages. They don't know what culture they will be born into and biology has prepared them well to be born into any culture.

- But in order for a specific language to develop, this "Citizen of the World" has to become a "Culture-bound Language Specialist" and discover the specific sound structure used in their particular language. American English doesn't use the same set of sound contrasts as Japanese.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 5

- Mastery of the sound system of language involves an intricate mapping of the speech information infants hear. We previously thought that this mapping began with the learning of words, but recent research confirms the fact that learning begins in the first six months of life. Infants are beginning to learn language in the crib. This was shown by studying infants in different countries who are raised listening to different languages. For example, one study showed that by six months of age, the perceptual systems of infants raised in Seattle as opposed to Stockholm differed as a function of the language they had listened to for the first 6 months. By 6 months, infants showed greater ability to categorize the sounds of their native language as opposed to the foreign language. By 9 months they have learned the stress pattern that is typical of word in their language, and prefer that sound structure over that typical of a foreign language. By 12 months of age, infants show definite signs of becoming culture-bound language specialists. They focus on the distinctions of their native language, and show less ability to hear distinctions in foreign-language sounds. This is a sign that their perceptual systems are becoming tuned to the sound structure of their specific language.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 6

- There is a wonderful synchrony between what is given by nature and what is acquired through nurture. Nature and nurture don't compete, they cooperate. Nature provides infants their keen abilities to hear the sounds language uses to convey meaning. Nurture provides complex information to the brain that infants acquire simply by listening to the ambient language that we bathe them in during the early months of life.

- The new research shows evidence of learning by 6 months of age. 6 month old infants are very young. They have yet to understand or produce a single word. Yet they are listening to us speak, and their brains are busy coding the sounds of language that they hear us produce. The young child's extraordinary response to language input puts some responsibility on us. We are the speakers that infants are listening to. Our input is important to them.

- What do we know about language we speak to infants? Research on "Parentese" has shown that speech we direct towards infants is unique. Scientists have discovered that parents the world over use a higher pitch, exaggerated intonation contours, and slower speech when speaking to

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 7

infants. Parentese is often described as melodic because of this. We also know from careful laboratory research that infants prefer this kind of speech, and choose to listen to it when given a choice. If you give a baby a choice of listening to Parentese vs. speech directed to adults they will turn on the Parentese speech. The most recent research in this area suggests that Parentese not only sounds better but teaches infants something. It contains exceptionally well-formed phonetic units, more than is the case for adult-directed speech. Language input to infants is a naturally enriched signal that makes it easier for children to learn.

- We also know that infants can master a second language quite easily during their preschool years, and that it is much more difficult to learn a second language, and produce it without an accent, if we try and learn it at our age. Scientists use the term "plasticity" to express this. Children are more plastic than we are. This suggests that if we spend money in our schools on second language learning, it would be useful to begin that training early. The window for language learning is wide open in early infancy and childhood. The window snaps shut, or at least greatly narrows after puberty. Timing is important.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 8

- Recent studies suggest that young infants learn by watching adults. They imitate what they see us do. They also imitate what they hear. Laboratory studies show that after short periods of listening to simple sounds, very young infants will begin to duplicate the sound patterns they hear. Speaking to an infant seems to prompt them to take turns and talk back. Infants thus master the give and take of conversation very early in life.

- In order for infants to learn in the way I've just described, they have to have normally developing sensory, linguistic and cognitive systems. It is very important to diagnose deficits in these precursors to language because early diagnosis allows intervention. Recent research indicates, for example, that children with developmental disorders that involve language have difficulties discriminating the basic sound units of speech. Deficits in these early precursors to language can be detected, and that allows the possibility that early intervention might reduce the severity of the later language problem. Again, timing seems to be important. Many interventions work better when done earlier. Plasticity makes early intervention more effective.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 9

- One caveat. Does this mean we should drop everything and spend more time talking, reading, and singing to our children? Research cannot at present tell us how much language input it takes to provide infants with an adequate sample from which to learn. We don't know if it takes 10 minutes or 2 hours a day of conversational interaction to produce the effects I've described. As researchers we would not advise parents to try and accelerate the normal pattern of development -- science doesn't lead us to recommend flash cards for word learning, or language learning solely from a disembodied tape hung on the side of the infant's crib. Natural language input to children in normal social environments causes language growth, and infants like the interaction. We should acknowledge our role in this, and the central importance of the social context, and take pleasure in the fact that we are causing our children's brains to change and their minds to develop.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 10

- This is, of course, what our grandmothers knew intuitively. Yet, part of it is indeed new. We now know why we shouldn't wait until infants talk before we speak to them. The reason is that infants' brains can't wait. Infants map language by listening to us speak. The information stored in their brains subsequently guides their own attempts to speak.

- Let me sum up with an analogy: When we do physical exercise with our children we can see their bodies change. Mental growth is often more difficult to see. One day your child produces his or her first word or sentence and as a parent you wonder "where did that came from — what's going on up there"? Modern behavioral and brain science is providing answers to these questions. It's showing us that when we speak to our children we provide them with a kind of mental exercise. The experience we give them, the mental exercise we provide, causes their brains to change.

- Infants are born to learn. Our role is to be good partners in this learning process, one that we now know starts in the first days of life, well before they can speak.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 11

Background Reading

(1) Scientific articles by Dr. Patricia K. Kuhl show how important learning and early experience is to language development. Four excellent papers on early learning, language, and the brain are:

Kuhl, P. K., & Meltzoff, A. N. (1982). The bimodal perception of speech in infancy. Science, 218, 1138-1141.

Kuhl, P. K., Williams, K. A., Lacerda, F., Stevens, K. N., & Lindblom, B. (1992). Linguistic experience alters phonetic perception in infants by 6 months of age. Science, 255, 606-608.

Kuhl, P. (1994). Learning and representation in speech and language. Current Opinion in Neurobiology, 4, 812-822.

Kuhl, P. K., & Meltzoff, A. N. (1996). Infant vocalizations in response to speech: Vocal imitation and developmental change. Journal of the Acoustical Society of America, 100, 2425-2438.

(2) There is a new book published in January, 1997 that supports the idea that children (from birth to three) are born to learn. It is called, Words, Thoughts, and Theories, by A. Gopnik and A. Meltzoff (MIT Press, 1997). The book describes how babies develop the ability to think before words, and how this helps them learn language. The book discusses children as "little scientists" striving to understand the world around them. Dr. Meltzoff is a Fellow of the American Association for the Advancement of Science and is Head of Developmental Psychology. He can be reached at the University of Washington Telephone: (206) 543-2543; Fax: (206) 543-5771.

expanding
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chatter -
talking to
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large rather
than policy
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The field I
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Preparing to be a parent should be no less important than preparing for your life's work. We have long understood that good health and medical care for women before and during pregnancy has an important influence on the health of their infants. In view of the recent remarkable scientific findings about brain development, all prospective parents, both women and men, must become actively and knowledgeably involved to assure the best possible health status before and during pregnancy because of its importance in newborn and early child development.

A healthy mother, giving birth to a healthy newborn, into a healthy family, offers the best chance to take full advantage of this new science demonstrating how much the young child's brain development benefits from a stimulating and interactive environment. The general society should be so infused with this information that no child could escape its benefit. Formal and informal education should ensure that future parents, especially girls and women of all ages, understand that proper personal habits, balanced nutrition, and family support are among the factors that improve pregnancy outcomes.

There is proven value in a specific medical consultation and evaluation when pregnancy is contemplated. This provides the opportunity for a complete family and personal history, physical examination, and needed tests to identify any conditions that might require special consideration or counseling. For example, medical conditions that might harm the woman or fetus and lead to a less than healthy start may be corrected. These could be obvious and symptomatic problems such as obesity, undetected medical conditions such as high blood pressure or diabetes, or unrecognized risks associated with genetic conditions, hazards in the work place, or diets and medications thought to be harmless by the patient. Personal habits such as smoking, drinking, or illicit drugs could be stopped or reduced. While all these will be addressed as part of prenatal care, some may affect the fetus so early that the pregnancy may not yet be suspected.

At the present time, medical care begins with pregnancy for most patients, since preconception care is a relatively new recommendation and the option is not generally exercised. There is no question that early and comprehensive prenatal care is added assurance that there will be a healthy mother joyfully interacting with a vigorous and responsive newborn. Such newborns have the best chance of maximal development. Mental and physical impairment or disability that could have been avoided with proper care may otherwise greatly increase the difficulty in reaching developmental potential. Prenatal care continues throughout pregnancy to identify medical and psychosocial risks and to provide health promotion and intervention or treatment to reduce or eliminate such risks. The advantages of this care are insufficiently understood by many who consider pregnancy a normal condition, and do not realize they may have no warning if a normal pregnancy does not remain so. Prenatal care not only improves chances for mothers and babies, but also has been documented many times to decrease overall costs. Still, there are many women in this country who do not get this care because of lack of knowledge or motivation, or who cannot afford it for lack of resources or insurance. We must work to overcome all such barriers.

The time immediately after birth, the postpartum period, is another critical opportunity to be captured for evaluation and education. A smooth transition from birth to parenting a newborn at home that provides comfort and reassurance about the details of newborn care and especially breast feeding, is enhanced by professional observation and assistance in the hospital and/or home. The common wisdom - what women know as best for themselves - regarding this advantage contributed to the public and professional outcry over postpartum hospital stays cut short by purely financial and

administrative considerations.

Throughout our population many barriers interfere with ideal prenatal and perinatal care; smoking, drinking, illicit drug use, poor nutrition, family violence, stress, lack of knowledge, and inadequate medical care. And we must remember, up to one in four children in this country is born in poverty. Special efforts should be made to bring insight and assistance related to personal health habits and access to care to the disadvantaged in our population.

upfront repeat
Much more emphasis should be placed on planned childbearing to pursue a more orderly approach for pregnancy preparation and medical care, since many of our problems are related to unwanted and untimely pregnancies. Fully 57% of pregnancies in the U.S. are unplanned. This is not only a problem of teenagers, but adults as well; teens account for only 15% of women at risk of unplanned pregnancy. The outlook for attentive care during the pregnancy and for the child receiving the care being discussed today is very different in a pregnancy that is planned and eagerly anticipated compared to an unwanted pregnancy without the necessary social and emotional support. Increasing planned pregnancies would have enormous impact in improving the conditions for newborn children.

Before the findings discussed here today, we already had good evidence upon which to act to improve pregnancy care for the benefit of child development. Hopefully, these new scientific findings will make more impelling the social and policy actions necessary to meet these needs.

NO
A good general guide to the care that I could only briefly outline here can be found in the report of the panel on prenatal care organized by the National Institute of Child Health and Human Development (NICHD), *Caring for Our Future: The Content of Prenatal Care (1989)* and the *Guidelines for Prenatal Care - 3rd Edition, (1992)* jointly published by the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics (ACOG/AAP).

Thank you for giving me the opportunity to add maternity care and the obstetric perspective to these important issues.

THE BRAZELTON INSTITUTE

D. Kalish

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White House Press Conference

Never before has there been such a window for change in our approach to families and to the most vulnerable members of our society. (Zero to three years of age). The Clintons have demonstrated their commitment to the change in supports for families which could make a real difference in the way I hear that parents feel now around the U.S.: isolated, lonely and unsupported in their passionate job of childrearing.

In our two years of work with the National Commission for Children we became aware that the U.S. is one of the two least child and family oriented countries in the world. Why? We still feel that families should be self-sufficient and if they're not, we as a nation don't choose to be responsible for their well-being. And, yet, stresses on families are increasing logarithmically. As I talk to large groups of parents around the country, I have identified 10 sources of stress that have increased to beset families since my wife and I were raising our own children in the 50s and 60s. They need help from all levels: national, state, local and business. Their feelings of isolation and stress are affecting their children. We cannot afford to ignore it any longer. Violence, drugs, pregnancy and suicide beset teenagers as a payoff.

The Parental Leave Act was the first steps that Bill and Hillary made toward family support. The attempt to institute Health Care Reform was another massive effort. Despite the watering down of the first and failure of the second effort, there was a shaking up of the community around families which followed. The Parental Leave bill only affected 5 percent and they were most vulnerable to taking the opportunity. But it shook businesses up to wonder what they are doing to family life. The health care bill shook up the medical system. It is in a state of turmoil at present. It is shaken to its roots and unfortunately insurance companies and malpractice lawyers are dominating the scene.

We can either give up to feel helpless and depressed or we can take this turmoil as an opportunity for change in our present medical system. But we in the profession, and families

must take the helm. My own fix on it is that families in this country can change it for the better if they face this with the passion they bring to childrearing. The Clintons will be behind us in changes we can suggest.

In the medical field, we all know that we need some appropriate form of *universal coverage* -- at least for pregnant women and dependent children. It is an investment. We have models in other countries, but none that seems workable here. It will take time to develop one for the US, and this gap in time presents us with an opportunity to think ahead. In this country it won't work just to provide "coverage." The failure of AFDC-funded medical care in the area of prevention is an example. Forty percent of children are still not receiving preventive health care. We need to change the medical model -- to an outreach model in which relationships are valued and are optimized. For example, immunization program's failure.

I have some ideas about changing the *pediatric model for outreach* -- we can do it by using children's development as our shared language with parents. Their passion for an answer, "How am I doing? How's he doing?" will lead to continuing care for most families. This means our medical education system needs revision -- prevention rather than treating disorders at the other end, training for relationships as critical, using the child's development and family issues as important in creating medical supervision. In other words, train physicians for family work, for a positive model of strengths rather than the deficit model of weakness we now use, share parent's successes first then address their problems with them. Vulnerable parents (and all are) can't take either an impersonal or a failure model for something as passionate as their children's development. We need to turn health care back to parents and children from the beginning. Our top down model is not working.

This morning we heard how critical it is for us to face early the development of our children. For instance, the opportunities for reinforcing the marvelous plasticity of the immature nervous system even after intrauterine or perinatal insults presents us with a challenge. The early influences of the environment can optimize the child's psychological and emotional development as well. Even after insults -- such as malnutrition, drugs, heavy smoking, stressful deliveries, there is an opportunity for recovery in the immature CNS. This opportunity resides in the environment. The extra pathways in the immature CNS which might otherwise drop out in

normal development can be captured to function if the CNS has been stressed. This capturing of extra pathways depends on appropriate input from the environment. We need a model of outreach from the neonatal period. With fragile or stressed neonates, if we present them with the stimuli which might normally come from an anxious, overwhelmed parent, they withdraw and demonstrate that their threshold for input, organization and discharge of "usual" experience overwhelms them. With babies from cocaine and crack addicted women they will stop breathing if we talk too loudly, handle them abruptly or look directly in their wide, frightened eyes. Yet, if we reduce stimuli to one modality and respect their hypersensitivity, we can capture even the most fragile babies for a positive response to the voice, to face-to-face contact and to cuddling. A fragile mother needs our modeling to see that and to emulate it. When we share the baby's behavior with her in the neonatal period, even addicted women are captured by their babies. We must start early. Can't we share their newborn's behavior and temperament with all new parents? This could even mitigate the destructive effect of early discharge today.

For abused, neglected children we are having an impact on their families by presenting their babies as people to them from the first. If they must be in foster care, we need to share the baby's temperament and behavior with the caregiver. Then we must continue this supportive outreach to capture the families of 40 percent of children who are not getting preventive health care in the first few years. Forty percent not immunized in this country is a statistic that needs to horrify all of us. It will only increase if preventive health care visits are rushed, aimed at only ruling out physical defects. We need to change the medical model to reach out for even the most vulnerable parents -- and all new parents are vulnerable for a good reason -- their passion to do it "right."

As we are pressed by time and funding into a managed care model, we must aim at a multidisciplinary approach to preventive health care which focuses on the child's physical, psychological and emotional development in these vital first years. Reach out for parents at each visit a shared approach, using the child's development as our language. Change from the deficit model of looking for illness and failure to one of sharing success in the area which parents can identify with and let parents set the agenda, not our overburdened, medical approach.

I would like to suggest that we can set up medical outreach centers in community centers.

in schools, in daycare and in businesses which combine this preventive medical outreach at optimal "touchpoints" in the infant's development. We can combine them with child care and community support systems. We cannot do it alone as physicians -- that has become obvious. But we can fight for change -- even in insurance run managed care in which physicians, nurse practitioners and all other disciplines combine in teamwork to reach out for, nurture and optimize families and their children's development. We recommend in our Touchpoint training that preventive health opportunities be aimed at making relationships -- a positive model, valuing passion wherever you find it, shared developmental and medical processes, multidiscipline approach. emphasis on communities of parents with same aged babies.

We do know how to support families. We do know how critical is the environment in the recovery of babies with threatened CNS disorganization. We know that we can make an ever more important difference in optimizing the development of all babies if we start early. We can give back hope in the future of parents through their babies, and a decent self-image to all babies by respecting their parents.

Examples: Bright Futures: prevention/families matter/health promotion is everyone's business

Carnegie: Rob Reiner

Commonwealth Foundation: Health Start

Touchpoints training here at HMS

TO: *Nicole Rabner*

DATE:

4/15/97

FROM:

NATIONAL RESEARCH COUNCIL
INSTITUTE OF MEDICINE
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Child Care Conf → #1
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Statement of Deborah Phillips

White House Conference on Early Childhood
Development and Learning

April 17, 1997

The new breakthroughs in research on early brain development have alerted all of us to the tremendously high stakes involved in providing infants and young children with nurturing environments, rich in human interaction and language, inviting of learning, and predictable with regard to what happens and who is there day by day.

At the same time that this neural research has been flourishing, research on child care has grown exponentially...and especially research on infant child care. Just as the research on the inner workings of the brain has, somewhat ironically, directed attention outward to the environment, research on child care has affirmed the centrality and salience of the family in children's lives. We now know, for example, that placing a baby in child care does not interfere with the development of the mother-infant attachment relationship--this bond is extremely resilient.

But, today, the vast majority of families are sharing the rearing of their children with child care providers, starting in the first weeks of life. We know from the new multi-site study of early child care, funded by the NICHD, that 80% of infants in the U.S. experience some regular nonmaternal child care during the first 12 months of life. Most of these babies that we studied started child care before their fourth month of life, and they were typically enrolled for close to 30 hours each week. We are looking at high dosage, very early exposure to child care environments for most U.S. born babies.

What do we know about these environments? Most of them fall short of a standard that any of us in this room would consider optimal. And, virtually every study that has involved going into child care settings and observing what really goes on inside finds that 20% -- about 1 in 5 -- are dismal, perhaps dangerous. Compared to older children, infants get the poorest quality of all. We also see fabulous child care in all kinds of arrangements, ranging from grandma to a trained teacher in a child care center.

Does it matter? Does it affect their development? Neuroscience tell us that it must matter. Child care research confirms that it does matter. Young children and, yes, babies can thrive in child care when it is of good enough quality. Not surprisingly, the key to "good enough" lies with the caregiver. Children show significantly better cognitive and language development when they are cared for by adults who engage with

them in frequent, affectionate, responsive interactions--who are attentive and know how to read the baby's or the child's signals and respond appropriately. When to raise the volume of an interaction because the child is asking for more and when to sit back and watch because the child is fully absorbed or tired and needs to rest.

Consider the difference: a one year old holds up a toy car and declares "ca!" and is immediately greeted by a caregiver, kneeling down to eye level, who smiles with joy and claps and says, "Yes, car, you have a car" versus the same gleeful infant whose first word, "ca!", is completely ignored...and is often ignored--not left unsafe, not abused in any way, but just ignored a lot. Consider the difference between a group of 2-year olds sharing a lunch table with their caregiver who not only eats with them, but uses the opportunity to help them explore the colors and textures of the different foods they are eating versus the same 2-year olds eating alone at the table while their caregivers talk among themselves. These are meaningful differences.

This is what quality boils down to. These are the real differences we see, as researchers, when we talk about high versus low quality child care environments. We also talk about adult-to-child ratios, because it's humanly impossible to offer an infant enough of these kinds of nurturing exchanges when a caregiver has to juggle the needs of more than 3-4 babies or more than 6-7 toddlers. And, we talk about training, because--at least in group care settings--it also increases the odds that a toddler or preschooler will receive a rich array of developmentally beneficial experiences from their caregivers. Finally, we talk about the stability of children's caregivers because what we euphemistically call "staff turnover," children experience as loss--and this brings us to the difficult issue of how little we value and reward those who provide child care in this country.

Parents care hugely about the quality of their children's child care. Some parents call it safety. Some call it trust. Some call it learning opportunities. But, they all care about it and worry about it. They struggle one by one to find it and then to keep it, doing their best under often very tough circumstances--constrained by the child care that is available, convenient, and affordable; constrained by their work hours and the demands of their jobs, into to which their child care arrangements must fit.

How can we help them? Most of all parents need real choices...about when to start using child care and how much, and they need to be able to avail themselves of high quality child care. This requires that parents know what to look for, how to look for it, and have the resources necessary so that they have good options to chose among.

Next to the family, child care is the most salient and

influential environment in young children's lives. It is where parents try to create safe and stable environments for their children when they cannot be with them. It is where parents--at least the lucky ones--establish close ties of trust and interdependence in the shared task of raising their young children starting remarkably soon after birth.

#2

Statement of Deborah Phillips

White House Conference on Early Childhood
Development and Learning

April 17, 1997

The new breakthroughs in research on early brain development have alerted all of us to the tremendously high stakes involved in providing infants and young children with nurturing environments, rich in human interaction and language, inviting of learning, and predictable with regard to what happens and who is there day by day.

At the same time that this research on the brain has been flourishing, research on child care has grown exponentially...and especially research on infant child care. Just as the research on the inner workings of the brain has, somewhat ironically, directed attention outward to the environment, research on child care has affirmed the centrality and durability of the family in children's lives. We now know, for example, that placing a baby in child care does not interfere with the attachment that is formed between the mother and the infant.

Today, the vast majority of families are sharing the rearing of their children with child care providers, starting in the first weeks of life. We know from the new multi-site study of early child care, funded by the NICHD, that 80% of infants in the U.S. experience some regular nonmaternal child care during the first 12 months of life. Most of these babies started child care before their fourth month of life, and they were typically enrolled for close to 30 hours each week. We are looking at high dosage, very early exposure to child care environments for most U.S. born babies.

Recent developments will result in many more children, including infants, spending much of their preschool life in child care settings. These include welfare reform, limited availability of family leave, and continued movement of women into the workplace to supplement family incomes. [In fact, it is those families that are most heavily dependent on the mother's wages to escape poverty that place their babies in child care the earliest and for the most hours.]

As a result, we are no longer debating WHETHER families will use child care, but rather when, how much, and what level of quality they will use.

There are five critical findings from research on child care that must guide public policy in addressing early childhood development:

- As millions of American children are moving into child

care, most of these settings fall short of a standard that any of us in this room would consider optimal. Virtually every study that has involved observing what really goes on inside finds that 20% -- about 1 in 5 -- are dismal, perhaps dangerous. Compared to older children, infants get the poorest quality of all. Given what we now know about very early brain development, this is highly problematical.

- Neuroscience tells us that these sub-optimal child care environments should affect early development. Child care research confirms that they do. The quality of the child care environment significantly affects the cognitive, linguistic, and social development of young children. Contrary to persistent concerns, young children, including babies, can thrive in child care when it is of good enough quality.

- The key to quality lies with the caregiver, plain and simple. Children show significantly better cognitive and language development when they are cared for by adults who engage with them in frequent, affectionate, responsive interactions. This is true regardless of the type of child care setting used, whether formal or informal, with kith or kin, at home or in a group setting. Liking babies or raising one's own children does not necessarily translate into possessing the skills that research demonstrates are most effective in providing high quality child care to young children. The elements of quality associated with caregivers that research clearly links to child outcomes are:

- Child-staff ratios, because it's humanly impossible to offer an infant enough of these kinds of nurturing exchanges when a caregiver has to juggle the needs of more than 3-4 babies or more than 6-7 toddlers.

- Training and education, because--at least in group care settings--trained providers interact more effectively with toddlers and preschoolers. Experience alone does not appear to make a difference.

- The stability of children's caregivers--just as the stability of their families--also matters because what we euphemistically call "staff turnover" children experience as loss.

- And, the wages we pay caregivers are the strongest predictor of stability, and, therefore a major factor in the quality of child care. Given this finding, we must soberly consider that child care workers earn among the lowest wages of any workers in this country. They earn significantly less than those who teach young children in our nation's schools even though their impact on the child's development is just as critical.

Parents understand the importance of quality in their

children's child care. It affects not only their children, but also their performance on their job. Some parents call it safety. Some call it trust. Some call it learning opportunities. But, they all care about it and worry about it. They struggle one by one to find it and then to keep it, doing their best under often very tough circumstances--constrained by the child care that is available, convenient, and affordable; constrained by their work hours and the demands of their jobs, into which their child care arrangements must fit.

Next to the family, child care is the most salient and influential environment in young children's lives. It is where parents try to create safe and stable environments for their children when they cannot be with them. It is where parents--at least the lucky ones--establish close ties of trust and interdependence in the shared task of raising their young children starting remarkably soon after birth.

Employers, government and parents themselves all share a responsibility for meeting the needs of America's children for quality child care. Parents need real options regarding when to start using child care during the first year--a matter of family leave policy. They also need assurances that their child care will provide their infants and young children with the quality environments in which they can thrive. Opportunities for caregivers to expand their education and training--through specific inclusion in post-secondary scholarships and grants, is a critical component of this.

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Diane Alexander



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Thanks -
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Language and the Brain of the Baby: Born to Learn

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Paper presented at the White House Conference:

**"Early Childhood Development and Learning: What New Research
on the Brain Tells Us About Our Youngest Children"**

April 17, 1997

The research described here is supported by grants to PKK from the National Institutes of Health

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 2

Language and the Brain of the Baby: Born to Learn

- Thank the President and Mrs. Clinton for focusing the nation's attention on our most precious resource, our children.

- Today I want to talk to you about language acquisition and describe a specific instance of how the brain begins to wire itself for this complex activity. Over the past 25 years we have learned a great deal about language acquisition. We previously thought that language began when infants learned their first words and began to talk. We now know that there is no such thing as the prelinguistic child. Right from the beginning, the infant brain is coding information about language. In the first few months of life, the brain's neural machinery is conveying specific information about the elementary building blocks of language, the consonant and vowel sounds of human speech. By 6 months of age, infants are well on their way to cracking the speech code. Let me explain this in a little more detail.

- It takes both nature and nurture, biology and culture, to bring this about. Newborn infants are biologically prepared for language learning. At birth they show exquisite sensitivity to the sounds of human speech, the vowels and consonants that distinguish words, and can hear differences between all the sounds used in the world's languages. This is a marvelous feat, given the minute acoustic events that they have to be responsive to. I like to refer to infants as "Citizens of the World" because they born ready to acquire any of the world's languages. They don't yet know whether they will speak Spanish, Japanese, or English and are prepared for any of them.

- But the amazing abilities of the newborn doesn't mean the job is done. They have a long way to go. In order for a specific language to develop, this "Citizen of the World" has to become a "Culture-bound Language Specialist." This is where nurture comes in. Infants need to hear language in order for their brains to map the intricate sound structure, words, and grammar used in their particular language.

- Recent studies show that this process is well underway by six months of age. Studies show that by this age, infants raised in Seattle listening to English as opposed to Stockholm listening to Swedish begin to diverge from the universal pattern of listening that they evidenced as newborns. By this age, both groups attend more to the critical distinctions in their language and ignore those that are not critical. They have begun to process language through a network of filters that highlight the contrasts used in the language. By 12 months, this mapping of native-language sound units causes infants to ignore distinctions they once heard — at this age, the Japanese infant no longer responds to the change from /r/ to /l/. They have begun to build mental maps for speech that indicate that this distinction is not used in Japanese. This is a critical step in their acquisition of a particular language.

- These studies show that infants' perceptual systems have been altered simply by listening to the language that surrounds them, and that this has begun by 6 months of age. Six month old infants are very young. They have yet to understand or produce a single word. Yet they are listening to us speak, and their brains are busy coding the sounds of language that they hear us produce.

- If infants are learning at this wee age, who are they listening to? Us! We are the speakers that infants are listening to. The language we produce is vital to them. This puts some responsibility on us.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 3

- What do we know about language directed towards infants? Research on "Parentese" has shown that when we talk to infants and children we unconsciously change our speech patterns. Parentese has a simpler grammar and vocabulary, and it has a unique sound. Parents the world over use a higher pitch, exaggerated intonation contours, and slower speech when speaking to infants. It sounds very melodic. We know from laboratory studies that infants prefer this kind of speech -- it's a acoustic "hook" that attracts their attention. If you give them a choice, they choose to listen to it over adult-directed speech. The most recent research in this area suggests that Parentese not only sounds better but contains exceptionally well-formed phonetic units. Language input to infants provides both melody and message; it conveys warmth and affection as well as providing a tutorial on language.

- What we see is a intricate interplay between biology and culture. Biology provides the blueprint. Culture provides the input that sculpts the brain. This all occurs in a deeply social context. Language is a social enterprise, one the community of people surrounding the infant have to help them with. Young infants learn the communication game by watching and listening to adults. Laboratory studies show that even with only short periods of listening to simple sounds, very young infants will begin to duplicate the sound patterns they hear, taking turns and talking back. They master the give and take of conversation very early in life.

- Infants early propensity to learn reminds us that learning depends on infants' ability to hear, see, and process information. Early diagnosis of potential problems allows intervention that might reduce the severity of later difficulties. Timing is important. Intervention is most effective when done early in life.

- Timing is also important in learning a second language. Infants can master a second language quite easily during their preschool years. It is much more difficult to learn a second language, and produce it with out an accent, if we try and learn it as adults. The window for language learning is wide open in early infancy and childhood, and narrows after puberty.

- One last point, a caveat. These findings on early learning should not put additional pressure on parents. Research cannot at present tell us how much language input is necessary. We don't know if it takes 30 minutes or 2 hours a day of conversational interaction to produce language. As researchers we would not advise parents who are communicating with their children to try and do more, or to try and accelerate the normal pattern of development. Science doesn't lead us to recommend flash cards to accelerate word learning, or to advance language learning by hanging a tape recorder on the side of the infant's crib. Nature has provided a perfect fit between the natural language parents unconsciously produce when talking to infants and infants' capacity to drink it up, a kind of intuitive parenting that biology prepared us for. Parents should take pride in the role they play in their children's development. Research has shown us that infants are very clever and adept at birth, but they aren't adults. They have a long way to go, and the developmental process takes us. We need to pay attention to that fact.

- Let me sum up with an analogy: When we see a young baby's physical growth we are comforted. Our child is healthy. Mental growth is is often more difficult to see. One day your child produces his or her first word or first sentence and as a parent you wonder "where did that came from -- what's going on up there"? Modern behavioral and brain science is providing answers to these questions. When we speak to our children something happens. We are bringing about changes in the brain that will allow them to eventually participate in the communication game. Infants are born to learn. Our role is to be good partners in this learning process.



FAX COVER
PAGE

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PETER HART RESEARCH

202 232 8134 P.02/02

PARENTS ASK THE EXPERTS...

What stimulus should I provide her? Should I be teaching her and coaching her or letting her ask me? Should I play with her or let her play by herself?

California mom, 33-month-old daughter

When do you first notice a child's intellect?

North Carolina mom, 8-month-old daughter

I'd like to ask them what a child should be doing at each stage of development; what I could do to help speed things along and what to do to keep him on track.

Pennsylvania dad, 8-month-old son

How to draw the line on giving too much attention or not enough - can you spoil a newborn?

Florida mom, 2-month-old daughter

Knowing how to learn faster, pick things up faster. Do certain books help more? Which books should I read? Which books should I read to them? What to teach and at what ages?

Texas mom, 19-month-old daughter

Fax Transmittal Cover Sheet

To: Early Learning Nicole Radner, - White House

From: Patricia Kuhl

Fax Number: 206-543-5771

Date: Tue, Apr 15, 1997 • 9:26 AM

Pages, including cover: 12

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Q 12:20

Phil 12:20 - 12:25

Q 12:40

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Born to Learn: Language and the Brain of the Baby

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Paper presented at the White House Conference:

**"Early Childhood Development and Learning: What New Research
on the Brain Tells Us About Our Youngest Children"**

April 17, 1997

The research described here is supported by grants to Patricia K. Kuhl from the National Institutes of Health

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 2

Born to Learn: Language and the Brain of the Baby

- I want to thank Mrs. Clinton and the President for convening this Conference. It calls attention to the country's most precious resource, our children.

- Today I want to talk to you about language acquisition and the results of new studies on infants. They show two things: first, infants are born to learn. One of the most striking characteristics of human beings is their passion for learning. Signs of language learning occur in the first months while the infant is still in the crib. Second, the first sign of language learning that occurs does not involve words or grammar, but the phonetic units of language, the consonants and vowels that make up words. We think the process uncovered at this level may mirror learning at higher levels of language.

- Language is one of the most complex mental activities we engage in, one that makes humans unique. No other animal on the planet has a communicative system even approaching the complexity of human language. Yet, as you listen to me speak you decode my message effortlessly. No computer in the world

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White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 3

can accomplish what you are now doing, though many computer companies are interested in creating computers that communicate through language.

- If computers can't master language, how is it that children the world over do it so well? If brilliant computer scientists haven't cracked the language code, how do babies crack the code? This is one of the most interesting puzzles in modern developmental psychology, and one I want to talk about today.

- Most of you have witnessed your own children passing through the well-established timetable for typical language milestones. Whether an child is born in Tokyo, Zimbabwe, Paris, Moscow, or Washington, at about 3 months the baby will coo, producing vowel-like sounds. At about 7 months the baby will babble, producing the /bababa/ or /mamama/ that constitutes the universal sign that the child has heard language and is beginning to master it. At about 1 year, normal infants will begin to produce their first words. At 18 months, their first 2-word utterances. And by 3 years of age, infants the world over will speak in sentences and can talk your leg off.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 4

- What makes this happen? Both nature and nurture are critical. First, we know that newborn infants are born with the ability to distinguish the sounds used to communicate meaning in the world's languages, like the 'p' in "pat" and the "b" in "bat." These are very subtle acoustic differences and infants can hear them at birth. In studies conducted on infants in the first few months of life in many countries of the world, research has shown that there isn't a single speech sound contrast used in the world's languages that infants can't distinguish at birth. They come prepared. I like to refer to infants as "Citizens of the World" at birth. Newborns are ready to acquire any of the world's languages. They don't know what culture they will be born into and biology has prepared them well to be born into any culture.

- But in order for a specific language to develop, this "Citizen of the World" has to become a "Culture-bound Language Specialist" and discover the specific sound structure used in their particular language. American English doesn't use the same set of sound contrasts as Japanese.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 5

- Mastery of the sound system of language involves an intricate mapping of the speech information infants hear. We previously thought that this mapping began with the learning of words, but recent research confirms the fact that learning begins in the first six months of life. Infants are beginning to learn language in the crib. This was shown by studying infants in different countries who are raised listening to different languages. For example, one study showed that by six months of age, the perceptual systems of infants raised in Seattle as opposed to Stockholm differed as a function of the language they had listened to for the first 6 months. By 6 months, infants showed greater ability to categorize the sounds of their native language as opposed to the foreign language. By 9 months they have learned the stress pattern that is typical of word in their language, and prefer that sound structure over that typical of a foreign language. By 12 months of age, infants show definite signs of becoming culture-bound language specialists. They focus on the distinctions of their native language, and show less ability to hear distinctions in foreign-language sounds. This is a sign that their perceptual systems are becoming tuned to the sound structure of their specific language.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 6

- There is a wonderful synchrony between what is given by nature and what is acquired through nurture. Nature and nurture don't compete, they cooperate. Nature provides infants their keen abilities to hear the sounds language uses to convey meaning. Nurture provides complex information to the brain that infants acquire simply by listening to the ambient language that we bathe them in during the early months of life.

- The new research shows evidence of learning by 6 months of age. 6 month old infants are very young. They have yet to understand or produce a single word. Yet they are listening to us speak, and their brains are busy coding the sounds of language that they hear us produce. The young child's extraordinary response to language input puts some responsibility on us. We are the speakers that infants are listening to. Our input is important to them.

- What do we know about language we speak to infants? Research on "Parentese" has shown that speech we direct towards infants is unique. Scientists have discovered that parents the world over use a higher pitch, exaggerated intonation contours, and slower speech when speaking to

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 7

infants. Parentese is often described as melodic because of this. We also know from careful laboratory research that infants prefer this kind of speech, and choose to listen to it when given a choice. If you give a baby a choice of listening to Parentese vs. speech directed to adults they will turn on the Parentese speech. The most recent research in this area suggests that Parentese not only sounds better but teaches infants something. It contains exceptionally well-formed phonetic units, more than is the case for adult-directed speech. Language input to infants is a naturally enriched signal that makes it easier for children to learn.

- We also know that infants can master a second language quite easily during their preschool years, and that it is much more difficult to learn a second language, and produce it without an accent, if we try and learn it at our age. Scientists use the term "plasticity" to express this. Children are more plastic than we are. This suggests that if we spend money in our schools on second language learning, it would be useful to begin that training early. The window for language learning is wide open in early infancy and childhood. The window snaps shut, or at least greatly narrows after puberty. Timing is important.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 8

- Recent studies suggest that young infants learn by watching adults. They imitate what they see us do. They also imitate what they hear. Laboratory studies show that after short periods of listening to simple sounds, very young infants will begin to duplicate the sound patterns they hear. Speaking to an infant seems to prompt them to take turns and talk back. Infants thus master the give and take of conversation very early in life.

- In order for infants to learn in the way I've just described, they have to have normally developing sensory, linguistic and cognitive systems. It is very important to diagnose deficits in these precursors to language because early diagnosis allows intervention. Recent research indicates, for example, that children with developmental disorders that involve language have difficulties discriminating the basic sound units of speech. Deficits in these early precursors to language can be detected, and that allows the possibility that early intervention might reduce the severity of the later language problem. Again, timing seems to be important. Many interventions work better when done earlier. Plasticity makes early intervention more effective.

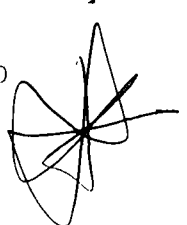
White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 9

- One caveat. Does this mean we should drop everything and spend more time talking, reading, and singing to our children? Research cannot at present tell us how much language input it takes to provide infants with an adequate sample from which to learn. We don't know if it takes 10 minutes or 2 hours a day of conversational interaction to produce the effects I've described. As researchers we would not advise parents to try and accelerate the normal pattern of development -- science doesn't lead us to recommend flash cards for word learning, or language learning solely from a disembodied tape hung on the side of the infant's crib. Natural language input to children in normal social environments causes language growth, and infants like the interaction. We should acknowledge our role in this, and the central importance of the social context, and take pleasure in the fact that we are causing our children's brains to change and their minds to develop.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 10

*start?*

- This is, of course, what our grandmothers knew intuitively. Yet, part of it is indeed new. We now know why we shouldn't wait until infants talk before we speak to them. The reason is that infants' brains can't wait. Infants map language by listening to us speak. The information stored in their brains subsequently guides their own attempts to speak.

- Let me sum up with an analogy: When we do physical exercise with our children we can see their bodies change. Mental growth is often more difficult to see. One day your child produces his or her first word or sentence and as a parent you wonder "where did that came from — what's going on up there"? Modern behavioral and brain science is providing answers to these questions. It's showing us that when we speak to our children we provide them with a kind of mental exercise. The experience we give them, the mental exercise we provide, causes their brains to change.

- Infants are born to learn. Our role is to be good partners in this learning process, one that we now know starts in the first days of life, well before they can speak.

White House Conference: April 17, 1997

P. K. Kuhl, University of Washington — 11

Background Reading

(1) Scientific articles by Dr. Patricia K. Kuhl show how important learning and early experience is to language development. Four excellent papers on early learning, language, and the brain are:

Kuhl, P. K., & Meltzoff, A. N. (1982). The bimodal perception of speech in infancy. Science, 218, 1138-1141.

Kuhl, P. K., Williams, K. A., Lacerda, F., Stevens, K. N., & Lindblom, B. (1992). Linguistic experience alters phonetic perception in infants by 6 months of age. Science, 255, 606-608.

Kuhl, P. (1994). Learning and representation in speech and language. Current Opinion in Neurobiology, 4, 812-822.

Kuhl, P. K., & Meltzoff, A. N. (1996). Infant vocalizations in response to speech: Vocal imitation and developmental change. Journal of the Acoustical Society of America, 100, 2425-2438.

(2) There is a new book published in January, 1997 that supports the idea that children (from birth to three) are born to learn. It is called, Words, Thoughts, and Theories, by A. Gopnik and A. Meltzoff (MIT Press, 1997). The book describes how babies develop the ability to think before words, and how this helps them learn language. The book discusses children as "little scientists" striving to understand the world around them. Dr. Meltzoff is a Fellow of the American Association for the Advancement of Science and is Head of Developmental Psychology. He can be reached at the University of Washington Telephone: (206) 543-2543; Fax: (206) 543-5771.

Carnegie Corporation of New York

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DAVID A. HAMBURG, M.D.

David Hamburg has been President of Carnegie Corporation of New York since 1983. He received his A.B. (1944) and his M.D. (1947) degrees from Indiana University. He was Professor and Chairman of the Department of Psychiatry and Behavioral Sciences from 1961-72 and Reed-Hodgson professor of Human Biology at Stanford University from 1972-76; President of the Institute of Medicine, National Academy of Sciences, 1975-80; Director of the Division of Health Policy Research and Education and John D. MacArthur Professor of Health Policy at Harvard University, 1980-82. He served as President, then Chairman of the Board of the American Association for the Advancement of Science (1984-86).

Dr. Hamburg is currently serving on the boards of: The Rockefeller University; The Mount Sinai Medical Center, New York; The American Museum of Natural History; and The Johann Jacobs Foundation, Zurich. He served as a trustee and vice chairman of the board of Stanford University and as a trustee and deputy chairman on The Federal Reserve Bank of New York. He is a member of the American Philosophical Society and the American Academy of Arts and Sciences. He has received numerous Honorary Degrees, most recently from Duke University and the Bank Street College of Education. Dr. Hamburg received the American Psychiatric Association's Distinguished Service Award. He received the Presidential Medal of Freedom at the White House in September 1996.

He has served on many policy advisory boards. In the international security field, he served on the Chief of Naval Operations Executive Panel; the Secretary of Energy Advisory Board; the National Academy of Sciences Committee on International Security and Arms Control; the Center for Naval Analysis; and the United States-Soviet Joint Study Group on Crisis Prevention. He currently serves on the Defense Policy Board, United States Department of Defense. He is co-chairman with Cyrus Vance of the Carnegie Commission on Preventing Deadly Conflict.

In science policy, he has served as chairman of several national groups including the Science Policy Committee of the Institute of Medicine and both the intra-mural and extra-mural Scientific Advisory boards of the National Institute of Mental Health as well as the Science Education Advisory Committee of the National Science Foundation. For a decade, he served on the Advisory Committee on Medical Research of the World Health Organization. He was the founder of the Carnegie Commission on Science, Technology and Government. In September, 1994 Dr.

Hamburg was chosen to serve on the President's Committee of Advisors on Science and Technology.

His research contributions have dealt with biological responses and adaptive behavior in stressful circumstances; and with several aspects of human aggression and conflict resolution. He has been concerned with the conjunction of biomedical and behavioral sciences--first in the context of building an interdisciplinary scientific approach to psychiatric problems, then in research on the links of behavior and health as a major component in the contemporary burden of illness. In recent years, he has concentrated on child and adolescent development.

Dr. Hamburg is the author of *Today's Children: Creating a Future for a Generation in Crisis*, (1992). He was chairman of the Carnegie Council on Adolescent Development, which recently completed its decade long study with a report entitled *Great Transitions: Preparing Adolescents for a New Century*. He was also the founder of the Carnegie Commission on Science, Technology and Government.

January 1997

**INSTITUTE OF MEDICINE
NATIONAL RESEARCH COUNCIL
COMMISSION ON BEHAVIORAL AND SOCIAL SCIENCES AND EDUCATION
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DEBORAH A. PHILLIPS, PH.D.

Deborah Phillips is currently Director, Board on Children, Youth, and Families, of the National Research Council's Commission on Social and Behavioral Sciences and the Institute of Medicine. Prior to this she was Associate Professor of Psychology at the University of Virginia. Dr. Phillips received her Ph.D. in developmental psychology at Yale University. As a Congressional Science Fellow of the Society for Research in Child Development, Dr. Phillips served as an analyst at the Congressional Budget Office and on the personal staff of Congressman George Miller. Immediately prior to joining the faculty at the University of Virginia, Dr. Phillips was a mid-career fellow at Yale University's Bush Center in Child Development and Social Policy. She was also the first Director of the Child Care Information Service of the National Association for the Education of Young Children. She is on numerous task forces and advisory groups that address child and family policy issues, including the Task Force on Meeting the Needs of Young Children of the Carnegie Corporation of New York, the research task force of the Secretary's Advisory Committee on Head Start Quality and Expansion of the U.S. Department of Health and Human Services, and the Advisory Committee on Services for Families with Infants and Toddlers of the U.S. Administration for Children, Youth, and Families. Dr. Phillips is a Fellow of the American Psychological Association and the American Psychological Society. She has testified numerous times before the U.S. Congress on issues of child care quality and continues her research in this area, most recently as Co-Principal Investigator of the Virginia site of the National Institute of Child Health and Human Development's Study of Early Child Care.



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Dr. Patricia Kuhl is the current chair of Speech and Hearing Sciences at the University of Washington. She has adjunct appointments in the Department of Psychology and the Department of Otolaryngology. She obtained her Ph.D. at the University of Minnesota and did postdoctoral work at the Central Institute for the Deaf in St. Louis. Her research interests focus on the study of language and speech, particularly its development, and on how language information is stored in the brain. Her research has played a major role in demonstrating how early exposure to language alters the mechanisms of perception, changing a person's abilities to hear certain distinctions in speech. Her work also shows that the processing of language information occurs through multiple modalities, including vision and audition, both in early infancy and adulthood. The results of her studies have illustrated how infants' early auditory experience plays a critical role in the acquisition of language in the first year of life. The work has broad implications, extending to psychology, ethology, and biology, for its identification of critical periods in development; linguistics and education for its applicability to bilingual education; neuroscience for its implications for brain mapping of complex information; and engineering for its implications concerning how computers might be programmed to respond to spoken language.

Dr. Kuhl is a Fellow of the American Association for the Advancement of Science, the American Psychological Society, and the Acoustical Society of America. She is an Associate Editor of two prestigious journals: *Journal of the Acoustical Society of America* and the *Journal of Neuroscience*. She is the Vice President of the Acoustical Society of America, and on many committees of the National Institutes of Health. She has published several papers in the journal *Science*, the premier journal for experimental results that have important implications across a wide variety of disciplines. In 1990, she won the Distinguished Alumni Award from her undergraduate institution. She has been elected to the Neuroscience Research Group at Scripps (run by Nobel Laureate Gerald Edelman) for a term of seven years beginning in 1994. Her work has been widely covered by the press for its implications for language processing in humans and implications for language processing by computers.

YALE UNIVERSITY



Donald J. Cohen, M.D.
Director, Child Study Center
Irving B. Harris Professor of
Child Psychiatry, Pediatrics
and Psychology
Yale University School of Medicine



Chief, Child Psychiatry
Children's Hospital at
Yale-New Haven

Donald J. Cohen, M.D.

Biographic Statement

Donald J. Cohen, M.D., is the Director of the Yale Child Study Center and Irving B. Harris Professor of Child Psychiatry, Pediatrics and Psychology, at the Yale University School of Medicine, New Haven. He is the Chairman of Child Psychiatry of the Children's Hospital of Yale-New Haven.

A child psychiatrist and child and adult psychoanalyst, Dr. Cohen joined the faculty of the Yale School of Medicine in 1972 and has been the Director of the Child Study Center since 1983. The Center is internationally recognized for its multidisciplinary programs of clinical and basic research, professional education, and clinical services and advocacy for children and families.

Dr. Cohen's clinical and research activities focus on developmental psychopathology of the serious neuropsychiatric disorders of childhood, including autism and pervasive developmental disorders and tic disorders (Tourette's syndrome). He is deeply involved in urban child development and approaches to intervention, as well as studies of the impact of violence and trauma on children and families in the United States and abroad. The research program he has led in the Child Study Center is characterized by the integration of biological, psychological and behavioral perspectives on psychiatric disorders of childhood, and the linkage between research and clinical services.

Dr. Cohen has published more than 300 articles, books and monographs. Among his academic activities, he is President of the International Association of Child and Adolescent Psychiatry and Allied Professions (IACAPAP); Co-Director of the Yale Mental Health Clinical Research Center; and training and supervisory psychoanalyst at the Western New England Institute of Psychoanalysis. Dr. Cohen is a member of the Institute of Medicine of the National Academy of Sciences and serves on various Boards, including the Anna Freud Centre in London.

DAVID A. HAMBURG, M.D.

David Hamburg has been President of Carnegie Corporation of New York since 1983. He received his A.B. (1944) and his M.D. (1947) degrees from Indiana University. He was Professor and Chairman of the Department of Psychiatry and Behavioral Sciences from 1961-72 and Reed-Hodgson Professor of Human Biology at Stanford University from 1972-76; President of the Institute of Medicine, National Academy of Sciences, 1975-80; Director of the Division of Health Policy Research and Education and John D. MacArthur Professor of Health Policy at Harvard University, 1980-82. He served as President, then Chairman of the Board (1985-86) of the American Association for the Advancement of Science (1984-86).

Dr. Hamburg also serves on the boards of: The Rockefeller University; The Mount Sinai Medical Center, New York; The American Museum of Natural History; The Johann Jacobs Foundation, Zurich. He served as a trustee and vice chairman of the board of Stanford University, and as a trustee and deputy chairman on the Federal Reserve Bank of New York.

He has served on many policy advisory boards, including the Chief of Naval Operations Executive Panel and the Advisory Committee on Medical Research of the World Health Organization. He presently serves on the Defense Policy Board, United States Department of Defense. In September, 1994 Dr. Hamburg was chosen to serve on the President's Committee of Advisors on Science and Technology.

He is a member of the American Philosophical Society and the American Academy of Arts and Sciences. Dr. Hamburg received the American Psychiatric Association's Distinguished Service Award in 1991. He received the Presidential Medal of Freedom at the White House in September 1996. He was awarded an Honorary Degree from Duke University and the Bank Street College of Education.

January 1997

Carla J. Shatz: biographical sketch

Carla Shatz graduated from Radcliffe College in 1969 with a B.A. in Chemistry. She was honored with a Marshall Scholarship to study at University College London, where she received an M.Phil. in Physiology in 1971. In 1976, she received a Ph.D. in Neurobiology from Harvard Medical School, where she studied with David Hubel and Torsten Wiesel. During this period, she was appointed as a Harvard Junior Fellow. From 1976-1978 she obtained postdoctoral training with Dr. Pasko Rakic in the Department of Neuroscience, Harvard Medical School. In 1978, Dr. Shatz moved to Stanford University, where she began her studies of the development of the mammalian visual system in the Department of Neurobiology; she attained the rank of Professor of Neurobiology in 1989. In 1992, she moved her laboratory to the Department of Molecular and Cell Biology at the University of California, Berkeley, where she is currently Class of 1943 Professor of Neurobiology. Her ongoing studies of how the orderly sets of connections present in the adult brain are wired up during development have gained her numerous honors, including the Society for Neuroscience Young Investigator Award in 1985, the Golgi Award from Fidia in 1992, the Silvo Conte Award from the National Foundation for Brain Research in 1993, and the Charles A. Dana Award for Pioneering Achievement in Health and Education in 1995. In 1992, she was elected to the American Academy of Arts and Sciences, and in 1995 to the National Academy of Sciences. Dr. Shatz is (1995-96) the immediate past president of the 24,000 member Society for Neuroscience.

The adult brain depends upon the precision of its neural circuitry for its function. Perhaps nowhere is this requirement for precision more evident than in the mammalian visual system, where the highly refined connectivity determines our ability to recognize minute details of the visual world. How does this precision of connectivity emerge during development? A great surprise has been that connections do not simply form at the outset in the adult pattern. Not only do connections form imprecisely initially and require neural function to achieve the adult precision, but entire cell types and neural circuits, essential during development for the construction of the adult pattern of connections, are themselves transient and eliminated by adulthood. Research in Dr. Shatz's lab is directed at elucidating the mechanisms that guide the formation of precise connections in the mammalian visual system. Two major projects are being pursued: 1) The role of a transient neural network in wiring up the cerebral cortex and 2) The role of neural activity in fine-tuning visual system connections. Since many of these connections initially form in utero, this research has emphasized the early, prenatal and neonatal developmental periods. The results of these studies have broad implications for our understanding of the normal development of the human brain including the processes of learning and memory, of neurological birth defects such as cerebral palsy and dyslexia, and of epilepsy.

and conceptualizers and consider individual variations in learning style. Public education in America has been profoundly value-laden, driven much more by culture than by brain biology. Perhaps neuroscience can help us develop more inclusive standards.

I'm excited about the implications of neuroscience for our work, but I want to suggest some safeguards against applying scientific findings hastily or haphazardly. Let's ask whether we're applying generally accepted neuroscientific knowledge; does it apply to all children or only to some, and if it applies to all children, is it amenable to change? Equally important, how can we make sure that scientific information isn't put into practice until it has been thoroughly tested and confirmed? How can we be sure every child should read by age 2 or play Suzuki at 18 months?

We also need to define who should be teaching our children during those crucial formative years. How can we assure that child-care workers have the necessary education — and appropriate pay — to be entrusted with the early training of these pliable young minds?

Language Development

How Babies Map Their Native Languages

Patricia K. Kuhl
Professor and chairwoman
Department of Speech and
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From Arabic to Zulu, the sounds of language constantly bombard the brains of infants around the world. We know from our studies in Japan, Russia,

Sweden, Finland and the United States that babies are born with a keen ability to distinguish among language sounds. These tiny master linguists are true citizens of the world.

Adults, on the other hand, can't readily separate similar sounds in a foreign language. That's why adult native Japanese speakers have great difficulty hearing the difference between *R* and *L* and native English speakers can't tell a *B* sound from a *V* sound in Spanish. What happens to turn off the young child's ability to absorb the sounds of many languages?

Within their first six months, infants develop "language magnets" that attract their ears to the sounds of their native languages. For instance, the vowel sounds *ah*, *ee* and *oo* occur in every language in the world, but not always in the same form. Babies are born with an ability to distinguish among all vowel sounds, but if a sound doesn't occur in the baby's language, the ability to discern it will decline. For example, a baby who listens to Swedish, with its 16 vowel sounds, will have different language magnets than a baby who hears English, with eight or nine, or Japanese, with only five vowel sounds. The Swedish baby retains all the distinctions, but American and Japanese babies lose the ability to distinguish those vowels because their languages do not contain those sounds. The American and Japanese babies' developing magnets pull sounds that were once distinct into a single category of similar sounds.

Babies learn to categorize their languages' specific vowel sounds simply by listening to their parents' speech. At six months, even before they can produce and understand words, infants' perceptual systems are



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Dr. Patricia Kuhl is the current chair of Speech and Hearing Sciences at the University of Washington. She has adjunct appointments in the Department of Psychology and the Department of Otolaryngology. She obtained her Ph.D. at the University of Minnesota and did postdoctoral work at the Central Institute for the Deaf in St. Louis. Her research interests focus on the study of language and speech, particularly its development, and on how language information is stored in the brain. Her research has played a major role in demonstrating how early exposure to language alters the mechanisms of perception, changing a person's abilities to hear certain distinctions in speech. Her work also shows that the processing of language information occurs through multiple modalities, including vision and audition, both in early infancy and adulthood. The results of her studies have illustrated how infants' early auditory experience plays a critical role in the acquisition of language in the first year of life. The work has broad implications, extending to psychology, ethology, and biology, for its identification of critical periods in development; linguistics and education for its applicability to bilingual education; neuroscience for its implications for brain mapping of complex information; and engineering for its implications concerning how computers might be programmed to respond to spoken language.

Dr. Kuhl is a Fellow of the American Association for the Advancement of Science, the American Psychological Society, and the Acoustical Society of America. She is an Associate Editor of two prestigious journals: *Journal of the Acoustical Society of America* and the *Journal of Neuroscience*. She is the Vice President of the Acoustical Society of America, and on many committees of the National Institutes of Health. She has published several papers in the journal *Science*, the premier journal for experimental results that have important implications across a wide variety of disciplines. In 1990, she won the Distinguished Alumni Award from her undergraduate institution. She has been elected to the Neuroscience Research Group at Scripps (run by Nobel Laureate Gerald Edelman) for a term of seven years beginning in 1994. Her work has been widely covered by the press for its implications for language processing in humans and implications for language processing by computers.

Babies Learn Sounds of Language by 6 Months

By SANDRA BLAKESLEE

Babies learn the basic sounds of their native language by the age of 6 months, long before they utter their first words, and earlier than researchers had thought, a new study suggests.

The findings indicate that recognition of these sounds is the first step in the comprehension of spoken language. As a result, the researchers suggest, babies whose hearing is damaged by chronic ear infections may have lifelong language problems, and the way parents speak to their infants exerts important influences on language learning.

Previous studies suggested that infants' sound perception changes by about 1 year old, when children begin to understand that sounds convey word meanings.

The new research, reported in the current issue of *Science*, was conducted by Dr. Patricia Kuhl of the University of Washington in Seattle and colleagues at Stockholm University in Sweden, the Massachusetts Institute of Technology and the University of Texas in Austin.

Adaptability of Newborn

Newborns are language universalists, Dr. Kuhl said. Able to learn any sound in any language, they can distinguish all the sounds that humans utter. But adults are language specialists, she said. Exposure to their native language reduces their ability to perceive speech sounds that are not in that native tongue. Thus Japa-

How parents speak to infants exerts important influences.

nese infants can hear the difference between the English sounds "la" and "ra," but Japanese adults cannot because their language does not contrast those sounds.

Dr. Kuhl said she and her colleagues set out to discover when, during language development, experience alters sound perception and to explore the nature of the change. She said she had thought it could be earlier than other researchers believed.

Recognizing Slight Differences

To test her idea, she used the concept of phonetic prototypes: idealized mental representations of the key sounds in a given language. An English prototype sound is the vowel linguists write as "i," pronounced as in the word "fee." When an adult English speaker hears something very close to this "i" sound (as when the sound is spoken by someone with a head cold), Dr. Kuhl said, the listener will hear the prototype "i" and not the slight variation. The prototype sound acts like a magnet, she said, pulling all similar sounds into one mental slot for language processing.

But the same is not true of foreign languages. Because English speakers



Andy Levine

have not memorized the prototype for a foreign vowel — like the Swedish vowel "y" (an EE-sound pronounced with front-rounded lips), they can discern when the vowel is pronounced slightly differently. They have no "magnet" that makes the sounds identical.

Using identical computer equipment to generate prototype Swedish and English sounds, Dr. Kuhl and her colleagues tested the magnet effect on 64 6-month-old babies in Sweden and the United States. During the experiment, each baby sat on its mother's lap and listened to pairs of "i" and "y" sounds. Babies were

trained to look over their left shoulders when they heard a difference in the sounds (they would see a cute puppet bang a drum) and to ignore any sound pairs that seemed the same.

American babies routinely ignored the different pronunciations of "i" because they heard it as the same sound, Dr. Kuhl said. But they could distinguish slight variations in the "y" sounds.

The exact opposite was true of the Swedish babies, she said. They ignored the variations in "y" because they sounded the same, while they noticed the variations in "i."

The experiment confirms that linguistic experience in the first half year of life alters an infant's perception of speech sounds, Dr. Kuhl said. Infants show a significantly stronger magnet effect for their native language prototypes.

The study shows that phonetic perception does not depend on the emerging use of words, Dr. Kuhl said, and that language experience shapes perception far earlier than anyone expected.

The research calls attention to the language tutoring role of parents, Dr. Kuhl said. By talking "motherese" with its high pitch, exaggerated intonation and clear pronunciation, she said, parents help babies acquire phonetic prototypes that are building blocks to language.

The study also underscores the importance of treating chronic ear infections in infants, Dr. Kuhl said. There is evidence that such infections may impair language development later in life.

EZRA C. DAVIDSON, JR., M.D., F.A.C.O.G.

Dr. Ezra C. Davidson, Jr., is Professor (and past chairman 1971- 96), Department of Obstetrics and Gynecology, The Charles R. Drew University of Medicine and Science. Currently, he also holds professorships in Obstetrics and Gynecology at UCLA and Dartmouth Schools of Medicine. He was chief-of-service, Department of Obstetrics and Gynecology at King/Drew Medical Center in Los Angeles (1971-96). In this position in 1971, he developed a new and subsequently nationally recognized full service academic department of Obstetrics and Gynecology. By 1990, the deliveries reached 9,000 per year becoming one of the ten largest obstetrical services in the country.

Dr. Davidson was born in Water Valley, Mississippi. He received his B.S., cum laude, from Morehouse College in Atlanta, Georgia and his MD from Meharry Medical College, Nashville, Tennessee as a member of the Alpha Omega Alpha Honor Medical Society. His residency training was at Harlem Hospital Center and his fellowship in blood coagulation at Columbia University, both in New York City. He served as a Medical Officer in the United States Air Force.

His academic career started at Columbia University, The Roosevelt Hospital, where he was Director, Departmental Research and the Coagulation Laboratory. He served as Acting Chairman of the department at Roosevelt Hospital before moving to Los Angeles.

Dr. Davidson has led an active career in research, education, and clinical and public services. He was an early contributor to the development of the technology of fetoscopy and fetal blood sampling. Because of his interest in affecting maternal and child health issues, his efforts turned increasingly to public policy. He was a Robert Wood Johnson Health Policy Fellow, Institute of Medicine (I.O.M.), 1979-80, during which time he served as a health advisor to Senator Bill Bradley of New Jersey. He has served on a number of Institute of Medicine, National Academy of Sciences Study Committees on issues of national health policy and has worked with government and private organizations in this regard.

He has served The American College of Obstetricians and Gynecologists as President (1990-91), National Secretary, six years, Section Chairman in District IX and a member of the first Health Care Commission in addition to a number of committees. His major organizational responsibilities have included president, Los Angeles Obstetrical and Gynecological Society; Chairman, Obstetrical and Gynecological Assembly of Southern California; Chairman, Section of Obstetrics and Gynecology, National Medical Association (NMA); Chair Board of Trustees NMA; President of the Association of Professors of Gynecology and Obstetrics; President of the Golden State Medical Association (Chapter, NMA); and President, North American Society for Pediatric and Adolescent Gynecology. He is an Examiner, American Board of Obstetrics and Gynecology. He holds a Certificate of Special Competence in Maternal-Fetal Medicine.

He has chaired the Secretary's Advisory Committee on Infant Mortality (U.S. Department Health and Human Services) and currently chairs the Advisory Committee for Reproductive Health Drugs, Food and Drug Administration (FDA). He serves on the National Institutes of Health (NIH) Advisory Committee to the Director and the NIH's Advisory Committee for Clinical Research. He is a member of the Council on Graduate Medical Education (COGME) and The California Wellness Foundation's Board of Directors.

He has lectured widely, both domestically and internationally. He has been elected to The National Black College Alumni Hall of Fame and Fellowship ad eundem, Royal College of Obstetricians and Gynaecologists and member, I.O.M., National Academy of Sciences.

T. BERRY BRAZELTON, M.D.**Biography**

Dr. Brazelton graduated in 1943 from Columbia University College of Physicians and Surgeons in New York City and accepted a medical internship there. In 1945 he moved to Boston to serve his medical residency at Massachusetts General Hospital before undertaking pediatric training at Children's Hospital. His interest in child development led to training in child psychiatry at Massachusetts General Hospital and the James Jackson Putnam Children's Center. He subsequently served as a Fellow with Professor Jerome Bruner at the Center for Cognitive Studies at Harvard University. There, the process of integrating his dual interests – primary care pediatrics and child psychiatry – culminated in 1972, when he and his colleague, Dr. Edward Tronick, established the Child Development Unit, a pediatric training and research center, at Children's Hospital.

Over the years, Dr. Brazelton has published more than 200 scientific papers and chapters. His research has focused on (1) individual differences among newborns and the contribution of the neonate to the parent-infant dyad, (2) the development of attachment between parent and infant over the first four months, (3) cross-cultural studies of infant behavior and early parenting practices, (4) the importance of early intervention to at-risk infants and their parents, and (5) the opportunities presented in early infancy for strengthening families. Sixty pediatric Fellows from the Child Development Unit now conduct research and head training units in pediatric departments throughout the United States.

Among his 26 books on pediatrics and child development are *Infants and Mothers*, which has been translated into 18 languages, and *Working and Caring*, which offers advice for working parents on raising children in the 1980s. *The Earliest Relationship*, written with Dr. Bertrand Cramer, was published in 1990. *What Every Baby Knows* and *Families: Crisis and Caring* discuss the parenting concerns of ten families featured on his LIFETIME television series. His latest book, *Touchpoints*, appeared in October 1992. Three videotapes for parents and professionals, also called "Touchpoints," are available. Dr. Brazelton is a regular contributor to *Family Circle Magazine* and writes a weekly column syndicated by *The New York Times*.

Dr. Brazelton was president of the Society for Research in Child Development for the 1987-1989 term, and the National Center for Clinical Infant Programs from 1988-1991. In recent years, his growing concern about the pressures and stresses that families face in the 1990s and beyond has led to his frequent appearances before Congressional committees in support of parental and medical leave bills; he has worked to improve child care support for all working parents. In 1989, he was

**INSTITUTE OF MEDICINE
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DEBORAH A. PHILLIPS, PH.D.

Deborah Phillips is currently Director, Board on Children, Youth, and Families, of the National Research Council's Commission on Social and Behavioral Sciences and the Institute of Medicine. Prior to this she was Associate Professor of Psychology at the University of Virginia. Dr. Phillips received her Ph.D. in developmental psychology at Yale University. As a Congressional Science Fellow of the Society for Research in Child Development, Dr. Phillips served as an analyst at the Congressional Budget Office and on the personal staff of Congressman George Miller. Immediately prior to joining the faculty at the University of Virginia, Dr. Phillips was a mid-career fellow at Yale University's Bush Center in Child Development and Social Policy. She was also the first Director of the Child Care Information Service of the National Association for the Education of Young Children. She is on numerous task forces and advisory groups that address child and family policy issues, including the Task Force on Meeting the Needs of Young Children of the Carnegie Corporation of New York, the research task force of the Secretary's Advisory Committee on Head Start Quality and Expansion of the U.S. Department of Health and Human Services, and the Advisory Committee on Services for Families with Infants and Toddlers of the U.S. Administration for Children, Youth, and Families. Dr. Phillips is a Fellow of the American Psychological Association and the American Psychological Society. She has testified numerous times before the U.S. Congress on issues of child care quality and continues her research in this area, most recently as Co-Principal Investigator of the Virginia site of the National Institute of Child Health and Human Development's Study of Early Child Care.

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T. Berry Brazelton, M.D.

2

appointed to the National Commission on Children by the U.S. Congress, where he advocated with vigor for disadvantaged children.

In 1988, Dr. Brazelton was awarded an Honorary Doctor of Letters degree by Russell Sage College, and Princeton University's Woodrow Wilson Award for Public Service. In 1990, Northeastern University awarded him the Doctor of Humane Letters degree, and in 1991, he received honorary degrees from Wheelock and Wheaton colleges. The University of Lisbon, Portugal, awarded its highest honorary degree, the Honoris Causa, in 1992. He received an honorary doctorate from Loyola University in Chicago in 1994, and from the University of Massachusetts-Dartmouth in 1995. In 1996, he received a Doctor of Laws from Boston College.

One of Dr. Brazelton's foremost achievements in pediatrics is his Neonatal Behavioral Assessment Scale (NBAS), published in 1973 and revised in 1984 and in 1996. Known as "the Brazelton," this evaluation tool is used worldwide, clinically and in research, to assess not only the physical and neurological responses of newborns but also their emotional well-being and individual differences. Increasingly, the NBAS is being used as an intervention to help parents understand and relate to their new babies, and new research is underway to study how it can be used to enhance early discharge from the newborn hospital.

Since 1988, Dr. Brazelton has held appointments as Clinical Professor of Pediatrics Emeritus at Harvard Medical School, where he still teaches and conducts research, and Professor of Psychiatry and Human Development at Brown University. In 1995, Harvard University Medical School established the T. Berry Brazelton Chair in Pediatrics. The first incumbent is Dr. Judith Palfrey, Chief of Pediatrics at Children's Hospital. Dr. Brazelton is an active member of the Child Development Unit at Children's Hospital, where he continues his clinical, teaching and research activities. Two research projects are ongoing. The Brazelton Center for Infants & Parents has been funded by Procter & Gamble to formulate a package of prenatal and perinatal visits (using the NBAS), and a three-day postnatal home visit to facilitate early discharge, to capture parents' interest in their newborn, and to encourage their continued commitment to using the health care system. The Touchpoints Project at Children's Hospital, funded by General Mills Foundation and private donors in Boston, formulates curricula for use in outreach programs around the country to capture high-risk, undervalued populations (40 percent of U.S. children) for the primary preventative health care system.

YALE UNIVERSITY



Donald J. Cohen, M.D.
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Irving B. Harris Professor of
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and Psychology
Yale University School of Medicine



Chief, Child Psychiatry
Children's Hospital at
Yale-New Haven

FAX TRANSMITTAL FORM

TO: Ms Nicole Rabner

FAX #: 202-456-6244

FROM: Donald Cohen

DATE: 4/14/97

NUMBER OF PAGES INCLUDING COVER: 17

Early Cohen
version

(In the event of incomplete or illegible transmission, please call 203-785-5759)

YALE UNIVERSITY



Donald J. Cohen, M.D.
Director, Child Study Center
Irving B. Harris Professor of
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Chief, Child Psychiatry
Children's Hospital at
Yale-New Haven

April 14, 1997

Ms. Nicole Rabner
Office of the First Lady
The White House
Washington, D.C. 20502

FAX 202-456-6244

Dear Ms. Rabner,

I am enclosing a copy of my presentation for the White House Conference. I would appreciate any suggestions. Also, would you like me to FAX a copy to Dr. Hamburg or will you collate the presentations for him?

I have two forms of my presentation – the short form (for oral presentation) and a longer form (with the word long form on the bottom). The short form is for oral presentation and is eight minutes long. The somewhat longer form is for distribution and has a few paragraphs more about brain development.

Please let me know, as well, if I can be of any help with the photographs or any other arrangements.

I appreciate this opportunity.

Sincerely,

Donald J. Cohen, M.D.
Irving B. Harris Professor of
Child Psychiatry, Pediatrics and Psychology

DJC:tlb

White House Conference

Early Childhood Development and Learning:

What New Research on the Brain Tells Us About Our Youngest Children

The Psychobiology of Development: Brain, Behavior and Care

Donald J. Cohen, M.D., Irving B. Harris Professor of Child Psychiatry, Pediatrics and Psychology and Director, Yale Child Study Center

Linda Mayes, M.D.

Arnold Gesell Associate Professor of Child Development and Pediatrics, Yale Child Study Center

April 17, 1997

For communication and identification:

Donald J. Cohen, M.D. is the Irving B. Harris Professor of Child Psychiatry, Pediatrics and Psychology, and Director of the Yale Child Study Center. He is also the Child Psychiatrist in Chief of the Children's Hospital of Yale-New Haven Hospital, New Haven, CT.

Linda Mayes, M.D. is the Arnold Gesell Associate Professor of Child Development and Pediatrics and director of the early childhood programs in the Provence-Harris Child Development Unit, Yale Child Study Center.

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Press briefing -
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President and Mrs. Clinton,

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We are all grateful for this opportunity.

The brains and minds of infants and young children are inseparable. We talk about neurology and psychology for convenience. Yet, your teacher and mine, Sally Provence, would remind us that babies develop as psycho-biological whole people -- as bodies and minds -- within families that are also developing. There is no such thing as a brain or a mind or a baby on its own.

purpose

and
plan

The foundations for a child's neurological and emotional development are laid before conception, when parents decide that this is the time to start or expand their family. The mother watches her diet, takes vitamins, and avoids compounds that can harm a developing fetus, such as tobacco, alcohol, and drugs. Psychological and physical nurturing converge, from before a baby is actually conceived. During pregnancy, mother and father begin the process of what will eventually become the care of their infant. They imagine the child and their roles in the child's life, and each cares for the other as they prepare for the birth. There is lots of room for variation. Yet, there are also situations almost beyond the limits of psycho-biological adaptation -- such as the experiences for the unborn baby when the mother is alone, hungry, unsheltered, or abused, or when the baby is born addicted.

The baby comes into the world neurobiologically ready for many environments. This is an all purpose, innately organized readiness, based on healthy maturation of the brain during gestation. The baby's potential quickly becomes more specialized and adapted to his particular world. Parents become preoccupied and actively engaged -- they inspect and clean the baby, smile and talk to the

baby to see if he can hear and see, check on the baby during naps and at night, and worry about the baby when they are separated. The strength of these preoccupations sometimes surprises a young mother when she first returns to work and must leave the baby in the care of someone else. Relatives and friends help out during this early care-giving and today, daycare plays an immense role.

The earliest social interactions are very intimate: a mother and baby gaze with long, sustained looks into each other's eyes or the baby intently follows his father's mouth as he speaks or makes silly noises. The adults are the scaffolds and pace-setters for the baby's attention and emerging capacities. These interactions become the building blocks for the young child's cognitive skills of focusing and concentrating, for recognizing the familiar and studying the unfamiliar, and for remembering. These cognitive processes later allow a first grader to focus on a book, quiet down, pay attention, filter out the buzz of classroom noises, and learn. Too many children in first grade -- perhaps 10% -- have troubles in just these areas of brain and behavioral development

Development occurs in the context of good care, when a baby is fed, bathed, carried, or when he is upset and then consoled. A crying three month old turns to her mother's voice, quiets, looks intently, slowly smiles, and begins to coo; her mother in turn smiles back, takes the moment of the baby's alert attention to slowly talk to her, to sing to her about how beautiful and strong she is. In hundreds upon thousands of moments such as these, the baby links the perceptions of looking, hearing, feeling the warmth of the caregiver's arms with the experience of being at first distressed and then comforted, at first overwhelmed and then calmly attentive and focused. The parent's soothing voice, the conversational babble between mother and baby serve as the roots for the child's later spoken language, interest in talking and internal speech. These moments of being held, fed, protected and consoled also become the foundations for the child's ability to soothe herself, to

tolerate discomfort without overwhelming anxiety. During these basic acts of caring, neuronal connections between cortical and sub-cortical regions of the brain are formed and enhanced.

When a twelve month old looks for a familiar red ball, sees it across the room, smiles with excitement, leans forward to try to reach the ball, and then points, looks up to his mother, and says "ba", many different lines of development are integrated into a pattern of emotion, attention, and social learning. Neuronal systems are activated and reinforced. The baby learns.

If the child gets the care he needs, he builds up an internal, emotional portrait of a protective, loving, available, and attuned parent to whom he can turn. These emotional, mental portraits of mom, dad, and siblings are elaborated by the child's imagination. They form a core of the child's social attachment. When the parent is not there --- when she is at work or busy with something else --- or when the child is upset, the baby can evoke the emotional, internal portrait for self comforting. He can think about mom and imagine her return and how nice it will feel to be held again.

In this context, try to imagine the internal world of a child who has been neglected or abused, or who has been moved from one foster home to another. What internal portrait can the child call to mind to soothe himself at moments of distress? For whom does such a child long? The developmental trajectory of these deprived and traumatized infants and young children is burdened biologically and psychologically, at each stage of life.

For fortunate babies and parents, the child's brain and behavior mature without special intervention. We see just how complicated these processes are when the child, the parents or both are medically or psychologically compromised. Infants with birth complications such as prematurity

are especially sensitive. With stimulation and structure, even quite small preemies can develop normally; without special attention, they are at serious risk for disability.

Other infants are born with constitutional or inborn disorders such as autism. Their brains are unable to develop normal social, emotional and language abilities. Studies of autism and similar disorders illuminate the preconditions for normal communication and socialization. Education and other interventions can greatly improve the adaptive functioning of children with severe intellectual and other developmental disabilities. Yet, we must await advances in basic research to dramatically alter their long term competencies.

The psychology of early experiences becomes the biology of brain functioning. In subsequent years, there may be opportunities for earlier templates to be reshaped, and for compensatory brain and behavioral systems to emerge. A child with low self esteem from repeated failures and neglect can blossom with a mentor and success, and an anxious child can be helped with therapy and emotional support. Teachers and parents should seize opportunities for therapeutic change, and no child's potential for recovery and achievement should ever be written off. But we cannot count on the success of such renovation when maladaptive processes have gone too long or too badly.

Children's biological need for continuity of care and parents' biological need and psychological ability to provide this care have evolved over hundreds of thousands of years. But in the last decades, the world in which children and their parents live has changed far faster than biology can adapt. Children must cope with environments far different from the average expectable ones in which humans evolved and even from the family and community environments of just fifty or

100 years ago. At the same time, greater demands are placed on children's brains for more rapid and effective learning, communication, and response to often uncertain, quickly changing worlds.

The task for all of us is to work towards creating new social and economic contexts in which both the child's and parent's inborn and psychological needs for stability, continuity and interaction can be met. In such developmentally supportive contexts, parents and communities can help assure that children's minds and brains develop to their optimal potential.

White House Conference

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longform

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President and Mrs. Clinton,

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The foundations for a child's neurological and emotional development are laid before conception, when parents decide that this is the time to start or expand their family. The mother watches her diet, takes vitamins, and avoids compounds that can harm a developing fetus, such as tobacco, alcohol, and drugs. Psychological and physical nurturing converge, from before a baby is actually conceived. During pregnancy, mother and father begin the process of what will eventually become the care of their infant. They imagine the child and their roles in the child's life, and each cares for the other as they prepare for the birth. There is lots of room for variation. Yet, there are also situations almost beyond the limits of psycho-biological adaptation --- such as the experiences for the unborn baby when the mother is alone, hungry, unsheltered, or abused, or when the baby is born addicted.

During gestation, the infant's full complement of neurons --- all that will ever be generated --- differentiate and begin to move out to form the regions of the brain. This period is especially sensitive to alterations in the intrauterine environment by illness or drugs. Cortical neurons will serve the role of perception and cognition that permit the newborn to scan his mother's face soon after

birth. Other neurons form the very large sub-cortical regions of the brain where attention and emotions are regulated. These structures influence the baby's temperament -- the thresholds for activation and arousal, the balance between curiosity and anxiety, the ease and comfort on being held.

Brain regions and sub-regions become inter-connected during the first years of life. The normal, nurturing care of parents and others stimulates connectivity, while an impoverished environment diminishes the density of synaptic connections. Brain areas receiving little input may lose connections between neurons while more active areas increase their connectivity, efficiency and rapidity of function. In this way, biological preparedness becomes psychology, and behavior shapes the maturing brain.

The baby comes into the world neurobiologically ready for many environments. This is an all purpose, innately organized readiness, based on healthy maturation of the brain during gestation. The baby's potential quickly becomes more specialized and adapted to his particular world. Parents become preoccupied and actively engaged -- they inspect and clean the baby, smile and talk to the baby to see if he can hear and see, check on the baby during naps and at night, and worry about the baby when they are separated. The strength of these preoccupations sometimes surprises a young mother when she first returns to work and must leave the baby in the care of someone else. Relatives and friends help out during this early care-giving and today, daycare plays an immense role.

Even in the newborn nursery, a baby searches the environment, scans a triangle and looks intently at his mother's face during feeding. Also, the newborn settles down and calms when

held, nursed or given a pacifier to suck. Attention to the outside world and regulation of internal arousal and state are intimately connected.

The earliest social interactions are very intimate: a mother and baby gaze with long, sustained looks into each other's eyes or the baby intently follows his father's mouth as he speaks or makes silly noises. The adults are the scaffolds and pace-setters for the baby's attention and emerging capacities. These interactions become the building blocks for the young child's cognitive skills of focusing and concentrating, for recognizing the familiar and studying the unfamiliar, and for remembering. These cognitive processes later allow a first grader to focus on a book, quiet down, pay attention, filter out the buzz of classroom noises, and learn. Too many children in first grade -- perhaps 10% -- have troubles in just these areas of brain and behavioral development.

Development occurs in the context of good care, when a baby is fed, bathed, carried, or when he is upset and then consoled. A crying three month old turns to her mother's voice, quiets, looks intently, slowly smiles, and begins to coo; her mother in turn smiles back, takes the moment of the baby's alert attention to slowly talk to her, to sing to her about how beautiful and strong she is. In hundreds upon thousands of moments such as these, the baby links the perceptions of looking, hearing, feeling the warmth of the caregiver's arms with the experience of being at first distressed and then comforted, at first overwhelmed and then calmly attentive and focused. The parent's soothing voice, the conversational babble between mother and baby serve as the roots for the child's later spoken language, interest in talking and internal speech. These moments of being held, fed, protected and consoled also become the foundations for the child's ability to soothe herself, to tolerate discomfort without overwhelming anxiety. During these basic acts of caring, neuronal connections between cortical and sub-cortical regions of the brain are formed and enhanced.

When a twelve month old looks for a familiar red ball, sees it across the room, smiles with excitement, leans forward to try to reach the ball, and then points, looks up to his mother, and says "ba", many different lines of development are integrated into a pattern of emotion, attention, and social learning. Neuronal systems are activated and reinforced. The baby learns.

If the child gets the care he needs, he builds up an internal, emotional portrait of a protective, loving, available, and attuned parent to whom he can turn. These emotional, mental portraits of mom, dad, and siblings are elaborated by the child's imagination. They form a core of the child's social attachment. When the parent is not there --- when she is at work or busy with something else --- or when the child is upset, the baby can evoke the emotional, internal portrait for self comforting. He can think about mom and imagine her return and how nice it will feel to be held again.

In this context, try to imagine the internal world of a child who has been neglected or abused, or who has been moved from one foster home to another. What internal portrait can the child call to mind to soothe himself at moments of distress? For whom does such a child long? The developmental trajectory of these deprived and traumatized infants and young children is burdened biologically and psychologically, at each stage of life.

For fortunate babies and parents, the child's brain and behavior mature without special intervention. We see just how complicated these processes are when the child, the parents or both are medically or psychologically compromised. Infants with birth complications such as prematurity are especially sensitive. With stimulation and structure, even quite small preemies can develop normally; without special attention, they are at serious risk for disability.

Other infants are born with constitutional or inborn disorders such as autism. Their brains are unable to develop normal social, emotional and language abilities. Studies of autism and similar disorders illuminate the preconditions for normal communication and socialization. Education and other interventions can greatly improve the adaptive functioning of children with severe intellectual and other developmental disabilities. Yet, we must await advances in basic research to dramatically alter their long term competencies.

The psychology of early experiences becomes the biology of brain functioning. In subsequent years, there may be opportunities for earlier templates to be reshaped, and for compensatory brain and behavioral systems to emerge. A child with low self esteem from repeated failures and neglect can blossom with a mentor and success, and an anxious child can be helped with therapy and emotional support. Teachers and parents should seize opportunities for therapeutic change, and no child's potential for recovery and achievement should ever be written off. But we cannot count on the success of such renovation when maladaptive processes have gone too long or too badly.

Children's biological need for continuity of care and parents' biological need and psychological ability to provide this care have evolved over hundreds of thousands of years. But in the last decades, the world in which children and their parents live has changed far faster than biology can adapt. Children must cope with environments far different from the average expectable ones in which humans evolved and even from the family and community environments of just fifty or 100 years ago. At the same time, greater demands are placed on children's brains for more rapid and effective learning, communication, and response to often uncertain, quickly changing worlds.

The task for all of us is to work towards creating new social and economic contexts in which both the child's and parent's inborn and psychological needs for stability, continuity and interaction can be met. In such developmentally supportive contexts, parents and communities can help assure that children's minds and brains develop to their optimal potential.