



# Minds

in the making

Institute *for* Learning & Brain Sciences

UNIVERSITY *of* WASHINGTON

## MESSAGES *from the* INSTITUTE FOR LEARNING & BRAIN SCIENCES

PATRICIA K. KUHL & ANDREW N. MELTZOFF  
FOUNDERS AND CO-DIRECTORS

In their first five years, children progress from crying and cooing to full-blown language. They master the traditions of their culture, learn how to solve cognitive problems, and show a budding sense of right and wrong. Children do all this propelled by a natural curiosity. Although adults may master topics to seek promotions, and adolescents to get good grades and fit in, young children learn because it is fun.



What makes children so adaptive and open to change? How can society maximize the power of early learning so children are prepared for school? What can schools do to augment this natural curiosity, instead of impede it?

The Institute for Learning & Brain Sciences (I-LABS) is embarking on the *Developing Mind Project* to answer these questions. The *Developing Mind Project* is a new and ambitious multi-year research initiative that will describe the brain development timeline and processes that enable a newborn to emerge into a capable school-ready child. The project provides a blueprint for building bridges between the science of the brain and the practice of learning.

With our state-of-the-art brain technology and the innovative studies we conduct with global research partners, we have the potential to close the gap between the child who arrives ready for kindergarten and the one who has fallen so far behind he or she may never catch up. We have the potential to identify best practices to help parents maximize their children's social, emotional and intellectual abilities. Our discoveries will help to identify children with developmental disabilities and social-emotional difficulties in the earliest stages – when intervention is most likely to succeed and is most cost-effective.

We are pleased to be part of a growing movement to help children maximize their full potential. We are excited about what I-LABS can achieve by making new discoveries on early learning, translating them into actionable programs, and partnering with organizations that will utilize the body of knowledge to benefit children worldwide.

Our children can't wait. And our future, quite literally, depends on them.

BILL HENNINGSGAARD      SUZAN LEVINE  
BOARD CHAIR AND          CO-FOUNDER  
CO-FOUNDER

On behalf of our advisory board, we thank you for taking the time to become familiar with the Developing Mind Project, an effort that we're confident will have a major impact on the future of learning. We are proud and excited to be part of a project that, in 20 years as we look back, will be seen as the point at which mankind truly unlocks the mystery and miracle of how the human brain develops in its first 5 years.

Throughout their careers, Professors Meltzoff and Kuhl have broken new ground with research of significant social and economic impact. Their work has transformed our understanding of how children learn. For example:

- In 1977, when Professor Meltzoff stuck out his tongue at a 42-minute old baby, he forever changed how parents view interaction with their babies. For today's parents, the notion that infants are "born learning" is a given, not the revelation it was when he first explored the social world of the newborn.
- Professor Kuhl discovered that listening to languages in the first 6 months shapes the brain. "Motherese," the natural and universal mode of speaking that parents use when talking to young children, long considered infantile or even counter-productive, is actually the key to this brain change.
- Over the past decade, Professors Kuhl and Meltzoff have advised policy makers, including two U.S. Presidents, a Nobel Forum panel, the Swedish parliament and state and federal legislators, on the importance of early learning.

The *Developing Mind Project* builds on their success and knowledge base and will provide a roadmap to the aspects of brain development that enable a newborn to emerge as a capable, school-ready child.

The *Developing Mind Project* is possible because it marries the expertise and vision of a world-class research team led by Professors Kuhl and Meltzoff with new brain-imaging technology. With the world's first child brain-imaging facility, I-LABS will use innovative techniques to provide the equivalent of a Hubble telescope's view into the youngest of brains and a glimpse into the origins of learning.

I-LABS is embarking on the *Developing Mind Project* at a time when policy makers, legislators and business leaders increasingly recognize that preparing children to learn prior to reaching school is the best and most cost effective way to achieve our goals for improving education quality, providing a future workforce and eliminating expensive downstream public expenditures. The *Developing Mind Project* will deliver a body of knowledge that ensures investments in early learning are made wisely and equitably.

Opportunities to participate and affect such a seminal project are few and far between. We invite you to join us in this unique prospect to truly change the world!



THE

# Developing Mind Project

Advances in brain and behavioral research have fueled a new sense of urgency about learning and school-readiness in children. Breakthroughs in brain science show how the cultural environment alters children's brain development. Discoveries in behavioral science document the fact that early learning sets the foundation for success in school and in life. The *Developing Mind Project's* multi-year research initiative will allow new basic research discoveries and formalize a way in which those discoveries will change society and improve the lives of children.

We now realize in a profound and new way that if we value preparing children to succeed in school and in life, there are things we can do early that make remarkable differences in their lives. The changes we seek require cooperation among all of us – *scientists* who discover the mechanisms explaining when and how children learn; parents who are children's first and most important teachers; *educators and healthcare professionals* who foster children's intellectual curiosity, growth, and well-being; *policy makers* who set standards that promote equity in opportunities for learning; and philanthropists, business leaders and foundation organizers who help get something done.

Each of these groups plays a vital role in the early learning ecosystem. At the University of Washington's Institute for Learning & Brain Sciences, we are helping to strengthen this ecosystem by combining the science and practice of learning.

## Vision

I-LABS' vision is to discover the fundamental principles of human learning and development with the goal of enhancing the lives of all children. The *Developing Mind Project* is an ambitious initiative designed to realize I-LABS' vision. It seeks to maximize the possibility that children will reach their full potential emotionally and intellectually. The Institute has two missions. The first is to be the foremost generator of new scientific discoveries about mind and brain development during the first five years of life. The second is to unite the science and practice of learning by translating cutting-edge research into global, national and local action. As a research institute producing this new knowledge, we seek to partner with other organizations that create and administer practical programs and disseminate information to parents, grandparents, families, neighbors and other key early learning stakeholders.

Scientists in the I-LABS laboratories are helping to shape tomorrow's guidelines for early learning, both prior to school and in school, as they explore the influence of biology and culture on child development.

By combining state-of-the-art brain-imaging technology and behavioral measures, we can plot optimal trajectories of learning. I-LABS' research shows that *timing* is important for learning. The human brain is especially sensitive to environmental influences at particular times in an individual's life. Biologists call these "critical periods." In the area of language learning, for example, I-LABS' research shows people learn multiple languages easier between 0 and 7 years of age than at any other time in life. But knowing that this seven-year period is a critical window is only the first step.

New studies now focus on *how* and *why* the brain optimizes language learning at one age and restricts it in another. New discoveries at I-LABS will lead to the design of scientifically based learning programs that can increase second language learning at all ages – an outcome of international importance.

I-LABS' research also focuses on the windows of opportunity for social and cognitive development. The ability to care about others, to live within the law and to delay gratification, to name just a few essential social skills, are also vital to a full and happy life. Understanding the timing and the milestones of early learning will also allow us to diagnose developmental disabilities at an early age, when the brain's plasticity for learning makes interventions most effective.

## I-LABS' strategic plan

Fundamental to understanding human learning and development is finding a way to peer inside the human brain to see how it works. We have to go beyond cellular neuroscience – a field more than a century old that examines the biochemistry of individual brain cells – and use new methods to look at the whole brain in action. This newer branch of neuroscience is called 'systems neuroscience.'

Systems neuroscience visualizes major networks in the brain that integrate activity across trillions of nerve cells. This helps us to understand what it means to be human – to understand

how language, compassion, personality, mathematical thinking and motivation emerge in the child, and how biology and environment interact to mold the mind over a lifespan.

I-LABS' investment in magnetoencephalography (MEG) technology – the newest of the brain imaging devices – is the critical breakthrough that makes systems neuroscience research possible in children. This safe, sensitive one-ton machine can map the whole brain activity of an adult or an infant only a few days old, tracking neurons as they work in concert, millisecond by millisecond.

MEG technology allows us to watch a human brain as its owner uses language to speak and read, makes a moral judgment, feels empathy, solves a problem, reacts to a stereotype, or decides on a specific course of action.

Like the Human Genome Project, the *Developing Mind Project* will change human lives. The Genome Project's technological breakthrough is affordable gene sequencing that will reveal a person's likelihood for diseases and potentially allow interventions. In the same way, the *Developing Mind Project's* technological breakthrough is the MEG brain-imaging device that will reveal how active young brains learn and how individual children differ. These findings will lead to the design of environments that maximize learning, taking into account differences among individuals.

## What are the specific goals of The Developing Mind Project?

### • Goal #1: Explaining Emergent Minds

I-LABS' discoveries show peaks and valleys in learning. Young children are geniuses at learning multiple languages, while adults struggle. Studies will allow us to understand whether similar "windows of opportunity" exist for other content areas, such as social-emotional and cognitive development. Is there a critical time to learn compassion, impulse control, self-esteem or mindfulness of self and others? A first deliverable is a time-windows learning map, which will describe the time in development when windows of opportunity are open and when they begin to close for specific learning domains. A second deliverable is a

learning-trigger guide, which will describe why specific triggers initiate, impede or enhance learning at various ages and the mechanisms regulating these triggers. Our work will identify the causes underlying and supporting infants' exuberant learning, natural curiosity and "plasticity" for learning. When we know the triggers and the developmental windows, we will be in a powerful position to help design programs that maximize children's early learning potential.

### • Goal #2: Assessing and Assisting the Developing Child

We will identify measures and tools to equip practitioners to gauge the progress of an individual child's development, identify problem areas and, where appropriate, help design research-based interventions and assess their effectiveness. I-LABS research will allow us to provide diagnostic tools and intervention methods, thus bridging the gap from basic research to practice.

### • Goal #3: Understanding Learning Diversity

We will develop an understanding of the brain mechanisms that maximize learning in all children, regardless of the socio-economic and cultural circumstances of their birth. These include understanding how children's initial capacities are affected by the richness of the learning opportunities in their individual environments, and how cultural stereotypes can raise or dampen expectations and aspirations of our young learners.

### • Goal #4: Putting Knowledge to Work

The science and practice of learning must be tightly coupled in order to maximize the benefit to society. Establishing ties to policymakers, innovators, educators, childcare providers, and parents and families is essential to ensure that the science is embraced and utilized. I-LABS will translate and help disseminate our scientific findings in actionable ways to help partner groups increase awareness about the importance of early learning and develop effective messages and programs. In turn, parents and educators will realize more successful outcomes for their children.

### What learning domains will we explore?

- **LANGUAGE** (*speech, reading, music*): Research shows that children's early language skills predict their later reading abilities and their success in school. Language is affected by a critical period and skills not developed early are not easily corrected by later remediation attempts. I-LABS will examine ways to enrich this early learning equitably. We'll also be looking at the effects of early experiences with music on cognition.
- **SOCIAL AND EMOTIONAL DEVELOPMENT** (*empathy, learning by imitation, identity formation, self-esteem and effects of stereotyping on children's aspirations*): Social skills and social-emotional well being are topics that matter not only to individuals, but to society at large. Recent discoveries indicate the important role social interaction plays in early learning and in later success in school and life. The development of a self-identity, empathy for others and self-esteem also depend on early environments that foster social understanding and trust. This, too, may exhibit a critical period in development.
- **COGNITION** (*memory, problem-solving, mathematical and technical knowledge*): Human cognition is complex and requires memory, problem-solving, logic, mathematical reasoning, and the manipulation of physical tools and abstract symbols. New studies integrating whole-brain data with cognitive tasks will help I-LABS researchers understand these processes and how early cognitive experiences may lead to optimal development in these domains.

### What key strategies are needed for The Developing Mind Project?

#### • Strategy #1: Becoming World Leaders in 0-5 Child Learning Research

There has been a revolution in our understanding of children's minds, brains and learning capacities. We now recognize that young children know, feel and learn more than we ever imagined. In laboratories at I-LABS and around the world, children's natural curiosity and drive to learn is being uncovered in basic research studies. Just as basic research into genetic mechanisms led to the Genome Project, discoveries about the developing mind set the stage for a new science of learning requiring new policies and programs. Combining interdisciplinary and cross-cultural approaches, I-LABS scientists are on the forefront of these basic discoveries. We have received multi-million dollar federal and private grants and are positioned to become world leaders in early learning and brain development research. To carry this strategy forward, however, we will need additional resources.

**“Significant scientific advances are rare and have cascading influence. I-LABS’ work on the role of early experience in learning is breaking new ground, and it’s having an international impact”**

TORSTEN N. WIESEL, NOBEL LAUREATE IN MEDICINE, 1981

#### • Strategy #2: Applying -State-of-the-Art Brain Imaging Equipment

I-LABS will open a new Developing Mind Brain-Imaging MEG facility in 2010, the first brain-imaging center in the world focusing on children. The new MEG machine allows I-LABS to take a systems neuroscience approach, instead of a molecular/cellular approach. Systems neuroscience looks at the whole brain to visualize the working together of billions of neurons and trillions of synaptic connections linking these neurons. To understand complex human systems such as language acquisition, social understanding, problem-solving, emotions and personality, a “whole brain” – systems neuroscience – approach, is critical. The initial acquisition of the MEG machine positions us to reach the Developing Mind Project's goals, but additional resources are required to maintain its operation and take advantage of technological advances.

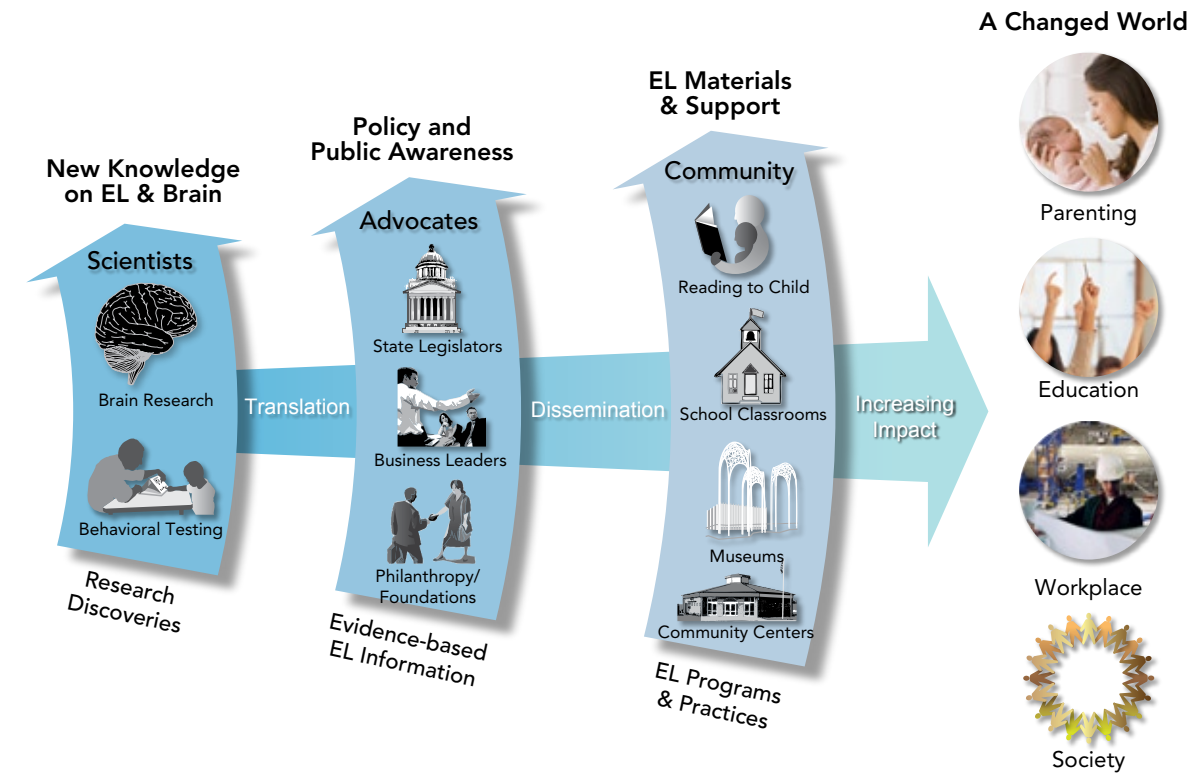
#### • Strategy #3: Attracting World-Leading Faculty and Staff

The leadership provided by I-LABS' Co-Directors Patricia Kuhl and Andrew Meltzoff is essential and has been secured. Dr. Meltzoff holds the Job and Gertrud Tamaki Endowed Chair. Dr. Kuhl holds the Bezos Family Foundation Endowed Chair in Early Childhood Learning. Both Kuhl and Meltzoff have been widely recognized for their scientific work. They are both members of the American Academy of Arts and Sciences and have individually and jointly been honored with numerous international awards and prizes. They were joint recipients of the Kenneth Craik Award from the University of Cambridge in England in 2005. Kuhl is also a member of the Rodin Academy and received the Gold Medal from the acoustics branch of the American Institute of Physics in 2008. Kuhl is overall director and Meltzoff a co-director of the \$25 million National Science Foundation Science of Learning project at the University of Washington, which integrates neuroscience and education across three institutions: the University of Washington, Stanford University, and SRI (Stanford Research International, an independent R&D organization in Silicon Valley). The leadership and expertise of Dr. Kuhl and Dr. Meltzoff are unmatched in the field. They have the combined talent and drive to propel the Developing Mind Project into exciting new frontiers.

#### • Strategy #4: Bridging From Science to Practice

For science to impact society, research discoveries must reach the public. This requires two coordinated steps. The first step is the “translation” of research. Scientific discoveries are typically published in scientific journals that are highly technical. They need to be translated and interpreted before they can be used to formulate policy recommendations and to put changes into practice. I-LABS scientists will solve this “translation gap” by developing actionable recommendations based on the

### Early Learning Ecosystem



scientific findings. The second step is dissemination. I-LABS and its partners will develop strategies that communicate recommendations to policy makers, business leaders, educators, parents and others who can benefit from them. These two coordinated steps will shorten the delay from discovery to practice in early learning.

#### Leveraged opportunities for the future

I-LABS' Developing Mind Project lays the groundwork for future expansion. There are two periods beyond early childhood when the human brain undergoes significant change: the teenage years and the aging years. The MEG brain-imaging equipment can be applied to these additional age groups. I-LABS' studies of early learning will uncover fundamental principles of learning that we believe will offer insights into learning across the human lifespan.

During adolescence, the brain quite literally prunes and sculpts its neural architecture, shedding the exuberant proliferation of synaptic connections formed in early childhood. The teenage brain reduces its connections to produce a more focused brain. Scientists know almost nothing about how this sculpting process works or about the role of experience and nurturing in optimizing outcomes. I-LABS' studies of learning and the brain will have the potential to illuminate some of the puzzling behavior of our teenagers and increase understanding of the changes they undergo during this period.

Our research will also tell us more about the aging brain and what can be done to keep the brain agile for as long as possible. Products on the market claim to prevent cognitive aging using

mental exercises. Our neuro-imaging tools and behavioral studies will help refine and pinpoint what works and why. We believe that understanding neuroplasticity in the young may help us teach old brains new tricks to keep them nimble.

#### Why here, why now?

Twenty years ago, politicians, parents, philanthropists, educators and scientists did not gather in living rooms and board rooms to discuss young children's minds, brains and what to do about them. But this has become a critical conversation, one with the potential to reshape the educational landscape.

At the Institute for Learning & Brain Sciences, we are poised to launch the *Developing Mind Project* in 2010. The necessary components are in place: key leadership faculty, state-of-the-art brain imaging equipment, two decades of research findings that identify critical research questions and protocols, strong support from the University of Washington, and a growing societal awareness of the timeliness and the economic and social advantages of supporting children early in life.

What we achieve in the next decade on the *Developing Mind Project* – as we share new understandings of the child's mind and brain and lay the groundwork to expand our work to the teenage and aging brains – has the potential to affect the state, the nation and the world. Combining the science and practice of learning will help us ensure that all children achieve their full potential and enable us to produce a society of lifelong learners.



# A STETHOSCOPE FOR THE Brain

New MEG technology maps mysterious minds of children

**“The MEG device is a triumph in bioengineering technology. In the hands of I-LABS scientists it will help advance health sciences and illuminate how brains learn.”**

LEE HUNTSMAN, EXECUTIVE DIRECTOR, WASHINGTON STATE LIFE SCIENCES DISCOVERY FUND

The Institute for Learning & Brain Sciences will soon be home to a one-ton machine that can safely read the mind of a seven-pound baby, yielding important clues into how, where and when human learning happens. The exquisitely sensitive MEG brain-imaging device can map the mental activity of an infant only a few days old and proves that the mysterious little brains of children are anything but empty.

In fact, those brains are often busier processing data than the brains of adults. I-LABS studies show newborns can hear the subtle distinctions between sounds used in all the languages of the world – a feat no adult can achieve – and that between ages 0–7 children have a much greater capacity to master foreign languages than their parents.

“Understanding why children easily learn a second language while their parents struggle requires a kind of rocket science for the mind, and our new MEG will allow us to do it,” says Institute Co-Director Patricia Kuhl, a world authority on early language development. “This could lead to second language learning programs that work for people of all ages,” adds Kuhl.

There are very few MEG machines in the United States and no other laboratory has developed MEG measures for infants and young children. In 2006, using a MEG machine in Helsinki, Kuhl and I-LABS faculty member Toshisaki Imada were the first in the world to record brain activity in awake infants as they listened to various languages in the MEG machine. With I-LABS’ newly funded MEG, the researchers can finally pursue their goal of creating the first brain-imaging center focused on children, right here on the University of Washington campus.

Like early explorers mapping unknown continents, pioneering researchers at the Institute will be able to plot the uncharted territory of a child’s developing brain, studying critical neural connections that make up human intelligence.

MEG, completely safe and quiet, acts like a large stethoscope or sensor for the mind. A child sits under the machine, which resembles a large beauty-parlor hair dryer. When he or she experiences a word, a sight, an emotion, or a touch on the hand, the neurons working together in the child’s brain generate tiny magnetic fields. MEG technology pinpoints those fields and tracks them millisecond by millisecond, with millimeter spatial precision, creating topographic-like maps of the brain.

These MEG maps could transform parenting, education, healthcare, child welfare and juvenile justice systems by leading to tools that identify children with disabilities at early stages, when intervention is most likely to succeed. That could mean detecting problems before babies ever speak their first words. It could mean screening infants who are at risk for autism as young as 15 weeks of age.

Bringing this leading-edge technology to the UW seemed an impossible dream. The I-LABS Advisory Board and donor community encouraged the researchers to ‘think big’ and set priorities based on scientific and societal importance, not cost. MEG was at the top of the list. With strong support from the University of Washington, I-LABS scientists were able to secure a \$4 million grant from the Washington State Life Sciences Discovery Fund to purchase the MEG and renovate I-LABS’ space to create the new MEG facility.

The MEG facility will explore not only the minds of children and the magic of early learning, but also can be used to study the neural activity of people at any age. Studying brains and learning over a lifespan will lead to improved diagnosis and treatment as well as improvements in ‘neural exercises’ designed to help keep the aging brain cognitively sharp.



MEG TECHNOLOGY



OUR YOUNGEST PARTICIPANT LISTENS TO LANGUAGES IN THE MEG

# Social- Emotional

## DEVELOPMENT

How do children learn about other people and themselves?



“Empathy and perspective-taking are the very essence of what it means to be human. What could be more important than discovering how we can contribute to the growth of these skills in the next generation of citizens?””

BOB WATT, BOARD CHAIR, THE SEATTLE FOUNDATION

A baby shakes a rattle and her mother shakes another rattle in return. Delighted, the baby repeats the game, this time to peals of laughter. The baby is tickled by the fact that someone is reciprocating. Imitation is flattering, even to infants.

Our research at I-LABS shows imitation is also serious business. Young children use it to learn how the world works. It teaches them about causal relations – how actions make things happen. Through imitation, they learn how to use levers, telephones, forks, chopsticks and other tools of the culture.

But children and adults are also interested in something deeper. They want to understand what is going on inside other people. In everyday interactions, they try to grasp other people's desires, thoughts and emotions. Scientists refer to this as the puzzle of “other minds.”

What makes it a puzzle is that we can't actually see the internal states of others. Yet when we observe upturned corners of a mouth, we immediately sense happiness. When we see streaks of tears, we register a person's sadness. How does the brain make the leap from these behaviors to the feelings that underlie them? What are the mechanisms for social-emotional understanding? And when does a child's learning enable this all-important step?

Understanding emotions is key to social-emotional health, empathy and what some call “mindfulness.”

Empathy is built on the ability to put ourselves in another person's shoes. Young children have difficulty taking the perspective of others. During the “terrible twos” children don't understand that others could want something different from what they want. By about 5 years of age, children have learned that two people can look at the same thing and feel or think differently about it. It is an insight that reorganizes their emotional lives.

Scientists at I-LABS are exploring perspective-taking and what makes some individuals more empathetic than others. Children with autism have particular difficulty understanding ‘other minds’ and cannot easily take the perspective of others. Research at I-LABS is driving new programs by clinicians to help children with autism learn these skills.

The typical child's tendency to relate to others socially is pervasive and positive, but it also opens them up to absorbing stereotypes from the people and media around them. One dramatic effect is that the social expectations of others influence children's academic interests, choices and aspirations.

For example, women in the United States are under-represented in science, technology, engineering and mathematics. Only 20 percent of the undergraduate degrees in computer sciences in the U.S. are granted to women. New research at I-LABS suggests that this may not be determined by biology but could be the result of young girls absorbing our culture's gender stereotypes about women's interest and ability to succeed in science, mathematics and other technical fields.

This leads to hard questions: When do children first become aware of stereotypes (gender, racial, and others)? How do we go about reversing the impact of these stereotypes? The long-term goal of I-LABS' research is to intervene with children, teachers and parents. We intend to design learning environments that can change or overcome the pernicious effects of negative stereotypes and foster a positive sense of identity in young minds.

“Our children are like sponges. They not only learn skills from watching us, but also from our sense of caring for others, and from our biases and prejudices.” says I-LABS Co-Director Andrew Meltzoff. “We want to project positive images that reflect our values right from the beginning.”



**“We need to ensure that no child starts behind in our schools. I-LABS research provides state-of-the art knowledge that will help us get our children ready for the upcoming challenges of the 21st century.”**

WILLIAM H. GATES, ATTORNEY, PHILANTHROPIST, AUTHOR

Education reports provide stark information about school readiness. They indicate that less than half of the children in Washington State enter school kindergarten-ready, and that only a quarter of the lowest-income students have the necessary preparation. Teachers find it difficult to help these students catch up on basic skills. Too many children who start behind stay behind, say education leaders.

I-LABS researchers are investigating the “preparation gap” behind these statistics. The science suggests that reducing the gap requires a focus on learning during the first five years of a child’s life.

“Children begin preparing to read early in childhood as they listen to language, play rhyming games and begin to identify letters,” says Institute Co-Director Patricia Kuhl. “Parents who read to children every day are providing valuable stimulation that sets the stage for life-long literacy.”

Not all parents take time daily to read and talk to young children, however. Recent brain research at I-LABS by post-doctoral fellow Raj Raizada, now a faculty member at Dartmouth College, looked at the pre-reading skills of children at the age of 5, before they attended school. He examined brain activation in the children while they listened for rhyming words. (Rhyming skills predict reading skills.) A brain scanner recorded the neural regions that were active while children worked on the task. The findings were a surprise: The strongest predictor of brain activation in Broca’s area – the brain area actively involved in language and learning to read – was the educational and occupational status of the child’s parents. Even when the child’s skill level was taken out of the equation, a parent’s education and occupation predicted the child’s Broca’s activation.

While this association does not prove a causal link, I-LABS researchers began to wonder how a parent’s education and occupation might be connected to their child’s brain responses to words. The researchers investigated many factors – the child’s general health, IQ and other cognitive skills – and none of these factors accounted for the association. They began to consider whether parents with less education provide less complex language stimulation for their children.

I-LABS researchers recorded language samples from the parents while they read to and talked with their 5-year-olds. Analyses showed that parents with more education and higher occupational status used more varied word choices and complex syntax when talking to their children compared to parents with lower education and occupational status.

Further analyses showed a direct correlation between the complexity of the language input from parents and the amount of grey matter in critical regions for language in their children’s brains. These brain-imaging results provide the first evidence that the richness of the language environment in a home directly influences the brain of a child growing up in that home, furthering our understanding of how the environment affects the brain. We think this result applies not only in the case of language, but also to the child’s early socio-emotional brain development.

Studying children’s brain development at even younger ages will allow I-LABS researchers to discover how early opportunities for learning sculpt brain development. Studies that connect children’s early intellectual skills, their developing brain, and the stimulation they experience will provide the information needed to design targeted and cost-effective intervention programs that will get all children ready for school – regardless of their parents’ education, income or occupation.

# A Great Start

FOR EVERY CHILD

Is the school preparation gap an opportunity gap?

“The Institute for Learning & Brain Sciences is central to our vision of the UW as a place where interdisciplinary research with significant positive impact on society can thrive.”

MARK EMMERT, UW PRESIDENT





**THE INSTITUTE FOR LEARNING & BRAIN SCIENCES**

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