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UCONN
UNIVERSITY OF CONNECTICUT

BRAIN, COGNITION & LANGUAGE

A Publication of the
CT Institute for the Brain and Cognitive Sciences

ATYPICAL LANGUAGE DEVELOPMENT

Disorders in the development of language

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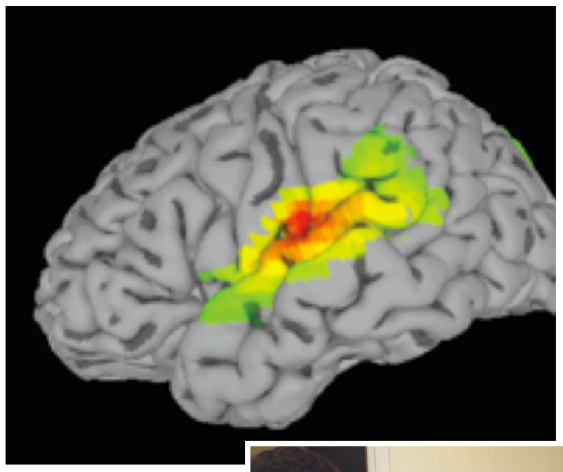

Our Research Community

Who are we?

The CT Institute for the Brain and Cognitive Sciences (CT IBACS) serves as an incubator for research across the brain and cognitive sciences at UConn and beyond; promoting and supporting the interdisciplinary science of the mind and its realization in biological and artificial systems. The Institute was conceived through cross-department discussion and collaboration fostered by the IGERT training program (see http://igert.psy.uconn.edu for more information) and the Cognitive Science Program. It has since grown to encompass a broad scientific community across the UConn campuses.

What do we do?

Our goal is to further the scientific understanding of the mind and its biological instantiation through a cooperative and integrative approach. This requires that new methods and frameworks be developed and that the tools and knowledge of familiar cognitive-level

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Science & The Public Good: Evidence Based Practice

Advances in scientific understanding proceed as a continuous interplay between current theories which drive the development of testable hypotheses, and careful analysis of empirical data resulting from experimental tests of hypotheses. The extent to which scientists trust experimental results depends on two factors: reliability (roughly, the stability of findings over time), and validity, (does an experiment measure what it purports to measure). Since scientists depend on the criteria of reliability and validity to interpret their findings, they can provide valuable tools to decision makers in many different spheres of the public arena. For example, empirical research on the effects of learning approaches, environments and materials, can help inform education policy.

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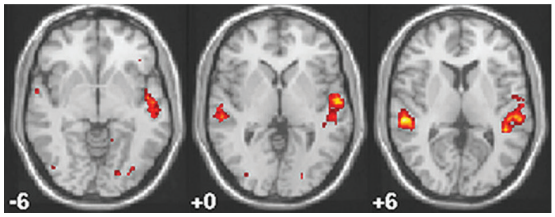

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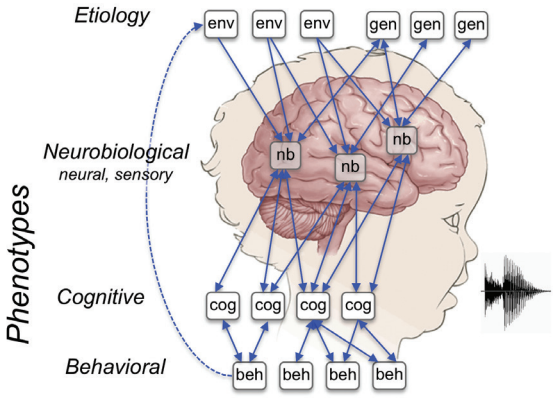
our research community

approaches to language be combined with biological and computational ones so that researchers may learn and become familiar with the theories and methodologies of their peers from other disciplines. These methods include computational and linguistic modeling, behavioral studies, electrophysiology, behavioral and bench neuroscience, genetics, and animal models.

A key area of Brain & Cognitive Sciences research at UConn is language development. There are still a lot of unanswered questions about how children acquire language, whether they are typically developing or are affected by a developmental disorder. Thus, our students and faculty do work on both typical and atypical language development, aiming to build a comprehensive picture of language development as a whole through studies spanning genetic, neural, theoretical, and behavioral aspects of language development. To the right is a small selection of our research findings concerning ASD (Autism Spectrum Disorder), Dyslexia, and Specific Language Impairment.



Definitions of Disorders

Dyslexia, Developmental Language Disorder/Specific Language Impairment, and Autism Spectrum Disorder are disorders that affect language and communication. Symptoms are present from early development and persist through the lifespan, except in rare cases.

Developmental Language Disorder (DLD) or Specific Language Impairment (SLI)

Developmental language disorder (DLD) or language delay, also known as Specific language impairment (SLI), is a language disorder that delays the mastery of language skills in children who have no hearing loss or other disorders that could explain why they are struggling with language. It is one of the most common childhood learning disabilities, affecting approximately 7 percent of children in kindergarten. It is a lifelong disorder, and it is associated with a host of outcomes that range from academic achievement to socio-emotional functioning to behavioral adaptation to occupational success.

Did You Know?

Specific Language Impairment (SLI), Developmental Language Disorder (DLD)

Did you know Specific Language Impairment (SLI), also known as Developmental Language Disorder, affects 7-8% of children in kindergarten (NIDCD, 2013) and is one of the most common childhood learning disabilities.

FACT CHECK: Children with SLI take longer than their age- matched peers to produce their first words. While most children produce their first words by age 1, children with SLI may not produce any words until age 2. Children with SLI may also show marked difficulty using verb phrases in their language and reading.

Did you know individuals with SLI are often late talkers and have special difficulty with verbs?

FACT CHECK: Children with SLI are often late to talk and may not produce any words until they are 2 years old. At age 3, they may talk, but may not be understood. As they grow older, children with SLI will struggle to learn new words and make conversation. Having difficulty using verbs is a hallmark of SLI. Typical errors include dropping the "s" from the end of present-tense verbs, dropping past tense, and asking questions without the usual "be" or "do" verbs.

Dyslexia/Reading Disability

Dyslexia is a brain-based learning disability that specifically impairs a person's ability to read despite having typical intelligence. A common characteristic among people with dyslexia is difficulty with phonological processing. Phonological processing includes skills that let people manipulate the individual sounds of words, such as saying the word cat without the first /k/ sound or saying words that rhyme with cat. Individuals with dyslexia also often have difficulty with spelling and with rapid visual-verbal responses.

Did You Know?

Dyslexia/Reading Disability

Did you know dyslexia reflects an underlying deficit in Phonological Processing, it is NOT a visual disorder (e.g., switching letters)?
FACT CHECK: It is often believed that individuals with dyslexia simply switch letters and that is the cause of the reading deficit. However, research indicates that the reading impairment is not linked to visual deficits; rather, it reflects underlying problems in phonological awareness.

Did you know that dyslexia is a lifelong condition, it is NOT a simply a phase children grow out of?
FACT CHECK: While many people with dyslexia may develop effective strategies for dealing with their reading problems, dyslexia is a lifelong condition.

Did you know dyslexia and intelligence (e.g., IQ) are SEPARATE?
FACT CHECK: Dyslexia is defined as a learning difficulty in the absence of other intellectual deficits. Dyslexia is a learning difficulty characterized by specific deficits to reading and reading fluency, which can also affect reading comprehension. With proper support mechanisms, individuals with dyslexia can learn to become good readers and writers.

Did you know there are clues BEFORE school that a child may have dyslexia?
FACT CHECK: Children with dyslexia often have delayed speech in addition to difficulty with rhyming.

Want to learn more about how neuroscience research has helped to debunk dyslexia myths? This blog post from the Cognitive Neuroscience Society can tell you more: http://www.cogneurosociety.org/dyslexia_myths/

Autism Spectrum Disorder (ASD)

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and social interaction as well as the presence of restricted, repetitive patterns of behavior, interests, and activities (National Institute of Mental Health).

Did You Know?

Austism Spectrum Disorder (ASD)

Did you know while language impairment is not a criterion for ASD, deficits in language are often found?
FACT CHECK: While some children with ASD acquire language comparable to typically developing peers, about 25% remain nonverbal. Trajectories of language acquisition also vary, some with typical but delayed development. The language domain in which deficits are found (e.g. sounds, words, sentences, conversation) can differ. Impairment in pragmatics (conversation) is most characteristic (Naigles & Chin, 2015).

Did you know children with autism benefit from early intensive behavioral intervention?
FACT CHECK: Children with ASD benefit significantly from behavioral intervention, particularly early in life. This intervention, "Applied Behavior Analysis", is the most effective way to strengthen verbal and nonverbal communication skills, such as making eye contact. Research at UConn shows the earlier this intervention is provided, the better.

Did you know that childhood vaccination and ASD diagnosis are completely SEPARATE?
FACT CHECK: Child vaccinations are an important component of early health care, helping to protect children from infectious diseases some of which can be fatal. Some may have heard rumors that ASD might be linked to childhood vaccines, as suggested by Andrew Wakefield in 1998. Wakefield speculated that the measles-mumps-rubella (MMR) might cause ASD or other neurodevelopmental disorders. Wakefield has since lost his medical license because of unethical behavior, and his ideas have been refuted. Over 20 studies, including millions of subjects, have looked for a relationship between the ASD and vaccines, and the verdict is in: vaccines do not cause autism (Gerber & Offit, 2009). Vaccines do provide essential disease prevention for children.

RESEARCH SUMMARIES

SLI/DLD

Dr. Tammie Spaulding's lab focuses on assessment of language disorders and the factors involved in identifying children with **SLI**. Current research examines cognitive abilities of children with **SLI** and how skills not related to language, including executive functioning and IQ, may differ in children with **SLI**. Research aims to examine long term outcomes of kids with **SLI**, and how this impairment may have an impact on other important life skills including understanding a driving test and the Miranda Rights. One reason why it is so important to focus research efforts on SLI is because it affects a large number of children, around 7-8% (NIDCD, 2013). Given that **SLI** may result in significant impairments, it is important to have a better understanding of the functional long term impacts of these deficits.

SLI/DLD

Dr. Sergey Kornilov's work focused on identifying the neurobiological sources of children's **speech and language difficulties**. He and his team worked with a very special geographically isolated population in rural Russia. A large proportion of children and adults in the population exhibit significant speech and language problems. Their goal was to use this unique population to find genes that could be responsible for the development of brain systems that support language development. Using DNA samples provided by ~400 individuals from the population, they were able to identify a novel candidate gene for language development difficulties *(SETBP1)*. In addition, they are developing a better characterization of the role of this gene in children's development in general, neural development in particular, by also obtaining recordings of electrical brain activity for linguistic and non-linguistic tasks.

AUTISM SPECTRUM DISORDER

Typically developing children's joint attention skills have been consistently linked to advanced language later in development. Before the current study, joint attention skills in children with **ASD** were only examined in formal tests, not in "regular" parent-child interactions. The research team coded joint attention and language from play sessions and found that typically developing children *and* children with **ASD** who participated in more joint attention episodes with their parents at earlier visits were the ones who consistently showed steeper language growth over time. The presence of joint attention at early visits had the strongest effect on low verbal children; that is, the ones who engaged in joint attention were the ones who showed steady increases in nouns over time (**Kelty-Stephen et al. 2014**).

AUTISM SPECTRUM DISORDER

The development of spoken language may rely upon the calibration of auditory processing abilities for speech. Some people with **autism spectrum disorder (ASD)** have superior auditory perceptual abilities. In fact, research by **Eigsti and Fein (2013)** shows that people with **ASD** are able to discriminate between auditory frequencies that typically developing people are unable to discriminate. Their research also showed that better auditory discrimination abilities are related to more difficulties in the acquisition of first words. Greater **ASD** symptom severity was also related to better auditory discrimination. This work suggests that heightened auditory processing abilities may contribute to deficits in language abilities in **ASD**.

DYSLEXIA/READING DISABILITY

Dr. Holly Fitch's lab examines the underlying biological and genetic causes of **Dyslexia**. There have been 14 candidate risk genes identified, however there are varying degrees of supporting evidence, and the functional roles of these genes remain poorly understood. One of these genes, dyslexia susceptibility 1 candidate 1 *(DYX1C1)* has been shown to be associated with deficits in short-term memory and non-word reading. Current studies further examine these deficits utilizing a mouse model with a knockout (i.e., the gene is made inactive) of *Dyx1c1*. Mice with the gene knockout showed deficits on memory and learning but not on any auditory processing or motor tasks, suggesting *DYX1C1* may play an underlying role in the development of neural systems important to learning and memory. Disruption of this function could explain the learning deficits seen in **individuals with dyslexia**.

DYSLEXIA/READING DISABILITY

While the structure and function of brain networks involved in **typical and atypical reading** are increasingly better understood, the underlying neurochemical bases of differences in reading development are mostly unknown. **Pugh et al. (2014)** is the first study to examine neurochemistry in children during the critical period in which the neurocircuits that support skilled reading are still developing. In a longitudinal study of emergent readers (ranging from **impaired** to superior), the relationship between reading and reading-related skills and concentrations of neurometabolites was examined. Higher concentrations of glutamate and choline were associated with poorer performance. Higher glutamate concentrations may affect networks involved in learning and consolidation. Higher choline might reflect excessive connectivity or abnormal myelination. These findings point to new directions for research on gene-brain-behavior pathways in human studies of reading disability. (**Pugh et al., 2014**).

UConn Brain Imaging Research Center (BIRC)

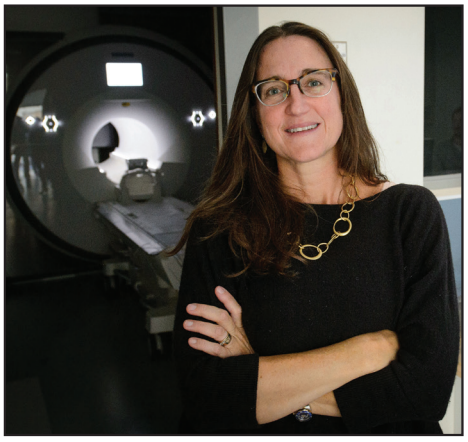
UConn has taken delivery of a brand-new MRI scanner that promises to give researchers their clearest pictures yet of the inner workings of the human brain.

The scanner will be the centerpiece of the new Brain Imaging Research Center (BIRC) at the University of Connecticut, and marks an important milestone in UConn's continuing rise to prominence in the cognitive and brain sciences.

The scanner, made by the Siemens engineering company, is the company's newest and most advanced model, and will offer UConn researchers one of the most advanced imaging platforms available anywhere in the world.

"This is huge," said Emily Myers, an assistant professor of Speech, Language, and Hearing Sciences whose work makes heavy use of MRI brain scans. For more than three years she has been traveling to Brown University to use the MRI scanner there, but she will now have a more advanced instrument just steps from her office. "It's going to bring all of us who are already doing imaging research on campus to the same hub. That's where the cross-pollination of ideas happens."

Projects currently planned for the center include work on the nature of language, the origin of speech, and recovery from traumatic brain injuries. "I'm particularly excited by the new lines of research," said Jay Rueckl, professor of psychology and director the the new center. "Many of them involve new and often interdisciplinary collaborations." Joining Rueckl is Peter Molfese, director of MRI operations, who came to UConn from Yale University. The scanner was officially declared 'open for business' in Fall 2015.



Inge-Marie Eigsti with the new FMRI at the Philips Communications Sciences Building on Sept. 28, 2015. *(Peter Morenus/UConn Photo)*

STATE OF UCONN

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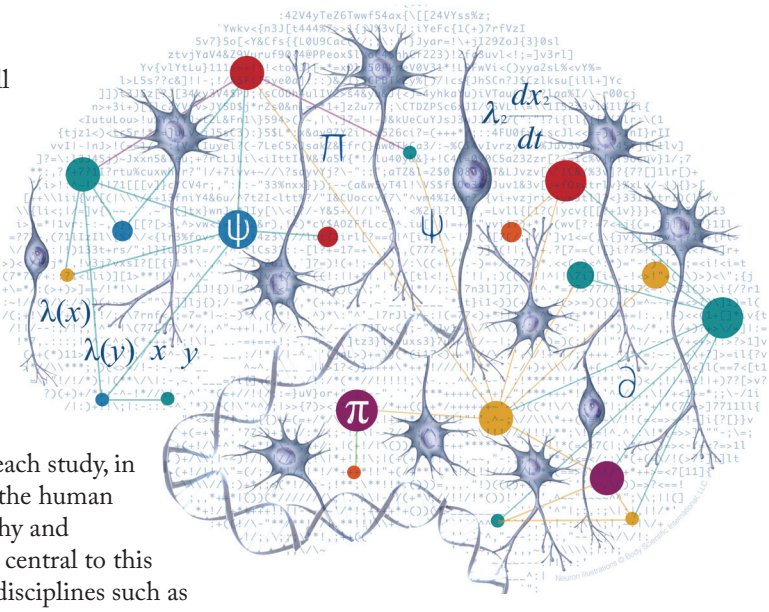
CONNECTICUT INSTITUTE FOR THE BRAIN AND COGNITIVE SCIENCES

Also opened for business during the Fall of 2015 was the new Connecticut Institute for the Brain and Cognitive Sciences (IBACS), funded by the University's Academic Plan. The Institute's mission is to promote and support the interdisciplinary science of the mind and its realization in biological and artificial systems. It will enable new research and educational opportunities for students, postdoctoral researchers, and faculty to extend their intellectual reach beyond traditional disciplinary boundaries.

"UConn has world-class but distributed expertise in the brain and cognitive sciences" said Gerry Altmann, director of the new institute, "and the Institute's mission is to bring this expertise together to push the science forward into new territory."

The Institute will be disbursing seed money and student fellowships to encourage research that crosses the traditional boundaries that separate the individual disciplines that each study, in their own ways, the human mind. "Philosophy and linguistics are as central to this endeavor as are disciplines such as neuroscience and psychology. What is so unusual at UConn is that people working in such different disciplines are already talking to one another; the Institute is a reaction to this groundswell of discussion and collaboration already taking place across the different communities at UConn".



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Meet Our Graduate Students

UConn is home to cutting-edge, state-of-the-art research that is integrative, interdisciplinary, and innovative. The new cognitive-biological synthesis approach requires expertise from a wide variety of disciplines. Collaboration is encouraged, helping foster strong interdisciplinary connections. This is most evident in our wonderful graduate student population. Grad students are an important element in academic research: our programs attract diverse and talented students from near and far. We are pleased to introduce graduate students whose research exemplifies this approach and is intimately related to the theme of this issue.

Amanda Rendall

Psychological Sciences: Behavioral Neuroscience

Research Focus: *Rodent models of neurodevelopment disorders, Genetic disruption of early neural development, Autism, Dyslexia, Specific Language Impairment*

Advisor: Holly Fitch

Emma Nguyen

Linguistics

Research Focus: *First Language Acquisition, Theory of Mind Development, Psycholinguistics*

Advisor: William Snyder

Julia Drouin

Speech, Language, and Hearing Sciences

Research Focus: *Speech Perception, Perceptual Learning, Auditory Processing, Neuroimaging Techniques (fMRI) and Electrophysiology*

Advisor: Rachel Theodore

Iliana Meza-Gonzalez

Psychological Sciences: Perception, Action, and Cognition

Research Focus: *Speech Perception; Perceptual Learning in Speech*

Advisor: Emily Myers

Oliver Sawi

Psychological Sciences: Perception, Action, and Cognition

Research Focus: *Language acquisition and development in typically and atypically developing populations, Bilingual Education, Biliteracy, Visual Word Recognition, Dyslexia*

Advisor: Jay Rueckl

Kacie Wittke

Speech, Language, and Hearing Sciences

Research Focus: *Specific Language Impairment, Autism, Executive Functioning*

Advisor: Tammie Spaulding

Alumni Feature

Dr. Sergey Kornilov

Dr. Sergey Kornilov received his specialist diploma (MA/MSc equivalent) from Moscow State University with a focus on Educational Psychology and Psychometrics. In 2014, He received his PhD from UConn in Experimental Psychology, with a concentration in Language and Cognition, under the mentorship of Dr. James S. Magnuson. Sergey currently works as a Postdoctoral Associate at the Yale University Child Study Center. In this position Sergey is able to work on multiple projects that directly relate to his research interests. Sergey works as a project director on helping to develop a standardized assessment for language in Arabic language. Additionally, Sergey is examining the molecular underpinnings of complex developmental traits and disorders and is the primary bioinformatician working on a set of genome-wide and candidate gene association studies on reading, language, and intelligence. Sergey also supervises the EEG/ERP portions of a large scale study which tracks children's development in different contexts including foster care and biological families. Sergey credits much of his academic success to the amazing research community at UConn and Haskins Laboratories. As a graduate student, Sergey was able to begin a highly interdisciplinary line of research through the mechanism of the IGERT. This has allowed him to begin to bridge some of the gaps of communication across major research disciplines, such as molecular genetics and psycholinguistics. The workshops, coursework, and support from the IGERT faculty have been essential for his success as both a graduate student and a scientist. These experiences has allowed Sergey to develop skills and methodological approaches which he has begun to implement in his postdoctoral work and plans to continue throughout his career.

"The students who produced this digest are all members of the Neurobiology of Language training program at UConn. This program is funded by a $3,000,000 grant from the National Science Foundation (entitled "Language Plasticity: Genes, Brain, Cognition, Computation"). The program brings together students and faculty from 7 PhD programs at UConn, including Linguistics, Neuroscience, several programs in Psychological Sciences, and Speech, Language & Hearing Sciences. Our aim is to develop a comprehensive understanding of language development throughout the lifespan, as well as how the brain adapts in the face of developmental language disorders (such as dyslexia or autism spectrum disorders) or acquired disorders (such as aphasia following a stroke or traumatic brain injury)."

— Prof. Jim Magnuson, Director of the Neurobiology of Language PhD Training Program

Dr. R. Holly Fitch

Faculty Feature

Dr. Fitch is a Professor at the University of Connecticut in the Behavioral Neuroscience Division of Psychology. She also holds the position of UConn Animal Care and Use Committee Chair, as well as serves as a member on the following committees University Scholar/Award & Summer Research Fellowship Committee, Cognitive Science Steering Committee and Institute for Systems Genomics. Her research interests include neurodevelopmental disruption of cognitive/sensory processing deficits as well as neurodevelopmental genetics and modulators (e.g. hormone, experience, stress and enrichment).

Dr. Fitch's primary contributions have been in the areas of behavioral and developmental neuroscience. She is one of the first neuroscientists to investigate behavioral phenotypes of language disorders risk genes in animal models. Recently, her lab investigated the genetic modulation of developmental neural features in mice that may, in humans, impact language. Interestingly, the language gap between humans and non-lingual rodents can be bridged by the examination of "intermediate language phenotypes," such as complex acoustic processing, and working memory. In fact, Dr. Fitch developed the modified pre-pulse inhibition paradigm that is used to assess rapid and complex auditory processing abilities in rodents in her lab. The most recent models that have been studied in Dr. Fitch's lab include mice genetically engineered for mutations in the Dyx1c1 gene (rodent homolog of DYX1C1, a dyslexia risk gene) and the Cntnap2 gene (an autism risk gene). The results from these studies indicate both of these genes may impact the development of language-relevant features (i.e., mutations are associated with complex acoustic processing impairments and working memory impairments, respectively).

Dr. Fitch's research is both translational and influential due to the fact that these specific genes can be tied to the developmental emergence of different foundational aspects of language function, which opens a new door to the study of genetic modulation of the neural basis for language development in humans. Furthermore, these studies may provide useful information for early screening that could allow for optimal intervention strategies on an individual basis. research and thinking in these areas.

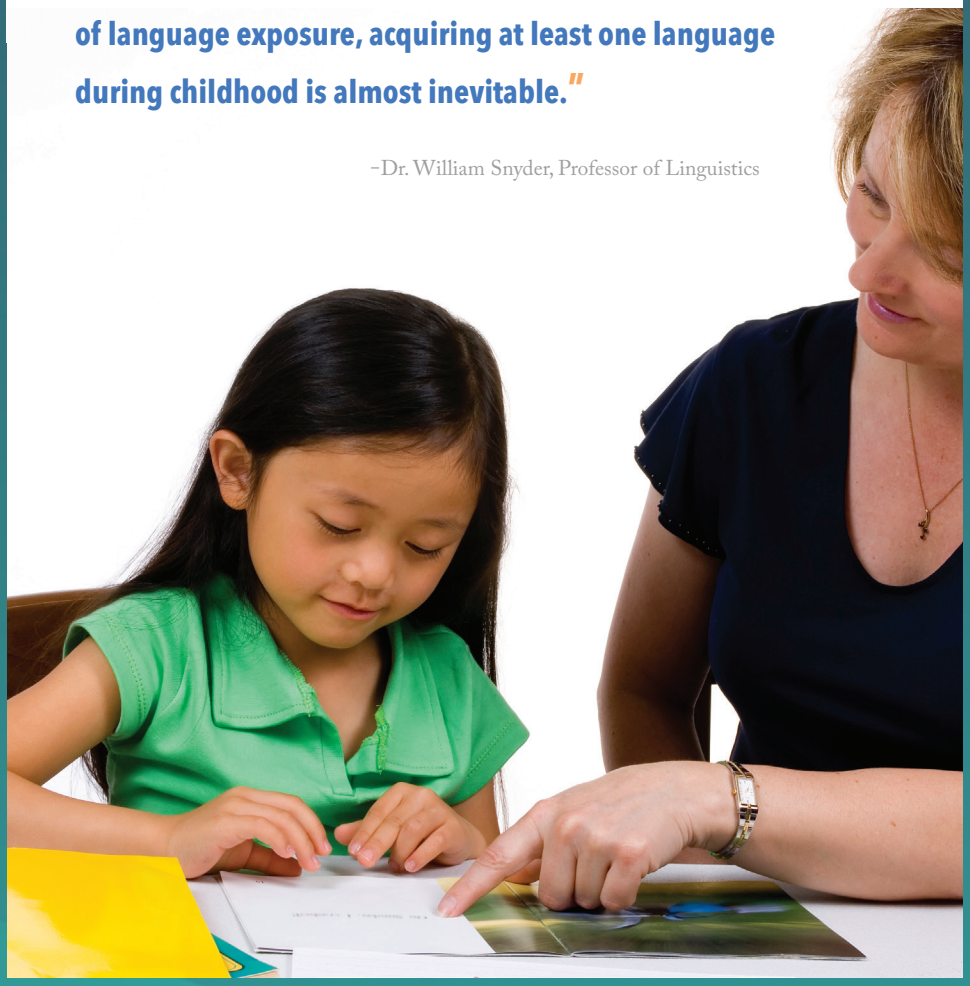
Continued from page 1

Science and the Public Good

Many brain and cognitive scientists examine problems that apply to the public good, including the areas of health, education, and human services. They study how people use language, read, remember things, solve problems, and behave socially. They investigate how the symphony of activity in the brain supports these mental processes. They also attempt to answer questions about how brain functions can become disrupted. Their work connects to public policy in a variety of ways. For example, when scientific studies reveal that a new reading intervention for children is more effective than existing interventions, education leaders could implement the new approach in order to increase the benefit for students. This exemplifies the concept of evidence based practice. Science informs best practices and policies for education, health, and related areas. Our practices must be founded upon scientific evidence of effectiveness, rather than conventional wisdom. History holds various instances of the damaging effects of reliance on practices that were not supported by research. With each new development in the field of brain and cognitive science, society gains a better foundation for promoting the public good.

"Many people believe that children acquire language because their parents TEACH it to them, but the reality is that children acquire language because they JUST CAN'T HELP it. Language is a biological characteristic of our species. Unless the child is somehow deprived of language exposure, acquiring at least one language during childhood is almost inevitable."

–Dr. William Snyder, Professor of Linguistics



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