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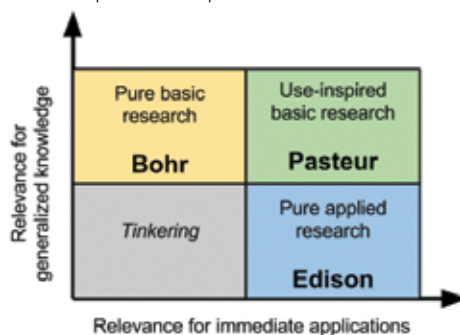
CHANGING THE WORLD THROUGH SCIENCE

NO. 19 // SUMMER 2015

At a recent PEN (PhD in Educational Neuroscience) and VL2 Distinguished Lecture given by the renowned cognitive psychologist David Klahr, he ended his lecture with an observation about VL2 gleaned from a day of visiting with faculty and students. He lauded our VL2 Center, new PEN program, and BL2's bilingual language discoveries for collectively striving for both the creation of basic scientific knowledge and the advancement of society through the translation of that knowledge to education.

During his presentation, Dr. Klahr spoke of the 1997 book, *Pasteur's Quadrant: Basic Science and Technological Innovation*, by Donald Stokes. Pasteur, of course, was the famed 19th century microbiologist who was driven by both the application of his work to cure diseases through vaccination and pasteurization, and to furthering basic knowledge about the growth of microorganisms. In Stokes' seminal work, he proposed a binary 2 x 2 matrix that *intersects* the scientific enterprise that focuses on the advancement of fundamental knowledge, with a second strand that focuses on translational research. Often, we think of these two strands as being mutually

exclusive, with basic science contributing to society somewhere down the road. Stokes instead points to a powerful intersection



of these two dimensions in his Pasteur's Quadrant as "use-inspired basic research," or what our NSF SLC has referred to as science and translation.

As we make plans for next year, we will continue directing our activities toward the achievement of the optimal marriage between basic science and translation. In looking to the new year, we are especially thrilled in this regard, as two of the leading pioneers in just this basic science and translation union have accepted to present in our 2015-2016 *Distinguished Lecture Series in Educational Neuroscience*: namely, Drs. Roberta Golinkoff and Kathy Hirsh-Pasek.

Through their stunning trailblazing of the science and translation ideal, they themselves have recently presented about Pasteur's Quadrant at both the Society for Research in Child Development and the Association for Psychological Science, where they received the prestigious James McKeen Cattell Fellow award honoring their respective lifetimes of outstanding contributions to applied psychological research. Along with our other distinguished lecturers in this series, our thriving PhD in Educational Neuroscience program and innovative training opportunities for PEN and VL2 students, our VL2 national and international MOU university partnerships, and our groundbreaking basic science research and exciting translational activities planned, we look forward to a fabulous new 10th year of Science of Learning Center life ahead! ***Wishing you all a happy and productive summer!*** ●

— Laura-Ann Pettito and
Thomas Allen, Co-PIs, VL2

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VISUAL LANGUAGE
AND VISUAL LEARNING



VISUAL LANGUAGE &
VISUAL LEARNING
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Recognition and Collaboration

Petitto Receives CEASD National Champion Award

VL2 Science Director and Co-PI **Dr. Laura-Ann Petitto** was recently awarded the Conference of Educational Administrators of Schools and Programs for the Deaf (CEASD) National Champion Award for her decades of research in language development in deaf children and adults. **Dr. T. Alan Hurwitz**, President of Gallaudet University, pictured here with Dr. Petitto, presented the award to her.



CEASD is an association of schools and educational programs involved with the education of deaf and hard of hearing individuals. The organization brings together a rich composite of resources to both enhance educational programs and influence educational policy makers. ●



Gallaudet's NSF Science of Learning Center, VL2, is thrilled to announce the creation of a major international Memorandum of Understanding (MOU) with the highly esteemed University of Hong Kong.

Spearheaded by Professor Petitto during her January 2015 visit, the MOU joins together Gallaudet's VL2 scholars and students with the outstanding team in the University of Hong Kong's Science of Learning Research Initiative, headed by Professors **Nancy Law, Brendan Weekes, Carol Chan, and Bradley McPherson**, with much appreciated support from **Dean Stephen Andrews**. Early SLC efforts were launched by Professor **C.K. Ming**, with the passionate and enduring advancements made by Professor Nancy Law and others, and the active involvement of an extraordinary interdisciplinary team of scholars. At our 2015 NSF Site Visit (June 11-12, 2015), we will have the distinct honor to welcome one of these Science of Learning scholars, **Dr. Susan Bridges** (pictured upper right), Assistant Dean Curriculum Innovation, who will travel from Hong Kong to represent the two universities' union and to help launch this exciting new MOU. ●



HKU Pioneers The Science of Learning



Cheng, Kai Ming



Brendan Weekes



Dean
Stephen Andrews



Nancy Law



Bradley McPherson



Carol Chan

Visual Language and Visual Learning (VL2) is a Science of Learning Center, funded by National Science Foundation Grant #SBE-1041725. Any opinions, findings and conclusions or recommendations expressed are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

The Keck team (from left), Brian Scassellati, Melissa Malzkuhn, Laura-Ann Petitto, David Traum, and Arcangelo Merla.



Petitto and Multidisciplinary Team Awarded **Keck Foundation Grant**

A multidisciplinary team led by VL2 Science Director and Co-PI Laura-Ann Petitto and based at Gallaudet has been awarded a three-year \$900,000 grant by the W. M. Keck Foundation.

The team will study and develop methods for enhancing early language acquisition in infants in a project entitled "Seeing the Rhythmic Temporal Beats of Human Language."

"If successful, the work will advance new understanding of how babies learn, resolve previously insoluble problems in the Virtual Human, Robotics, and the Neuroimaging studies of language, create a new science of Intelligent Agents, and yield a transformative learning tool that benefits all children," explains Dr. Petitto.

The research team is comprised of Principal Investigator **Laura Ann Petitto**, Gallaudet University (fNIRS Brain Imaging & Eye-Tracking); **Melissa Malzkuhn**, Gallaudet University (Motion Light Resource Hub); **Arcangelo Merla**, Universita di D'Annunzio, Chieti Italy (Thermal Infrared Imaging); **Brian Scassellati**, Yale University (Robotic Scientist); and **David Traum**, University of Southern California (Avatar Scientist).

The team's goal is to create a learning tool that provides the core components of language's rhythmic patterning to babies during critical periods of brain development. The "RAVE," or "Robot Avatar thermal-Enhanced" prototype, will be placed near a baby's crib to facilitate sensitivity to language patterns. A baby's interactive eye gaze with the robot will trigger a virtual human to provide rhythmically patterned nursery rhymes in a visual language, with speech options. "The RAVE learning tool is intended to break the communication barrier widely impacting many young children with minimal language interactions or delayed language input," said Dr. Petitto.

The RAVE project builds on a sequence of major discoveries by Petitto and colleagues, who found that deaf babies are sensitive to the rhythmic patterning of human language's phonological structure even though these patterns are conveyed silently on the hands in signed languages.

"The new interdisciplinary science created in this Keck research involving socially-assistive 'Intelligent Agents' has the possibility of providing fundamental scientific answers about how babies discover their native language that are key to language learning and reading. It can also yield a transformative, tangible deliverable for the benefit of young children with minimal interaction and delayed language input, thereby preventing the potentially devastating impact on learning, language and reading that delayed early first language exposure can cause," concluded Dr. Petitto.

Based in Los Angeles, the W. M. Keck Foundation was established in 1954 by the late W. M. Keck, founder of the Superior Oil Company. The Foundation's grant making is focused primarily on pioneering efforts in the areas of medical, science and engineering research. ●

For more information, please visit www.wmkeck.org



Petitto invites Langdon to Become Assistant Director of the Brain and Language Laboratory for Neuroimaging (BL2)

Dr. Laura Ann Petitto has invited **Dr. Clifton Langdon**, Assistant Professor in the PhD in Educational Neuroscience (PEN) program, to become Assistant Director of the Brain and Language Laboratory for Neuroimaging (BL2).

BL2 was first established by Petitto in 2012 when she came to Gallaudet to become VL2's Co-PI and Science Director. Now in its third year, BL2 has evolved into Gallaudet University and VL2's major research and resource hub for discoveries about the brain-based foundations of language, reading, and bilingualism in young children.

"Nearly two dozen undergraduate and graduate students have trained in BL2 and we have had over 600 visitors from around the world. Significant scientific leadership will be essential to its vitality and sustainability in the future," explains Petitto. "I have had many wonderful opportunities to observe Dr. Langdon's outstanding leadership skills and brilliant scientific insights and I was thrilled that he accepted the role of Assistant Director of BL2."

"Under the directorship of Dr. Petitto, I saw that BL2 was designed so that the people passing through its doors (researchers, participants, and visitors) would carry with them the seeds of a long legacy of revolutionary science," says Dr. Langdon. "I am honored to join her in continuing this legacy, to continue to strive to inspire the public at large and the next generation of scientists to see beyond the horizon of the known and train them in becoming our vanguard." ●



Evaluating and Improving Educational Tools

Storybook App Usability Study

The VL2 Storybook App Usability Study, designed and conducted by Dr. Melissa Herzig, Director of the Translation Lab for the Science of Language and Learning (TL2), and Dr. Thomas Allen, VL2 Co-PI and Director of the Early Education and Literacy Lab (EL2) investigates how children are using the VL2 storybook apps in authentic school settings. The results of the study will inform future app development and ensure that the scientific discoveries that led to app development are effectively translating to the product's use.

“Usability studies are a crucial stage in the development of any product that is developed based upon scientific findings,” notes Dr. Allen. “In such studies we look for evidence that product users are attending to features that were designed based on those findings and therefore likely to contribute to learning.”

“In the current study, we are curious about how children interact with the apps,” Dr. Herzig explains. “We want to know how children use the three modes featured (Watch, Read, and Learn) and also if they engage meaningfully with the ASL, Fingerspelling, and Reading features built into the app. We are also interested in whether children’s early language experience has any impact on their reading behavior while using the app.”

In the study, 43 children ages 5-8 from

four schools were shown the **Baobab Storybook App** and introduced to the three modes. They were videotaped looking at and interacting with each mode. After they had experienced all three modes, the children were then instructed to return to and interact with whichever mode they wished (free play). The Study team timed and documented all of the children’s choices. After free play, the children were then asked to retell the story and to share their opinions about the app.

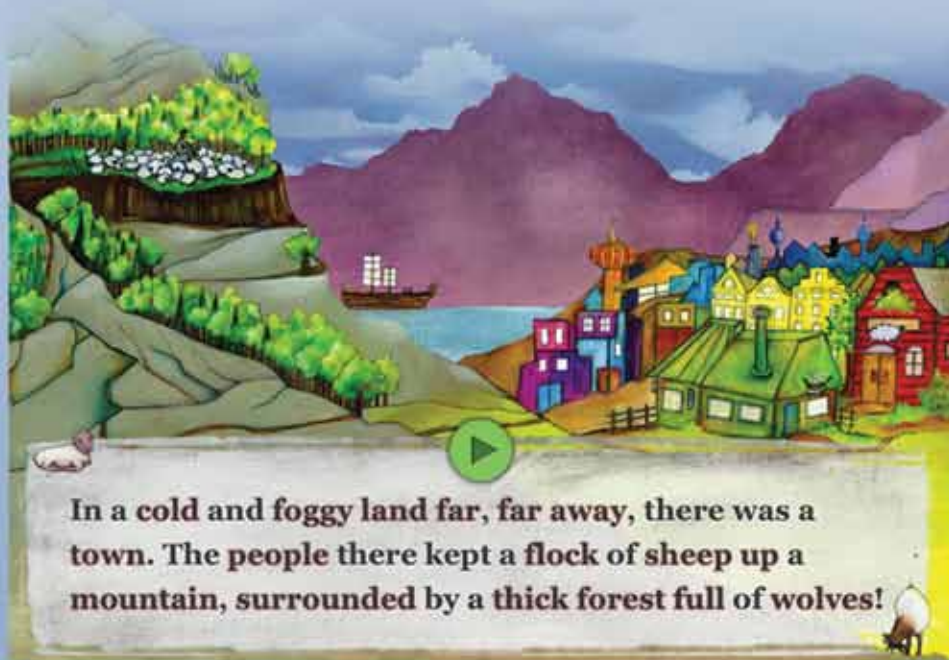
“What we have learned so far is that the participants in the study were fully engaged in the app and interacted with both languages using the app’s bilingual features,” says Dr. Herzig. “They tapped individual words on the ‘Read’ pages to see ASL and fingerspelled translations of

that word more often than they choose to view the sentence or page-level ASL translation. Also, early exposure to ASL seems to strongly affect the children’s choice during free play; children who had been exposed to ASL from birth were more likely to return to Read mode, indicating a greater interest in the reading tasks in the app than was demonstrated in children with later ASL exposure.”

“We are looking forward to continuing our analysis of the study data—for example, we have not yet examined the re-telling videos, nor have we looked at reading abilities of the participants,” Dr. Allen explains. “These additional analyses may lead to improved technological strategies that can engage children in ways that will improve their emerging literacy skills.” ●

“What we have learned so far is that the participants in the study were fully engaged in the app and interacted with both languages using the app’s bilingual features...”

- Dr. Melissa Herzig



Tracking Childrens' Emerging Skills in ASL

Updated Version of Visual Communication and Sign Language Checklist Debuts Soon

The Visual Communication and Sign Language Checklist for Signing Children (VCSL), is a comprehensive checklist that helps to track young children's sign language development. The VCSL documents signing milestones and monitors progress of children who are visual learners, regardless of level of hearing.

"This product is the first standardized measure of young children's, from birth to age five, emerging skills in American Sign Language," says Dr. Thomas Allen, Co-PI of VL2, who contributed to the standardization of the test with a national sample of deaf children from families with deaf parents who developed ASL as their first language.

The checklist, which was developed by **Dr. Laurene Simms** of Gallaudet, **Dr. Sharon Baker** of The University of Tulsa, and **Dr. Diane Clark** of Gallaudet with support from NSF through VL2, benefits children and their caregivers and teachers. Besides monitoring childrens' progress in ASL knowledge and usage, it helps educators and parents identify possible developmental delays, set learning goals, plan intervention programs and develop educational materials. Because VCSL is an observational tool used to document language in natural environments, no specialized materials or prompts are required to use it.

Dr. Allen says that VL2 has filled over 30 orders for the first version of the VCSL, including a large order from the state of Florida which is intending to distribute the instrument statewide. Proceeds from the VCSL sales have been used to develop an enhanced second version as well as an online version of the checklist using the VL2 ASL portal. In the second version, a DVD glossary will be provided that demonstrates, with age-appropriate children, every behavior described in the checklist. This will dramatically increase the validity of the ratings. The online version will make the checklist more universally available and will allow us to collect data for ongoing psychometric analysis and enhancements of the test.

"In addition to the new versions of the VCSL, the checklist authors are developing training modules for parents and educators," says Dr. Allen. "The modules will include training on how to best use the checklist, how to interpret the scores that are derived from the tool, and more general information for parents and teachers about best communication practices in the home and school." ●

For more information about the VCSL, access <http://vl2.gallaudet.edu/resources/visual-communication-and-sign-language-checklist/>



Graduate Assistant Phoebe Tay with the VCSL Checklist.



VL2 in the News!

Laura-Ann Petitto chats with former British Prime Minister Tony Blair regarding BL2 discoveries about the nature of human language and the benefits of the bilingual brain at the JPMorgan Chase Institute launch in Washington DC. The Institute is a global think tank dedicated to delivering data-rich analyses and expert insights for the public good. The event, which brought together top policymakers, financial leaders and academics, among others, featured a panel discussion of what new types of questions can be asked of big data that can both serve the good of society and positively impact policy in the nation and on the world stage. ●

Petitto Awarded **Distinguished Visiting Professorship in the Humanities**

VL2's Science Director and co-principal investigator, Dr. Laura-Ann Petitto, was awarded the Sin Wai-Kin Distinguished Visiting Professorship in the Humanities at the University of Hong Kong (HKU).

Petitto spent the month of January 2015 at HKU establishing partnerships with HKU faculty and serving as a resource for building the disciplines of the Science of Learning and Educational Neuroscience in China.



"Being with these outstanding scientists at the University of Hong Kong was very exciting. I was also thrilled to see how prominently Gallaudet University figured on the world stage regarding its advancements in the Science of Learning and in Educational Neuroscience training of the next generation of future scholars," Petitto noted.

During Petitto's stay, **Dr. Soo-Siang Lim** (Program Director and Chair of Coordinating Committee Science of Learning Centers Program, National Science Foundation)—and leading pioneer of the Science of Learning discipline—visited. Together, Lim, Petitto, and Professor **Nancy Law** (one key head of the University of Hong Kong's Science of Learning Initiative) engaged in rich discussion about how best to advance the Science of Learning in Asia.

Dr. Petitto gave an intensive training workshop in the principles of neuroimaging and functional Near Infrared Spectroscopy neuroimaging measurement of human language and reading functions. She also delivered a series of three formal lectures at HKU, which were attended by her faculty colleagues and also open to the public.

Her topics included:

- "How babies discover language: Insights from a research journey spanning chimpanzees to children, and from co-founding the new discipline of Educational Neuroscience."
- "Humanities and the Science of Learning: Revealing the essence of human thought."

- "The 'Science of Learning'—Why it matters to schools and families—and all interested in the future of society."

On January 13, in advance of her final talk, HKU held a press conference where Dr. Petitto shared her research findings about the benefits of bilingualism on cognitive development. Reporters from seven local news organizations including *Hong Kong Economic Times*, *Apple Daily*, *Sing Tao Daily*, *am730*, *Ta Kung Pao*, *Ming Pao*, and *South China Morning Post*, attended this press conference. ●

Professor Laura Ann Petitto (left), Professor Nancy Law (center) and Dr. Soo-Siang Lim.

VL2's Scientific Advisory Board Shares Expertise and Support

VL2's Scientific Advisory Board (SAB) held its yearly meeting at Gallaudet on March 8 and 9, 2015. The VL2 team shared its research findings, extensive outreach and evolving vision for the future with these valuable and trusted advisors.

The meeting consisted of formal presentations with breaks for discussion and questions. Presentations covered topics that included VL2 research on the forefront of scientific development, translation and dissemination activities, and educational activities involving VL2 students. The Board also met privately and held a gathering with VL2 student attendees.

As always, the VL2 team benefited greatly from the synergistic discussion, exchange of new ideas and scientific analysis this meeting provides. The team extends its profound thanks to the SAB for their time, thoughts and insights. ●



The 2015 Scientific Advisory Board meeting team

EXCITING Developments for PEN Program

PhD in Educational Neuroscience Update

PEN is celebrating the end of our second full year! Our first cohort of students are now half way through the program, and are preparing for their second summer lab rotation.

This summer our second-year students Adam Stone and Geo Kartheiser will join the University of Hong Kong's group of scientists called The Science of Learning Initiative; more about their upcoming adventure is featured in the "Students" section of this issue.

We are completing searches for two new full time tenure track faculty positions, and will be quite excited to announce our new PEN colleagues very soon! In the Fall we should have a full slate of PEN faculty to teach all our required courses, with time to spare for new faculty to develop exciting elective courses in their areas of specialization that will enrich our offerings.

In the meantime we want to thank our expert adjunct faculty, who have taught critical courses in our curriculum over the past two years, including: **Dr. Peter Hauser**, VL2 Mentorship leader, Associate Professor and Director of the Deaf Studies Laboratory at the National Technical Institute for the Deaf, who taught Foundations of Educational Neuroscience-II; **Dr. James Giordano**, Chief of the Neuroethics Studies Program in the Pellegrino Center for Clinical Bioethics at Georgetown University, who has taught Neuroethics for two years, and will be teaching for us again in the Fall, 2015; and **Dr. Ted Supalla**, Professor in the Department of Neurology, Center for Brain Plasticity and Recovery at Georgetown, who taught Guided Study: Research. We also welcome **Dr. Guinevere Eden**, Professor in the Department of Pediatrics and Director of the Center for the Study of Language at Georgetown University (and a VL2 Legacy Scientist), who will be teaching Guided Studies: Theory in the Fall, 2015.

We also recognize faculty members at Gallaudet University who contribute immeasurably to our work as an interdisciplinary program. **Dr. Lawrence Pick** (Psychology) is serving as a Departmental liaison and member of the PEN Interdisciplinary Committee. Dr. Pick's primary research program focuses on the neuropsychological mechanisms underlying cognitive and affective processes in deaf and hard of hearing people. Also serving in this capacity is **Dr. Terra Edwards** (Linguistics Department), whose area of research concerns the interactional and social foundations of language and language use, growing out of her interest in the Deaf Blind community. Our group of Secondary Advisors includes: **Dr. Deb Chen-Pichler** (Linguistics, Advisor to Geo Kartheiser) whose research interests focus on the

PEN and VL2 students gather...



acquisition of ASL by deaf children and hearing bilinguals (coda children), as well as the acquisition of ASL as a second language; and **Dr. Maribel Garate** (Education, Advisor to Adam Stone), who is the Chair of the Department of Education. She has studied the effects of an ASL/English bilingual training model on the beliefs of Deaf education teachers. This year we welcome two new Secondary Advisors: **Dr. Gaurav Mathur** (Linguistics, Advisor to Diana Andriola), whose primary research interests center on the relationship between language modality and language structure; and **Dr. Karen Garrido-Nag** (Hearing, Speech and Language Sciences, Advisor to Paul Twitchell), whose interested in the normal and disordered acquisition of language, the neurophysiology of language, and clinical speech and language pathology. ●

MOU Agreement with American University Creates Exciting Opportunities for PEN Students



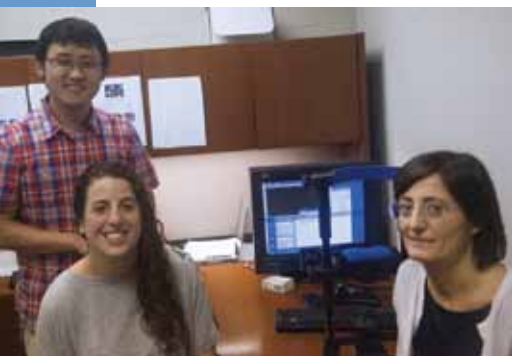
VL2 has established **Memoranda of Understanding** (MOUs) with many other universities and institutions, ensuring ongoing networking and research collaborations with labs from around the country and around the world. One of those MOUs is with American University (AU) who recently created targeted partnership opportunities specifically for Gallaudet's VL2 and PEN students.

This MOU partnership with the **Center for Behavioral Neuroscience at American University** provides new research and training for our students, including lab rotation opportunities in the Biology and Psychology Departments, and access to graduate courses at American beginning in Fall 2015. AU's Center for Behavioral Neuroscience is a unique interdisciplinary research and training environment that promotes excellence in the study of brain function and its manifestation in behavior.

"In my career, I have never experienced a set of internationally respected, top-notch and very busy faculty at one university doing such a thing for a completely different faculty and students at another university," said **Laura-Ann Petitto**, Science Director and Co-PI of VL2. "We are especially grateful to Professor **Terry Davidson**, Director of the Center for Behavioral Neuroscience at American University (*pictured*) for his leadership in advancing this MOU initiative and for the many faculty and Deans who supported it. This is an astounding connection and good will gesture for PEN's advancement and future. It expands choices and career options for our current students and our students to come." ●

Knowledge from New Data

VL2's Early Education and Literacy Lab (EL2) *Director: Thomas Allen*



Pictured from left:
Dae-Kun Kim, Danielle Previ and
Dr. Pilar Piñar

The EL2 has been busily pursuing its research activities, expanding its research projects beyond the Early Education Longitudinal Study and developing new collaborations with faculty at Gallaudet and at other Universities. As well, we have been continuing to enhance the VL2 research and assessment tools and the ways we provide sharable data to others, most noticeably to students for their statistical training, dissertation work, and future publications.

Early Education Longitudinal Study.

The EELS project is focused on analysis and publication. Two publications based on Wave 1 data have appeared, and one poster has been accepted for presentation at the Association for Psychological Science meeting. Other papers are nearing completion, and analysis has been focusing on developing longitudinal models of literacy growth for different subsets of the EELS sample.

Collaborations beyond EELS. EL2 Director Dr. Thomas Allen is collaborating with researchers from the University of Tennessee (UT) and the University of Connecticut (UC) on a proposal to assess the efficacy of a writing instruction curriculum called "Strategic and Interactive Writing Instruction (SIWI)" for deaf and hard of hearing children. **Drs. Kimberley Wolbers** (UT) and **Hannah Dorstal** (UC) developed SIWI and have been supported through the field development phase by a grant from the Institute for Educational Science. The proposal seeks funds to advance this innovative curriculum through an efficacy study employing a national randomized control trial design.

Dr. Pilar Piñar, VL2 affiliated researcher, with research assistants, **Dae-Kun Kim** and **Danielle Previ**, are collaborating with **Dr. Matt Traxler**, VL2 affiliated researcher at the University of California, Davis in a study of reading among bilingual readers. Funded by NIH, Dr. Piñar is conducting an eye-tracking and cognitive development study of deaf bilingual adults. Dr. Traxler is running a parallel study in California with hearing bilinguals. The combined datasets will allow the researchers to test hypotheses about reading strategies among bilingual readers, both deaf and hearing.

VL2 Tools. Enhancements of both the ASL Assessment Portal (ASL-AP) and the VL2 Data Sharing Project are continuing. EL2 is continuing to build new features into ASL-AP software, is inputting and testing the Visual Communication and Sign Language checklist into the portal, and has developed a partnership with the new "ASL Central" initiative at Gallaudet, a program initiated by the Department of ASL and Deaf Studies to build a set of online resources for ASL training and Assessment. ●

Enhancements to ASL Assessment Portal (ASL-AP)

EL2 has been working on enhancing features of VL2's ASL Assessment Portal (ASL-AP) and on inputting two ASL Assessments into the portal for widespread use. The enhancements include features that will help facilitate assessment design, such as new item formats, the ability to preview items, and the ability to demonstrate different assessments and items to different audiences. We are also enhancing the data scoring capabilities and the generation of files that can be easily exported for statistical analysis and advanced score reporting.

We are also inputting the new version of the Visual Communication and Sign Language Checklist (VCSL; article on page 5) into the portal, and working with Gallaudet's ASL and Deaf Studies Department on inputting and piloting an ASL placement test intended for both Gallaudet students and individuals from around the world using ASL training products through "ASL Central." ●

Research Informing Science

VL2's Brain and Language Lab for Neuroimaging

Director: Laura-Ann Petitto

Adam Stone with **Drs. Clifton Langdon** and **Laura-Ann Petitto** were fortunate to be accepted to present two presentations at a major conference in Philadelphia on child learning and development, the Society for Research in Child Development (SRCD.) The trio presented findings from two separate studies utilizing distinct methodologies that early exposure to a signed language supports optimal development of reading and normal language processing.

The BL2 team is working hard to advance the five studies currently being run in the lab. This includes the VL2 NSF Breakthrough Science Network Study 2, **Petitto, P.I.**, which examines how young children process complex visual scenes containing linguistic (text and sign) and non-linguistic (moving visual images) information, and the depth of phonological processing.

Our undergraduate and graduate research assistants and interns continue to amaze many with their ambition and nascent contributions into our understanding of language, reading, and higher cognition.

Adam Stone resubmitted his exciting NIH NRSA application that examines the role of early exposure to visual language and how this impacts language acquisition, reading and higher cognitive outcomes.

Diana Andriola followed up on her NSF fellowship application last year with a strong submission to NIH's NRSA Fellowship Program, to support her very intriguing work into understanding the underlying mechanisms that give rise to the observed relationship between phonological awareness and reading outcomes.

TraciAnn Hoglind, one of our brilliant undergraduate students under the direction of **Geo Kartheiser** and **Dr. Langdon**, has been collecting data and making some exciting findings about the role language plays in visuospatial working memory. Additionally, TraciAnn's ambition has landed her two coveted summer positions. The first, at the Illinois Summer Neuroscience Institute, is designed to give undergraduate students an intensive training in the fields of neuroscience. The second is at **Dr. Karen Emmorey's** research laboratory at San Diego State University with support of the Sheila and Jeff Lipinsky Internship award.

Finally, **Drs. Petitto** and **Langdon** submitted a multimillion dollar grant to the National Science Foundation for the highly competitive Major Research Instrumentation mechanism to support the advancement of neuroimaging technologies and its integration into multimodal systems, which would permit researchers across the country to ask radically new questions about cognition and learning by capitalizing on an innovative methodology proposed to be designed in BL2. Petitto and Langdon are each hard at work submitting another pair of grants to both NSF & NIH. Fingers crossed! ●

Disseminating Science and Translational Products

VL2's Translation for the Science of Language and Learning Lab (TL2)

Director: *Melissa Herzig*

VL2 recently formed its fourth sustainable resource Hub at Gallaudet, the **Translation for the Science of Language and Learning Lab (TL2)**. According to Director **Dr. Melissa Herzig**, the TL2 team develops synergistic connections between VL2 and the people it impacts by helping to disseminate information and products created in the Center.

"TL2 serves as a bridge between science, innovative products, and the people we serve," says Dr. Herzig. "We share information through our parent package and research briefs. We also create educational resources to support language and literacy development through lesson plans to go along with the VL2 Storybook Apps. Additionally, we do presentations and trainings about VL2's research, bilingual education and language policy."

Recently, Dr. Herzig has done presentations at locations including the Center for Deaf and Hard of Hearing Education (CDHHE) in Indiana; the National Early Childhood Education Summit IV at Gallaudet University; the Kendall Parent and Teacher Association (KPTA) ASL Day; the Maryland School for the Deaf in Columbia; and the Arkansas School for the Deaf. This summer will be equally busy for Dr. Herzig and her TL2 team. In June, she plans to share VL2's work with the parents at the American Society for Deaf Children conference in Indiana, and in August, she will present to educators and professionals at Illinois School for the Deaf Outreach Program conference.

The TL2 team is revising VL2's popular parent information package, updating the design and research information with the latest Center findings. The current packages are still available online (vl2parentspackage.org) and through requests.

New research briefs are presently in the developmental stage. "In one brief, the focus will be on reading with deaf children. **Dr. Michele Berke** will write how parents read with their children. She will share research information and help make the techniques of successful of reading with deaf children more transparent to parents," says Dr. Herzig. She added, "The other brief will cover children's social-emotional development. **Linda Lytle** and **Gina Olivia**, who recently published the book *Turning the Tide: Making Life Better for Deaf and Hard of Hearing Schoolchildren*, will share key findings about social emotional development among deaf children and what can be done to nurture their positive self-esteem and a healthy sense of well-being." ●

NEW SignWise Quality Assurance Website

Our new initiative is the **SignWise for Kids** project, founded to ensure the quality of sign language products for children. **SignWise** will be a website where parents and educators can go to be advised about the quality, accuracy and usefulness of educational products. "SignWise will feature developers and resources that have met our high standards, featuring reviews of products geared for young children from infants to school age," explains Dr. Herzig.

The quality assurance review board of SignWise, a team composed of professionals and parents who are fluent bilinguals, will review a range of items including apps, DVD/videos, e-books, printed books and websites that include sign language. Categories for evaluation include accuracy and clarity of sign language and bilingualism, as well as interactivity, engagement, educational value and originality.

"We want to ensure that children have access to high-quality signing models, and they are receiving accurate language input," says Dr. Herzig. "VL2's research has demonstrated that children receive rich language, reading and literacy benefits when they have input through fluent signing models and bilingualism." ●

Intersecting Creativity and Technology VL2's Motion Light Lab (ML2)

Director: *Melissa Malzkuhn*

In VL2's Motion Light Lab (ML2) the team focuses on using the power of digital technology to develop engaging educational resources based on VL2 research findings.

"There are so many exciting things happening on the technological frontier that open up opportunities for us to design resources that make learning fun," says **Melissa Malzkuhn**, Director of ML2.

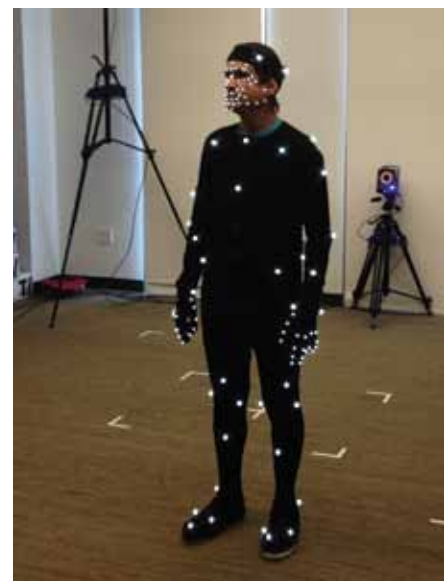
The Solar System is ML2's newest app combining creativity, information and accessible technology. "This is our first non-fiction, science based app, targeted towards upper-elementary (fourth and fifth grade) students. **The Solar System** is also different from our previous Storybook apps (which include **The Boy Who Cried Wolf** and **The Blue Lobster**) because the project was led by VL2 students supported by the ML2 lab." For more information about the app, access <https://itunes.apple.com/us/app/solar-system-vl2-storybook/id950418754?mt=8>.

Another exciting development at ML2 is the acquisition of state-of-the-art motion capture equipment thanks to VL2's Keck Foundation Grant. "It's a wonderful opportunity to take our work to a whole new level!" says Malzkuhn. "Installing and setting up all of the equipment has been a tremendous learning process, and now we are training with face, hand, and body markers, calibrating the cameras, and programming the data. We will eventually be able to convert 3D signing data into avatars."

The ML2 team did two presentations at Gallaudet's ASL/English Bilingual Early Childhood Education Consortium Summit in April. The first, "Project Genesis: Developing Patterned ASL Texts for Early Childhood" was conducted by **Todd Czubek** and **Megan Malzkuhn** from Boston University, and **Benjamin Bahan** and **Melissa Malzkuhn** from Gallaudet. The second presentation was led by VL2's Education and Research Translation Manager Melissa Herzig and Melissa Malzkuhn and was titled, "Promoting Literacy: VL2 Storybook Apps & Storybook Creator."

This summer Malzkuhn will be traveling to Istanbul as a plenary presenter at the World Federation of the Deaf Congress on Technology and Accessibility. "I will be sharing our groundbreaking work in research to translation material and development, as well as discussing what the future possibilities are with advances in technology, particularly in 3-D development involving sign language," she says. "I'm excited to introduce the Storybook Creator program and discuss what it means to 'learn' with new digital tools to this international audience."

To learn more about ML2 activities and sign up for updates, access vl2storybookapps.com/contact, visit our website at motionlightlab.com, or find us on Facebook at [Motion Light Lab](https://www.facebook.com/motionlightlab) or Twitter @[motionlightlab](https://twitter.com/motionlightlab). ●



Breakthrough Science Networks

Year 8 SFA Leaders and Studies

SFA 1: Visual and Cognitive Plasticity

Led by Rain Bosworth,
University of California,
San Diego

SFA 2: Language Development and Bilingualism

Led by Erin Wilkenson,
University of Manitoba,
Canada

Study 1

Development of Visual Phonology in Deaf Infants: The Role of Rhythmic-Temporal Properties of Sign-Phonetic, Sign-Syllabic and Prosodic Language Perception Using Eye Tracking

PI Rain Bosworth, University of California San Diego (UCSD)
Network: So-One Hwang, UCSD
Laura-Ann Pettito, Gallaudet University
David Corina, University of California Davis

This study uses cutting-edge, high-resolution eye tracking technology to investigate where infants and children look while viewing a signer using American Sign Language. With the support of VL2 funding, Dr. Bosworth and her colleagues used this method to investigate infants' early looking preferences for visual language and non-language stimuli, with the goal of unveiling the early precursors of language learning in infants. Their results show that young infants between 5 to 6 months of age, despite never seeing sign language, are able to discriminate between real signs and other non-language stimuli like gestures or "unnatural" signs played backwards. This result suggests that infants do have an early language bias that is found for natural languages conveyed both manually or orally.

Study 2

The Impact of Early Visual Language Experience on Visual Attention and Visual Sign Phonology Processing in Young Deaf Emergent Readers Using Early Reading Apps: A Combined Eye Tracking and fNIRS Brain Imaging Investigation

PI Laura-Ann Pettito, Gallaudet University
Network: Rain Bosworth, UCSD
PEN Students Geo Kartheiser and Adam Stone, Gallaudet University
Clifton Langdon, Melissa Herzig, Thomas Allen and Melissa Malzkuhn, Gallaudet University
Kaja Jasinska, Yale University

In this study, conducted in the Pettito BL2 Laboratory for Neuroimaging, we ask if differences in early life visual language experience impact visual attention and visual allocation in the young emergent deaf reader. If early visual language experience positively impacts aspects of reading in early sign-exposed deaf children, it may suggest that select visual properties of visual sign phonology selectively enhance visual sight word recognition of the printed English word (rather than contrary predictions that early sign exposure would hinder such processes). It would further suggest the surprising conclusion that early visual sign language exposure advantages deaf children's acquisition of reading in English. This fall, we completed preliminary data collection, which indicated successful implementation of our design and enabled us to improve our methodological procedures. We are now beginning our second data collection phase in which we implement an empirical innovation: we simultaneously collect neuroimaging, eye gaze, and reaction time data via a new innovative experimental design.

Results from the present study will provide first-time research-based insights into all young children's visual attention to linguistic and non-linguistic visual information in dynamic moving scenes (such as iPad Apps, for which the field has no knowledge), even though this combined information is commonly used in today's e-literacy technology. Our findings will also provide new knowledge for the optimal design of e-literacy and Avatar translational learning and reading tools for all children, inclusive of the young deaf visual learner.

Study 3

The Development of Perceptual Span in Beginning and Developing Deaf Readers

PI Keith Rayner, UCSD
Network: Natalie Belanger, UCSD
Jill Morford, University of New Mexico

We are examining how reading span develops in deaf children (ages 7-9, and 13-15 years). We test the hypothesis that early sensory and linguistic experience affect the size of perceptual span, having an impact on reading fixation patterns. We have finished our data analysis and are currently writing a paper. We recently presented a talk (March 2015) including this data at the Symposium on Visual Aspects of Reading, in Grasmere, U.K.

SFA 3: Reading and Literacy in Visual Learning

Led by Lynn McQuarrie, University of
Alberta, Canada

Science

SFA 4: Translation in Education: Translational Products, Tools and Dissemination

Led by Melissa Herzig, Gallaudet University

SFA 5: Integration of Research and Education (IRE): Student Training for the Next Generation

Led by Peter Hauser, National Technical Institute for the Deaf/Rochester Institute of Technology

Study 4

Do Young Deaf Bilingual-Bimodal Readers Access ASL Forms While Reading English Words?

PI Erin Wilkenson, University of Manitoba, Canada
Network: Jill Morford, University of New Mexico
Pilar Pinar, Gallaudet University

Building on earlier VL2 research demonstrating that ASL signs are activated when adult ASL-English bilinguals read English words, this study investigates the developmental trajectory of bilingual activation. Do the lexical relationships between the two languages change over time, as children become better readers? We hypothesize that they do, and that lexical co-activation will be in evidence among children in the middle school years. We have developed age appropriate tasks for children in grades 6-8 and are working with five schools throughout Canada collecting data. We are also working with several more schools who may be joining our study.

Study 5

Speed of Visual Sign Language Processing, and Visual Sign Phonological Awareness Processing, in Young Deaf Typically and Atypically-Developing Bilingual-Bimodal Readers

PI David Quinto-Pozos, University of Texas
Network: Thomas Allen, Gallaudet University

At the University of Texas Signed Language Lab, we have crafted ASL, fingerspelling, and written English measures to investigate visual language processing in bilingual-bimodal deaf children and adolescents. Rate of processing has been shown to be an important factor to consider in developmental language disorders of hearing children who acquire spoken language, and our study design allows us to extend this area of inquiry to deaf children who are developing bilinguals. Our measures manipulate rate of language presentation (slow, regular, and fast) for ASL and English to measure processing via response time for identifying key lexical items. We also assess the comprehension of fingerspelling across rates of presentation in order to examine this linguistic bridge between ASL and English. Data collection is ongoing. However, preliminary analysis of the ASL rate measure data from 25 children (typical = 19, atypical = 6, 11 females; ages 6-16) reveals that atypically developing children process sped-up linguistic stimuli differently than typically developing children do. In particular, atypically developing children are slower at processing ASL when it is sped up; this matches what has been found for hearing atypically developing hearing children and their processing of English stimuli. Analysis of English and Fingerspelling measures for this study remain, and that will occur after data collection has been completed. We expect that our results will inform VL2's continued work on visual sign phonological awareness.

Study 6

Learning To Read With Visual Languages: Investigation of the Impact of Visual Phonology (L1) Training on Emergent and Developing Literacy in L2

PI Lynn McQuarrie, University of Alberta, Canada
Network: Charlotte Enns, University of Manitoba, Canada

The current study is a school-based intervention study designed to examine the effects of intensive individual and small group explicit signed language phonological awareness training on sign vocabulary and print vocabulary word learning in children ages 5-9 years (grades 1-3). During Phase 1 of the project, a strength-based ASL visual sign phonological awareness instructional program was developed and refined. Training materials and technology tools that support implementation of the training protocol were also developed. The technology tools have been developed with deaf children as co-design partners. The intervention protocol and technology tools are currently being piloted with a diverse group of bilingual deaf children. It is hoped that the results of this pilot will advance understanding of visual signed language phonology and its role in early reading, and provide teachers with additional tools and strategies to support teaching for cross-language transfer in dual language education.

Study 7

Home, School and Early Language Factors Impacting the Acquisition of Reading Skills Among Deaf Children With and Without Cochlear Implants, and With and Without Early Exposure to Sign Language

PI Thomas Allen, Gallaudet University
Network: Donna Morere, Gallaudet University
Graduate Student Amy Letteri, Gallaudet University
Matthew Traxler, University of California, Davis

Study 7 is deeply into the analysis and publication stages of the project work. The three-year longitudinal dataset has been fully built and verified. Two publications based on earlier analyses of Wave 1 data have been published, most recently a paper published in Sign Language Studies, that examines the role of ASL and Fingerspelling skills in pre-school-aged deaf children in emerging literacy, as measured by alphabetic letter naming and letter writing skills. VL2 student scholar Amy Letteri has been working with project PI Dr. Allen on two papers that examine models of social competence and effortful control that hypothesize the joint impact of early language and visual attention on these social outcome measures. Early longitudinal analyses of growth trajectories in Letter Word Identification and visual attention are now underway.

Selected Presentations:

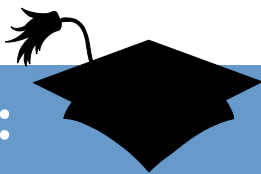
McQuarrie, L., & Enns, C. (2015, March). Bilingual Deaf children as co-design partners in developing ASL/English word learning technology tools. Paper presented at the **Society for Research on Child Development (SRCD) Pre-conference on Deaf Education**. Philadelphia, PA.

McQuarrie, L., & Enns, C. (2015, January). HandsUp! for literacy: Tapping into Signed Language phonological awareness training in the development of literacy in English for bilingual deaf children. Poster presented at the **12th Annual Hawaii International Conference on Education**, Honolulu, Hawaii

McQuarrie, L., Baron, T. Lam, E. (2015, January). Nothing about us without us! Bilingual deaf children as co-design partners in the development of an interactive digital word learning game. Poster presented at the **12th Annual Hawaii International Conference on Education**, Honolulu, Hawaii.

McQuarrie, L. (2014, October). "Kiss your Brain!" What the Science of Learning on Visual Language and Visual Learning Offers Teachers of Reading. Plenary keynote address at the **Canadian Association of Educators of the Deaf and Hard of Hearing (CAEDHH) Conference**. Vancouver, B.C.

Scientists of the Future: Student Updates



One of VL2's most vital missions is helping to train and support the scientists of the future. Our VL2 students make significant contributions to our research, translation projects and relationships in the larger community. As always, we would like to express our appreciation to our wonderful 2014-15 Student Leadership Team (SLT members include **Diana Andriola**, **Jessica Contreras**, **Adam Stone**, and **Erica Wilkins**) mentored by SFA 5 Leader **Dr. Peter Hauser**, for organizing and promoting student activities and keeping students at our various sites connected.

PEN Students Travel the Globe

Stone and Kartheiser Join UHK Science of Learning Initiative

This summer **Adam Stone** and **Geo Kartheiser**, both second-year students in the PhD in Educational Neuroscience (PEN) program, will join the University of Hong Kong's (UHK) group of scientists called *The Science of Learning Initiative*, headed by Professors **Nancy Law** and **Brendan Weekes**. Stone and Kartheiser will attend UHK's Summerfest in Educational Neuroscience to learn advanced techniques in neuroimaging and neurorecording (fMRI, EEG). They will also give several public lectures (on advances in Educational Neuroscience, visual sign phonology and reading, and visual spatial processing in young deaf visual learners), and help to advance the University of Hong Kong's exciting new initiative to build an Educational Neuroscience fNIRS Neuroimaging Laboratory.



This opportunity is the result of VL2's Co-PI **Laura-Ann Petitto**'s submitting a supplemental grant to the National Science Foundation for Stone and Kartheiser to be student representatives of Gallaudet's Science of Learning Center, the Science of Learning Centers in the USA at large, and Gallaudet's prominent advances in Educational Neuroscience—especially Gallaudet's pioneering PEN program. Petitto's successful grant request was co-funded by the NSF Science of Learning Program (Dr. Soo-Siang Lim, NSF Program Director and Chair of Coordinating Committee, Science of Learning Centers Program) and the NSF Office of International Science and Engineering (Dr. Akaysha C. Tang, East Asia & Pacific Program Director).

Professor Petitto will also be at the University of Hong Kong this summer as the Sin Wai-Kin Distinguished Visiting Professor, and together the Gallaudet team will be supporting UHK's effort to establish a Science of Learning Center in Hong Kong and other similar initiatives elsewhere in China. The ultimate goal of this larger USA-Hong Kong-China initiative is to build vital scientific bridges between Asia and the USA and to promote the establishment of new scientific exploration and discovery through synergistic international collaboration. ●

Adam Stone (left) and Geo Kartheiser, pictured above, will be student representatives of Gallaudet's Science of Learning Center at the University of Hong Kong's Science of Learning Initiative, Summer 2015.

NEWS makers

Loh Plenary Speaker at Harvard Research Conference

Timothy Loh, a VL2 student based at Georgetown University, was one of 12 plenary speakers at Harvard University's National Collegiate Research Conference in January. "My presentation discussed anthropological research I conducted last summer in Jordan, exploring the cultural construction of deafness and of deaf education in the Holy Land Institute for Deaf and Deaf-Blind Children (HLID), which is widely regarded as the leading institution in the Middle East for deaf education and sign language research," explains Loh. "Three themes emerged over the course of my fieldwork: the HLID's self-regulatory ethos, the centrality of Jordanian Sign Language in education, and interreligious relations in the school.

"It was really inspiring to see the breadth and depth of research that is being done out there by undergraduates all over the country," Loh continues. "I would encourage other VL2 students to apply to present their research at the National Collegiate Research Conference in January next year!"

Loh is one of the founders of **GU Signs**, Georgetown's American Sign Language and Deaf culture club. ●



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