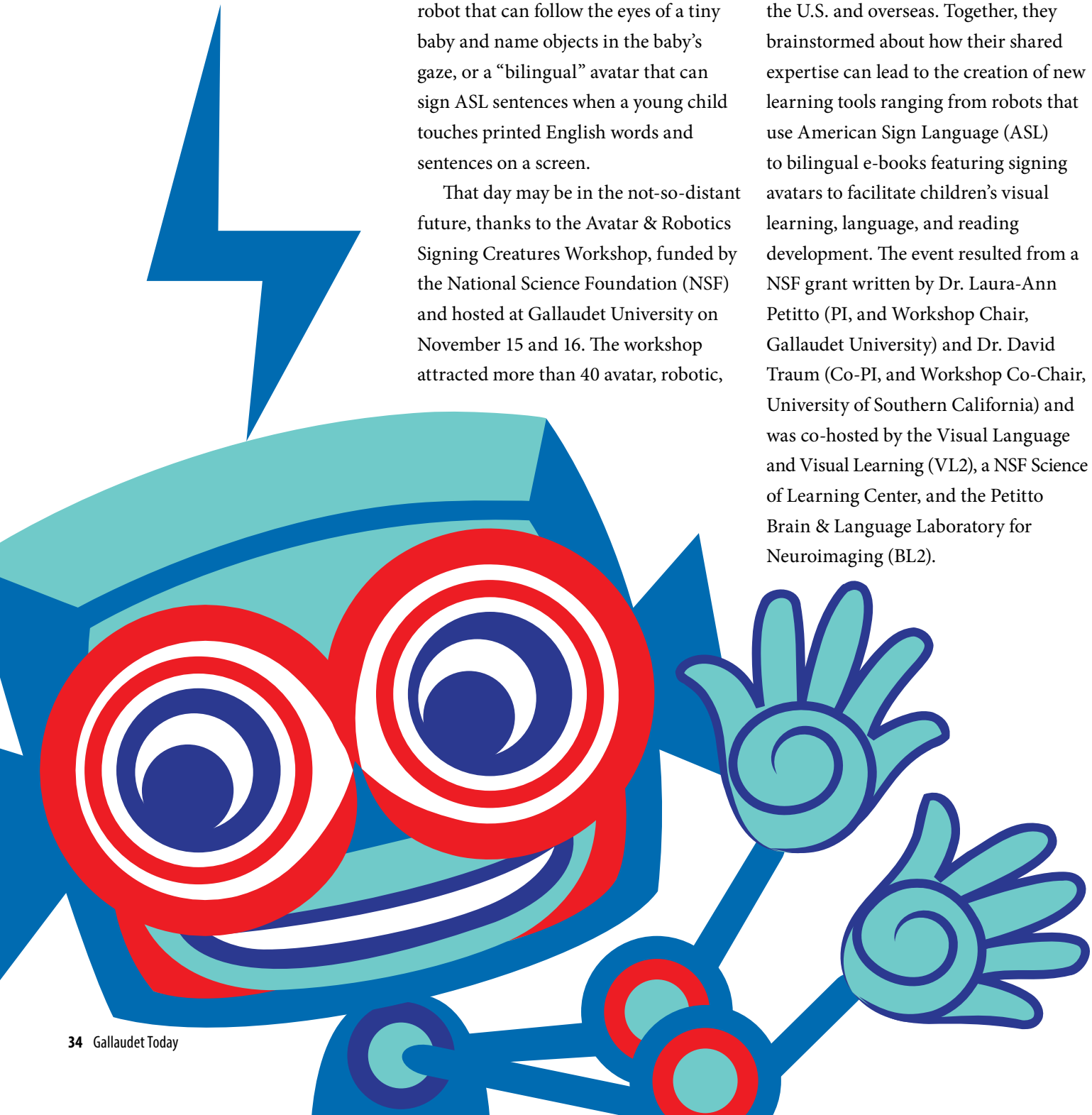
New Frontiers in Visual Learning

By Megan Clancy

Imagine a day when toy dolls can sign in American Sign Language (ASL), or a robot that can follow the eyes of a tiny baby and name objects in the baby's gaze, or a "bilingual" avatar that can sign ASL sentences when a young child touches printed English words and sentences on a screen.

That day may be in the not-so-distant future, thanks to the Avatar & Robotics Signing Creatures Workshop, funded by the National Science Foundation (NSF) and hosted at Gallaudet University on November 15 and 16. The workshop attracted more than 40 avatar, robotic, and visual language scientists, and children's learning product experts from the U.S. and overseas. Together, they brainstormed about how their shared expertise can lead to the creation of new learning tools ranging from robots that use American Sign Language (ASL) to bilingual e-books featuring signing avatars to facilitate children's visual learning, language, and reading development. The event resulted from a NSF grant written by Dr. Laura-Ann Petitto (PI, and Workshop Chair, Gallaudet University) and Dr. David Traum (Co-PI, and Workshop Co-Chair, University of Southern California) and was co-hosted by the Visual Language and Visual Learning (VL2), a NSF Science of Learning Center, and the Petitto Brain & Language Laboratory for Neuroimaging (BL2).



"We have many VL2 studies underway at Gallaudet and at our partner universities nationwide. Each one of our studies are targeted towards understanding the Science of Learning, specifically in children, and spanning key ages in child development (infants, children, and young teens)," said Petitto, who is also VL2's Science Director and Co-PI. "We have remarkable findings about visual sign phonology, reading, and bilingualism—based on behavioral, neuroimaging, and longitudinal data—and we're ready to take the next step and start thinking about how we can make learning tools to improve language, reading, and literacy outcomes for all young visual learners."

"Building on deaf people's processing strengths, the purpose of the workshop was to explore innovative ways to design learning tools that most optimally utilize these strengths," explained Petitto.

"One outcome goal of the workshop was to form teams of collaborators in which VL2 scientists share information with top avatar and robotic scientists about what young visual learners need to learn, and when in development, in order to become the best readers possible," said Adam Stone, a doctoral student in educational neuroscience and the workshop's manager. He added that this is a golden opportunity for Gallaudet to show the world how ASL scientists can help advance innovation in diverse fields.

A cadre of Gallaudet undergraduate and graduate students helped with the workshop—designing name tags, creating posters, taking notes, writing press releases, running the database, and managing the workshop's website, signingcreatures.weebly.com. "We absolutely want Gallaudet students to be involved in our projects in the future, such as creating avatars through motion capture (mocap) technology," said Stone. "This is the beginning of many new collaborations. This is how big science happens—by having many fields work together."

The workshop kicked off with "The Knowledge Explosion," during which each of the participants presented their recent innovations or product developments. Dr. Brian Scassellati, a scientist from Yale University who builds robots to facilitate the development of eye gaze and social interaction in young autistic children, showed how a young boy with autism was able to focus his attention more on humans after having interacted with a robot dinosaur. To date, Scassellati's robots have been used to increase eye gaze and the development of social skills and motivation in hundreds of autistic children ages 8 to 12. "I would like to see a robot that could make facial expressions," Scassellati said. "It'll be challenging to see how robots can understand sign language." He noted that visual learning "goes beyond the deaf community—everyone has on headphones and lives in noise, so gestures will benefit everyone."

There was a lively panel discussion that included a top team of producers from PBS KIDS Interactive, Silvia Lovato and Abby Jenkins, internationally renowned for their design of children's learning math games on the Web and PBS television. The panel also included Ellen Doherty of WNET/Thirteen. These product developers discussed contemporary issues in how to create educational technology, what works with children and what doesn't, and how
to impact the broadest possible audience of children and their parents. The panel was led by VL2's Melissa Malzkuhn, digital innovation and media strategies manager and moderator Melissa Herzig, VL2 education and translation manager, noted, "I would love to see an avatar signing stories in ASL. Kids would love that."

Dr. Krister Schonstrom from Sweden's Stockholm University presented on the results of his 10 years of research in bimodal bilingualism, language acquisition and sign language assessment. "It is a big opportunity for me to visit Gallaudet, because of VL2 and the Brain and Language Laboratory for Neuroimaging (BL2)'s projects, resources, and scientists, and Gallaudet is a center for top scientists to collaborate," Schonstrom said. "We need to work with experts in robotics and avatars to bring many possibilities for children and adults to use at home and in the classroom—we need them and they need us."

Dr. Dom Massaro from the University of California, Santa Cruz, Department of Psychology and Computer Engineering, and president of Psyentific Mind, hopes to use technology and behavioral science to facilitate speech and sign language development in

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Participants of the National Science Foundation Avatar and Robotics Signing Creatures Workshop include organizers (front row, starting fifth from left): workshop manager Adam Stone, Gallaudet doctoral student in educational neuroscience; workshop chair Dr. Laura-Ann Petitto, BL2 Scientific Director and VL2 Science Director and Co-Principal Investigator; and workshop co-chair Dr. David Traum, from the University of Southern California. (Not pictured is National Science Foundation Program Director of the Robust Intelligence Division, Dr. Tatiana D. Korelsky.)

children. "I would love to work with Gallaudet to develop methods for deaf children to acquire written language at the same time they acquire sign language," said Massaro, who has already developed a virtual avatar named Baldi (www.psyentificmind.com) to help children develop speech skills.

Gallaudet students who assisted with the workshop expressed their enthusiasm for seeing these visual learning tools developed. "I want to read and learn more about the scientists' research, and I would personally use a computer to play with avatars that can sign in ASL," said Gerald Caci, a Gallaudet student from Buffalo, N.Y. Caci said he is particularly intrigued by multimodal communication technology being developed by Dr. Louis-Philippe Morency, a research faculty member from the University of Southern California's Institute for Creative Technology. Morency's research at USC on multimodal communication involves computers that can analyze people's words, facial expressions, body posture, and what gestures are being used at the same time. Addressing the possible use of this multimodal technology for deaf people, or for those who are deaf-blind, the technology can help those individuals keep up with a group by knowing what is going on with the help of a virtual companion (i.e., a robot).

"I was extremely interested and really excited to see the students and researchers talking and signing to each other (at Gallaudet). The dynamic of a group of signers is amazing. Our technology can help anticipate who will be signing next, or when a group is working well together versus when it needs virtual help," Morency said, adding that he can see the prototypes coming into life within five years by using Google glasses and mobile phones. "I can use the multimodal method's multisensory approach to 'see' everything in class because I have a visual problem that makes me miss aspects of what the professor says. So I'd benefit from technology that conveys multimodal communication," Caci said.

Courtesy of University of Massachusetts Lowell

Katherine Tsui, founder of the robotics laboratory at UMass Lowell, which is currently working on developing robots to help people with disabilities, and Tom Ryden, chief operators officer and cofounder of VGo Communications, demonstrate "Margo," one of the robots that is being used to assist patients at Children's Hospital Boston. Yanko said she is interested in working with Gallaudet on developing robots to assist deaf children with their communication development at home.

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—Adam Stone

Dr. Holly Yanco, a professor in computer science and director of New England Robotics Validation and Experimentation Center from the University of Massachusetts, Lowell, uses robots to assist patients at Children's Hospital Boston. "I'm definitely interested in working with Gallaudet on the creation of learning tools. I have been creating robot systems to interact with people for many years. I think there's an exciting opportunity to help children learn ASL by combining robotics with the expertise of researchers and students at Gallaudet," Yanco said. She mentioned several applications for the deaf community after learning at the workshop that some deaf children of hearing parents do not have anyone who signs with them. She further explained that her robots could be in the child's home, used by ASL teachers and ASL interpreters to facilitate communication with family members, or used by other deaf children who could come for a remote play date. The child could learn new words by pointing to an object then seeing the sign on the robot's screen. Unlike Skype on a computer, the robot could move throughout the house with the child. Petitto also added that robots have embodiment (entities possessing the overall body form of a human), unlike flat computer screens. Pointing to the robotics research showing that children and adults are more compliant to robots with embodiment, as compared to those that do not look like us, Petitto noted that embodiment may ultimately prove to be an important component in the design of high-impact learning and teaching robots for young children. She added that the wealth of VL2 research to date suggests additional factors that will be key in future product design, such as the capacity of the robots and avatars to engage in contingent eye gaze with children and to engage in contingent social interactions. Beyond merely being able to respond to a child's face and body movements, robots and avatars will need to respond with contingency, that is, to respond in appropriate ways based on whether the face and body movement are stemming from a child who is crying and distracted or a child who is smiling and attentive.

"We achieved a lot at the workshop!" noted Stone. "We proposed specific types of learning products that can best utilize Visual Language, Visual Learning, Virtual Humans, and Socially Assistive Robotic products to advance learning tools for all children."

Workshop attendees also identified the most important scientific and technical challenges in their respective disciplines, those that constituted the roadblocks to advancing avatar-robotic learning tools for young children. Together they recommended that these be the highest funding priority directions for the National Science Foundation in order to push to new frontiers in creating visual language learning tools that incorporate signing and robotic creatures. "We are about to dive into assembling science teams and start grant-writing so we can embark on these exciting new scientific and technological advances," Stone said.