Transcripts
VL2 Knowledge Festival
May 9, 2016

Introduction: Dr. Laura-Ann Petitto

Welcome. We're delighted that you're here with us tonight. Thank you so much for coming out to support our first annual VL2 Knowledge Festival.

I'm Dr. Laura-Ann Petitto. I'm the co-PI and Science Director of VL2. VL2 is the National Science Foundation's Science of Learning Center, housed at Gallaudet University. It is called Visual Language and Visual Learning, or VL2 for short. We're one of six Science of Learning Centers in the United States, and we are privileged and proud to be here at Gallaudet University.

VL2 is 10 years young now, and we began in our first five years with a focus on basic science. And then in year six, we started to identify across the different labs some synergistic scientific findings, and that led to the establishment of scientific themes and the realization that the age of language exposure is critical for human development and that the brain has neural plasticity to a degree that amazed us. And finally that there are multiple routes to learning language and to learning to read. After that, we started to redirect and target our studies to focus on breakthrough science. When I say breakthrough science, I mean scientific discoveries with the highest impact, that will have lasting impacts on society.

There are many people who have helped throughout the years. Clearly, we don't have time to name all of them tonight, but we would be remiss if we didn't mention just a few of them. I want to especially thank our Provost, Dr. Carol Erting, who's here tonight. Thank you. And representing the NSF, I want to thank Dr. Lim, who encouraged the founding of the Science of Learning Centers in the United States, and Dr. Karelsky, who has been a boon to our center since the beginning. So, I want to thank those three especially.

Now, just like a family tree or a genetic map, you can see on this slide how we have grown, our parent cells, NSF and Gallaudet, which of course led to the founding of VL2. And from VL2 we have created four knowledge resource and research hubs, and you'll be learning about each of them tonight. In addition to that, VL2 has established the first-ever program in the United States or, actually, in the world, a doctorate in educational neuroscience. And educational neuroscience is studying the brain and behavior in concert to figure out how children learn best, how humans develop, with a commitment to translating those findings to society. We take our research results and translate them into products and resources that will benefit society.

When we began, there were three of us — just the three of us — and see how we have grown. Our future looks very bright. We have three new faculty in the PEN program: Dr. Lorna Quandt, Dr. Clifton Langdon, and the faculty member who will be arriving this fall, Dr. Ilaria Bertoletti. And that's exciting for Gallaudet for a couple of reasons, one of which is that obviously new faculty members bring new knowledge to the campus. They also bring new students, in other words, helping with recruitment and with retention as well. And finally and not least importantly, they bring new grant funding to the campus, which means more money for Gallaudet.

VL2 is proud to have as many strong partnerships as we do. We have 11 science laboratories that we work with, 90 school partners, including the Clerc Center here on Gallaudet campus, so thank you, of course, to the Clerc Center. We also have 22 partnerships with other universities, which is wonderful because those universities are all over the world, and that means training and opportunities for our students to go globally to study in different labs, to meet and network with different scientists, and to get the most up-to-date training.

VL2 started by asking a set of questions. We wanted to examine knowledge. What happens to humans when knowledge is acquired through the eyes? How does this impact the brain? What happens to the brain's neural plasticity, to its cognitive function? How do children learn language? How do they learn how to read to become literate? How do they become bilingual? And how do they learn important content in school? VL2 is contributing to a revolution. We like to call it The Third Revolution. We all know the linguistics. Linguists have examined the language and understand that sign language is a real language. We all know that deaf people have a unique and distinct culture. We know that well.

Interestingly, the last third point that some continue to resist accepting is that speech and sign language have equal biological status. There are some myths out there regarding this issue. The first myth is that speech is biologically superior. The second myth is that speech exposure should be provided to young children initially, and then if you're going to expose them to sign language, it can happen at some later date. Perhaps if they failed in learning to speak, you can then place them in a signing program. Another myth is that learning sign language will impair the acquisition of English and literacy skills.

VL2 has contributed to busting those myths. All of these assumptions are wrong. They are in fact myths. Sign language and speech are equal to the human brain. The same neural systems, the same neural sites are activated. The second myth, that children acquire sign language and children acquire speech in some different kinds of ways. In fact, that acquisition happens in the same way. There are no differences; it is the same route to the acquisition of language.

And the third myth has to do with exposure to sign language, whether or not it will hurt the acquisition of English. In fact, it helps the acquisition of English. It makes children better language learners, which translates into being literate. So, I've talked about some of the similarities, but interestingly enough, we have also discovered that people who are exposed to sign language from an early age show advantages over their hearing peers. In fact, in some ways, hearing children actually lose the capacity to acquire those benefits seen in deaf children exposed to sign language early.

That has a powerful translational impact in terms of policy. We could be helping hearing children as well as deaf children. And finally and most significantly, we are contributing to a greater understanding of what it means to be human, and that has tremendous policy implications. I'll give you three examples. The first example has to do with young deaf children exposed to sign language at an early age and their strengthened abilities in visual processing. They outstrip their hearing peers. They have better eye-tracking abilities. They have enhanced visual processing abilities. They have stronger selected cognitive benefits, which leads to enhanced vocabulary, better reading skills, better social self-regulation skills compared to hearing children.

Those hearing children could have had those benefits had they been exposed to sign language at those critical years, but they've lost that opportunity. And interestingly enough, children who have been implanted with cochlear implants who focus only on learning speech skills also lose those potential benefits. That early visual exposure is vital. If we use this knowledge that's a gift that we can bring to hearing children as well to enhance their visual processing skills.

There are many myths about bilingualism, and VL2 is contributing to busting those myths. ASL and English is a bilingual situation, just like Spanish and English would be, or French and English. ASL and English is the same, and confer the same benefits of bilingualism, seeing and hearing children learning two different spoken languages. VL2 is contributing to destroying some of these myths.

For example, myth number one: children who receive cochlear implants don't need sign language. They should have only intensive speech training. That is wrong. They absolutely need early exposure to natural visual language that they can access. Many people believe that early bilingual exposure will cause language confusion. It's simply not true. Another myth is that you shouldn't sign with your baby until you are fluent. That is wrong. Children will benefit even if parents are not yet fluent in sign language. A final myth is that children should learn one language first and then be exposed to a second language. That is not true, that is wrong. Bilingual exposure means exposing a child at the same time in those critical early years.

The policy implications are that we can promote early bilingual education for all children in the United States. We can promote early sign language exposure for deaf babies. Regardless of their background, they should have exposure to sign language. And, of course, there can be enhanced speech training at the same time.

Other findings from VL2 are that if you have early exposure to sign language, young children will be able to watch sign language and pull important segments, phonological units, and map them onto letters or words on a page. They do that, mapping and decoding, exactly as hearing children do, who auditorily pull and segment phonological units to map onto the written letters and words. So, young children who have visual sign phonology will show enhanced reading abilities compared with those children who don't.

What's revolutionary about this finding is that it can also be seen as a potential aid to support hearing children who are struggling with reading. Another policy implication is that deaf children who are exposed at an early age to bilingualism and visual phonology of sign language develop into readers. It's not complicated. It's not rocket science. Early exposure to sign language will do it. It will help the brain.

Now, looking towards our future, VL2 will continue to make innovative science discoveries. In VL2, we are integrating new technologies, new kinds of tools to delve even deeper into the brain. We are integrating the fNIRS brain imaging equipment with thermal infrared imaging that will measure a child's engagement, emotional engagement, with the world. And higher cognition as measured by eye-tracking that follows where their attention is.

We are continuing to make innovative translational products as well. For example, in VL2 we are bringing together signing avatars to make new language learning tools for young deaf

babies who are not exposed to sign language otherwise, which they need to have to keep those important pathways open to stimulate their brain tissue during the right times in their development. VL2 and the Motion Light Lab will continue to make revolutionary innovative translational products. You will learn from Melissa Malzkuhn about the groundbreaking work that they are doing on new ways to capture stories in ASL digitally, and how new apps are being created and used. These include stories for young babies. And she is working with her new ML2 science director, Dr. Lorna Quandt. We have a wonderful team working together.

VL2 and the PEN program will continue to make groundbreaking achievements in education and training for young scholars. We will continue to make new opportunities and experiences possible for them, and to help our students enter STEM fields, to become scholars themselves, to own the science, doing science that they own because we are training them to become leaders.

Finally, VL2 is contributing with other researchers in the world to changing minds, to spring that third biological revolution that shows that sign language and speech are equal in the human brain. The human brain does not discriminate. The human brain doesn't care what you give it, whether it's a sign language or spoken language. It accepts both equally. We have found that scientifically there is an equivalence between sign and speech. The human brain is more neurally plastic than previously thought possible. Speech is not in fact special, but human language is special. We know now that for sign language and spoken language timing in development is key. The critical period in human language acquisition is the same for all languages. We also now understand the ultimate ways in which we learn language, when, why and how. Finally, this work has translational impact.

We are challenging decades of medical and educational dogma. We are showing with these human biological findings that fly in the face of what people have believed. And we are offering new solutions to society. Thank you. And now, as I promised, you will learn a little more about our four hubs that are bringing us into the future.

Video available at https://youtu.be/atm3LdIuUA0

BL2: Dr. Clifton Langdon

Hello everyone. As was mentioned, I'm Dr. Clifton Langdon, Assistant Director for the Brain Language and Learning Lab, working with Dr. Petitto there in her role as Science Director for BL2. Our lab was established in 2011 and since its opening has enjoyed burgeoning growth. We have now a lab director, a post-doc research assistant and directors. We also have PhD in Educational Neuroscience, also known as PEN students, now working in the lab that are comprised of both graduate and undergraduate students.

Since 2011, we've had a number of people you see before you on this screen. BL2 poses important questions about human cognition and human learning in three primary areas. We research basic questions about human language acquisition. Through this study, we hope to understand more about human cognition and its role in language acquisition. Language acquisition acts as a foundation for the further questions that we pose about bilingualism. Finally, building upon that foundation, we will explore more about how one learns to read.

For us to research these questions in innovative ways, we have been able to leverage the use of innovative technologies, such as the fNIRS neuroimaging, Functional Near Infrared Spectroscopy, to examine more about brain processes, human emotion and cognitive function. We are using not only the fNIRS system, but this allows us to explore these questions with a number of different populations that we would be unable to explore using other methods. Infants just newborn can use these neuroimaging technologies to simply rest on their heads to give us information about the entire lifespan of a human being from infancy to the time when a person is a senior citizen. We can still be studying these same questions in different contexts as well. The fact that it's a mobile platform allows us to take that research either in the lab or in the field as well.

In addition to that, we're using eye tracking technologies. Eye tracking allows us to understand more about attention and where we allocate attention, using eye tracking to track that attention in particular contexts. We are also able to use this remotely.

In addition to these two innovative technologies, we're also using thermal infrared imaging. These cameras allow us to measure skin temperature. We do so to measure emotional excitement and emotional attention and engagement.

Beyond even these technologies, we're also working in partnership with other labs that have expertise in robotics and avatars. In addition to that, we're partnering with the ML2 lab, which you'll be hearing about moments from now, and leveraging all of these laboratories and their findings to answer our underlying questions.

Language acquisition is an important domain. Babies are born with the challenge of learning and acquiring language in a dynamic world, whether that be spoken or sign language, English or Finnish. What's more, when infants are born, they have no textbook to give them parsed-out segmented units of language.

Nonetheless, this Finnish language that is up on the screen is presented without any spacing between, without any of those cues that allow us to segment it and understand, understand its underlying meaning. Infants, however, are able to detect the smallest phonological units. Think of it as something like a letter unit or something around that scale. There are particular

rhythms and patterns that infants are attuned to. We are using this knowledge to examine how brains learn language, whether it be signed or spoken.

Dr. Petitto's prior research examined how both deaf and hearing children examined the incoming stream of language, whether it be signed or spoken, and what areas of the brain might be involved in that. Her findings showed us that indeed the brain is perceiving phonological units, regardless of whether they be signed or spoken. It is processing those in the same manner in the same systems. That tells us that the brain is not looking for a particular signor a particular kind of speech, but rather some underlying function of language.

This is the means by which babies enter the world and immediately begin to acquire language. We want to investigate that. How are they doing it? One key clue is found in the fact that when one is engaging with infants, there is a syllabic pattern, 1.5 syllables per second, that seems to be the natural point at which infants cue into the pauses in between segments and are able then to parse them out and detect them on the level of the syllable. We're now using our systems, the fNIRS, thermal imaging and eye-tracking systems all in an integrated fashion to answer these questions. Early results tell us that, indeed, infants are primed to detect these units at 1.5 Hz per second. This measure is important in that it tells us at what point these segments are parsed in infants.

There are a number of other areas that pose important questions for us that we're looking into. Bilingualism poses the question of whether two languages ought to be presented to a child simultaneously or rather consecutively, whether one needs to master one before being able to master the other. The scientific findings from our lab show clearly that earlier exposure is far better, because children that have not yet learned to tie their shoes are not going to be overwhelmed as one might think. They mature on a biological timeline. Their brains are adapting from an early age and are ready for it. Whether they be deaf or hearing makes no difference. Children enter the world readily able to acquire a language, given a rich language environment. It makes no difference whether that language comes in a stream of a single language, two, three or four. They can learn the language. Their brain will respond the same way, no matter the type or number of languages. Whether there be a mixture of one signed/one spoken, two spoken/one signed or any other combination, the brain will acquire the languages quite easily. The exposure is what's most important.

With very young children who are acquiring language, we have to then ask how they're acquiring literacy skills, how they are understanding these squiggly lines on a page and deciphering meaning. Well, they have a process of mapping the language that they've learned onto this written system. Our research has shown us — In fact, past research has shown us that phonological processes of breaking sound units into smallest meaning and mapping, those are important for spoken language users to acquire literacy. That's been well known for some time, but we wanted to examine whether that was true only for spoken language users.

In fact, we find that there are visual phonological systems that are at play. Visual language exposure, especially at an early age, provides children with tools to be able to segment the language input and detect the patterns in the language that they've observed and signed and mapped those onto the systems of writing and reading. Our lab's findings tell us, in fact, that these are important, important markers for early childhood language exposure.

Video available at https://youtu.be/J6PHhoFKWWA

EL2: Dr. Thomas Allen

Hello, my name is Dr. Tom Allen. I'm the co-PI with Dr. Petitto of the VL2 Science of Learning Center. I'm also the director for one of the labs here, the Early Education and Literacy Lab like we have up here and there.

I'd like to briefly introduce you to my team pictured on the screen, especially Dr. Donna Morere. She is one of the faculty in the psychology department here at Gallaudet and she's an expert in neurocognitive assessment psychology. Her assessments are very important to the work we do in EL2 and very important to VL2 in general. I would also like to give special thanks to Ralph Fernandez as well. He is our fairly new database manager in the lab. He's responsible for putting a lot of the data into the computers in a good structured way. Then we also wanted to say hello to all of the — he creates our interfaces as well. So he's been working with us at VL2 for a while now. Then also pictured here is our three research scholars.

So what do we do in EL2? We do a lot of things but I'm going to talk about two areas specifically. Our first area, we have done studies on children in the real world. Now you've heard a lot about the Brain Lab and what occurs in the Brain Lab, in the lab, and what's going on in the brain in terms of plasticity. But what's happening in the schools and what's happening in the classrooms? What's happening in the homes?

In our labs we focus on what's going on in the real world, in the EL2 lab. We look at these two different settings and see what the similarities are, and what changes when we put a child in a classroom. The second area we're looking at is developing facts and distributing them for assessment tools. They measure language competency and skills that children develop. They measure reading skills, they measure the cognitive skills that children develop. We've been doing those and we haven't really had very good assessments historically for deaf children at a very young age. So it's an important part of what we do in EL2.

Now these two areas are very closely linked and the reason is because we want to study the children in the schools. We also need to measure things that they're doing, the activities. But if we don't have assessments, we're not able to do that. So before we even did the research, we had to develop the tools. We've been working very hard on developing different assessments at the VL2 center since the beginning of the center 10 years ago. We've made a lot of great progress over the years.

So Area One, studies in the real world, what's happening in the classrooms. We've collected quite a lot of data from the homes, from kids' schools, and we've compiled it. We'll talk about the exact types of data we've collected in a minute. We have a very large mountain of data in EL2 in our database. Ralph, of course, is responsible for that, thanks to him.

We also have EL2 students who are working in EL2 statistical labs. They've come up with some very great statistical models that they use to conduct their work. The models test hypotheses about what we expect to see in the classroom. They can be very complicated statistical models with variables and it can get very dense. So some of those models that we published have been published in a variety of places, books, conferences, talks, and then we disseminate them to the schools as well.

In EL2 we work very closely as well with other hubs in VL2. We often ask what's going on in the Brain Lab and that informs us what we should be looking into in EL2. So the data looks like what? Here's some of the learning outcomes. We use it to measure these learning outcomes, what children are learning in schools. We ask what predictors are predicting learning outcomes. We get a lot of information but what will be the end result of what we find?

We divide the predictors into two parts. One are things we cannot change about a person. We can't change if a person is deaf or if they're hearing. If a person is born chromosomally male, we can't change that. But some things can become predictors for learning outcomes, right? Finally, there are things that we can change and those are the most important things to be looking at. What is it about a kid's life that we can change to increase their learning outcomes?

Our main project over the years has been a longitudinal study in early education. We've been working on that since 2008. So this is the planning, when the planning began originally in 2008. We collected data over a period of three years where we went to schools, collected information, brought it back to the lab. Then we spent the next year going back to the schools, to the same schools, collecting more information and back and forth we went until we had sufficient information. Then we looked at the growth, not only at one point in time, but we were able to evaluate it in patterns over time. What makes children change their behavior over time? So we studied deaf and hard-of-hearing children, and they receive most of the information in the world through their eyes. They were aged 3 to 5 in the first year, and then 4 to 5, 4 to 6, 5 to 7 and so forth. They were all over the country. We collected information from 20 different states. We collected information on 254 schools.

So we found three very important discoveries. I'll run through them real quick. Language is a single underlying trait of human development. You may be wondering what that means. In the longitudinal study, we studied the children's ASL skills. We collected information on their fingerspelling and we collected information on their English competency. So there's three language forms here. We separated them out and then we looked at each of them individually. Then we went into the homes and assessed how they were using them in their home. What we found was that ASL and finger spelling are highly correlative. Kids who master ASL also are typically mastering finger spelling as well. In our database we also found English was also correlated with these skills. Kids proficient in one language or one of these forms was also proficient in the other two.

So when psychologists look at research like this, they just see a big overlay of these three forms of language. They may think, oh these are just three measurements. They may all occur under the same trait. They may put them in one category, language. So we see in the classroom something that, we see language occurring, sign language, English, and they're measuring the same thing about the human brain. So next we saw signing in the home. If there was signing in the child's home, it improved their cognition. Parents would give statements to the child that we gave them as prompts to test the child's cognitive skills to see if they had mastered those skills.

Then we divided the children into three groups. Children who had deaf parents in the home who use sign language, children who were deaf with hearing parents in the home who also use sign language, and then deaf children in homes with hearing parents who didn't use sign

language. Those were the three groups. So one example the topic we gave them was to exceed at least six, list at least six items in a category. It's a very important skill for children to develop. If you're to tell a child name animals to me, they need to be able to name six different animals in that category. Or if you say to a child a bird and a horse and a whale, why are they all the same, they should tell you that those are all animals.

So we divided them into these different kinds of categories. Then we calculated the percentage of the children in each group that were able to master this skill. What we found was that we saw many, many times the highest performing group was the deaf kids with deaf parents. However, deaf children with hearing parents who did also sign also showed big benefits as well from using sign language. So it doesn't necessarily have to be deaf parents signing to their deaf children. Any sign language will help. So the results show that a lot has to do with whether the parents sign, not whether or not they're deaf or hearing. That's what really leads to cognitive advantages.

Finally, in terms of ASL and fingerspelling, it does contribute to reading and literacy. Remember I said we did a longitudinal study where we continuously went back to the schools. We divided the children into different groups in terms of their mastery. So we looked at the rate of change. We put them all on the same graph. Now obviously that's a little complicated, but you see different kids growing different ways. They're not growing in different abilities, some are just growing quickly rather than others, and some are growing more slowly. Because we measured their skills in ASL, what we did was we cut the top 25% and the bottom 25% of the skills. Then we averaged them for the rates to see what the average was. We found that yes, kids who have high ASL competency excel in reading when compared with kids with lower competency in ASL. But at the same time we also found that the rate of change was different. The slope is much steeper, the learning is faster.

The longitudinal study, you see language acquisition is distributed over the development of language for reading cognition. The thing is that language can be taught with the right tools, the right mechanisms, and we have those at VL2. So briefly now I'll talk about ASL assessments, Area Two of our work. Now we've been talking about long history in the work of ASL. We've developed different tools and made them available for readers, teachers, parents. It gives you psychological ways of measuring mastery.

I do want to spend the most time talking about our most recent tool assessment, the Visual Communication and Sign Language Checklist. Now it was published and distributed to a lot of different locations. It's been given to over 4,000 kids nationwide in the U.S. Now this is where communication experts judge the level of mastery that children have accomplished based on different behaviors. Recently we had an e-version published, so it's now available online.

So we'll give you a couple of examples of the mastery of cognitive skills we're measuring. For example, when a kid turns their attention to someone talking, that's a communication skill. Or if you were to ask a kid a two-word question, they should be able to say an answer to it. If you're just saying where should I put this, where's the dog, they should be able to give you a response. Then it reports on what the expectations are for kids to be able to have mastered at a specific age. So I want to show you one example and then I will leave the stage. So this is a skill, understanding conversational turn-taking. This is an important skill for kids to learn because it indicates to them whose turn it is in a conversation. So we'll look at it real

quick. It's available online in the online version, and all of the transcripts have the videos attached to them.

> Adult: Hey do you remember what happened when the police came? What happened yesterday? Something was--
>
> Child: Stole it. The bad guys.
>
> Adult: Right, bad guy came yesterday. That was yesterday, what happened this morning?
>
> Child: It was this morning.
>
> Adult: Yeah, so what happened yesterday?
>
> Child: The door was open. The bad guy came in and took the camera.

Okay so you can see here in the checklist we have an example of different skills. So the assessor can then look at the child, look at the checklist, and see if they've mastered this skill or not. Then you total them up for a very good estimate of the child's level of competence in the language. So that one item we see that deaf children who are native signers acquire that skill at about 2 years, 8 months, based upon the research we have. Each item has an age of development level that we typically expect to see children reach this mastery.

So we've studied the classroom, we've developed these assessments, but you're probably wondering what's the future of VL2. We have a lot more research to do with our lab. We have a lot more assessment work to do. It's good now that many states are involved. Many states are now passing laws that require assessments for communication skills for kids from birth to five. So we're already getting a lot of calls about the VCSL. In fact, it's used I think in a couple of different states already.

So we have a lot of work left to do, and we want to make our work spread to all of the states and all of the communities so that they have a valid assessment for their deaf children at their schools. Thank you very much.

Video available at https://youtu.be/eEhqCoSQ0m8

ML2: Melissa Malzkuhn

I'm very excited to be here and to talk to you about the Motion Light Lab. My name is Melissa Malzkuhn, and I'm the Creative Director of ML2. We're excited about a new member joining us. Welcome Dr. Lorna Quandt, our Science Director and a true genius.

The Motion Light Lab is one of the four hubs here at VL2. We started in 2009, with informal discussions among colleagues. Those creative discussions then blossomed into what we now have, a state-of-the-art lab with a motion capture system and a number of new technologies. Our ongoing mission has been to take digital technology and merge it with creative literature, such as storytelling, to create immersive learning experiences and create new knowledge. That has an impact on youths and creates lifelong learning experiences.

Naturally, I have a fantastic team. We call ourselves Imagineers. We call ourselves that because we design, innovate, and create results with imagination. Innovation is our culture. We all come from different backgrounds: Deaf Studies, arts, science, neuroscience, and many other disciplines. We bring our backgrounds to work collectively. We have great interns too, and you'll see their work today. We train and grow students' skills in our lab.

A lot of amazing things are happening in our lab, and I know my time is short. But today I'm going to address three highlights, which overlap one another. Our work initially focused on young learners, ages 3 to 8. Now we're also including younger children from birth to 3, with the goal of providing a lifelong learning experience.

Our work with apps is groundbreaking because of the ways that we are utilizing technology. We look at how deaf children learn to read. Now, historically, parents and teachers have signed to deaf children while holding a book. And they still do this. Add in DVDs with the books, and you need to alternate between watching the signing and pausing to read the printed text. In this way, children acquire ASL and start to make connections for reading. The key here is learning to read and then reading to learn. Once they read to learn, the world is theirs.

Now with current technology — iPads and touchscreen tablets — we can integrate video and text into a single bilingual interface. This is what is groundbreaking. This design has never been seen before and came about through our innovative work at VL2, so that it can now be revealed for the first time.

We're not stopping with just apps. What we've developed are apps, but we've also developed a template on which to create more apps and build a digital library for the world, so our findings on bilingualism can impact children, worldwide.

Now, the third part is our new Motion Capture system. We received this through a grant, and it has really opened opportunities for language preservation. Historically, we have documented our literature on film. Now, and this is unprecedented, we can capture our literature in three dimensions. As we know, technology is progressing. We have augmented reality, virtual reality, and more 3-D-based platforms. However, right now, you don't find sign language in any of this. We must initiate the design, and we are starting it here. We must create a way for signing in 3-D data, to be represented fluently, which in turn will boost the level of comprehension.

One of Dr. Petitto's questions to us was to think about a hundred years from now. What will that look like? I often think about that overarching question. We are starting here, and of course, we have to start at day one and keep that big end goal in sight. Language preservation is just one element. By adding imagination, we can create different learning tools. For example, imagine if we could have an avatar of Laurent Clerc. What were his experiences? His journey?

Imagine the impact we could have for learning, if immersive interactions were there. Interactivity is crucial, because that's how a child learns best. You can receive information one way, but with interaction, you can ask questions and get answers. Avatars can provide children this interaction. Avatars can be built on behavior and signed dialogue systems. They can play games and have interactive conversation. These create opportunities for learning, and those opportunities are endless.

I'd like to start by talking to you a little bit about our storybook apps. We have five now, and we have two more that will be released soon, thanks to our interns. They are working on a deadline, and I'm looking at you guys. Those hopefully will be released in the next couple of weeks. I'd like to mention that these storybook apps are just amazing. We searched carefully to select only talented deaf storytellers, outstanding ASL models, and pair them with deaf artists to create these stories. You will see distinctive styles in the apps.

We've received significant recognition with this award. Reggio Emilia, in Italy, started the Montessori Philosophy and Education, Guided Learning, which changed how we teach young children. This award was given to us in 2014. We are very proud of this.

Our storybook app design is founded on VL2 research findings on the importance of bilingualism. The information that Dr. Petitto, Dr. Allen, and Dr. Langdon shared, such as the importance of fingerspelling. We've incorporated these research findings into the design of our apps. Here's a video, a short preview. Watch and enjoy.

These apps have three modes: Watch, Read, and Learn. Children watch the entire story in sign. Then they go into Read mode and make connections to the text, and then they can learn vocabulary, all in one place. This is fantastic for hearing parents who are learning how to sign. They can sit with their children and learn together. That's very important.

Next, we are having a global impact. Starting with our very first app, The Baobab, we generated interest. Other countries contacted us. They wanted the same platform so that they could give children in those countries the experience of self-directed reading and learning. To start with, we collaborated with a team in Norway. Now, we are developing a Japanese addition, working with Miyuki. She's here, sitting back there, and I see some of you have been talking with her. She's an outstanding signer, wonderful to work with. So if you are interested in translations, please talk to her.

I'd like to show you something interesting about all of these translations. This is amazing to see. Children in other countries can benefit from this. And it also benefits children right here in the U.S. because they can see and learn sign languages from other countries. The goal, again, is being able to provide language exposure to children. We can have this global impact through our Storybook Creator program.

But we can't stop with just the apps that we've created. We need community participation and involvement to create a digital library. One of my favorite questions that I get when I show children these storybook apps is, “Well, I'm done with this one, I want more. Where's the next one?”

When children are finished reading a book, they often seek more resources. We can go to a library that is full of books in print. We need the same for bilingual sign language resources. With this program, we have created a template. For those of you who are not familiar with coding and programming, you don't need to be. We've set a framework, and you can input your own images and videos and a new script to create your own story. This can be anything. Your favorite folklore that you want to preserve, or your own story. This is a tool for you to use. We are so excited about this.

I mentioned focusing on reading for ages 3 to 5, and on to 8 and beyond. But newborn to age 3 is an important population as well. Those children need to be exposed to language and literacy for their future growth. We are collaborating with Dr. Petitto's lab and others to focus on this group. We're doing an exciting study with the others mentioned, and looking at temporal rhythmic patterns of language.

Dr. Petitto's findings show that the brain is sensitive to specific patterns, which stimulate language learning. We are searching for this algorithm, which we can then use with avatars and other technologies to create that exposure for infants. When deaf newborns are alert and ready to learn, they are receptive to this language input. We're doing this through a number of different avenues, including nursery rhymes. English has a rich literature of nursery rhymes, and we want to see that same thing for American Sign Language too.

Often, people try to translate English nursery rhymes into ASL, which is fun. But the needed rich phonology and linguistic information is lost in translation. We developed original ASL nursery rhymes with parameters, including hand shape, location, and orientation. We use MoCap to further examine the structures and temporal rhythmic patterns.

I'd like to show you this example of how the system works. With Motion Capture, we can capture data in 3-D and study the parameters of sign language through different viewpoints. We actually have a mannequin over there that you can examine in order to see how this works. We use dots, or markers, along limbs and joints. The motion capture cameras intersect on a marker to capture the 3-D coordinates. The more cameras we have, the more consistent our data is. The data we retrieve allows us to study the rhythms through the 3-D coordinates.

In this example, we are signing boat. To see what this looks like in 3-D data, we can select a marker and examine the coordinates and the frequency of the movement. This is how we examine the temporal rhythm patterns. It's truly amazing to see how technology has enabled new perspectives on our signed language. As I mentioned before — oh, and I see you noticing this slide. Remember in the slide previously, I showed you boat as it was represented in three dimensions, and you could follow the rhythm and speed of that sign? Now, I can show you something from a different perspective, the signer’s perspective.

I should also emphasize that our work includes avatars, and it's difficult, and incredibly challenging. The reason is because the avatars that are available, which you often see in

computer games, are easily identified as computerized. They look stiff, and the movements look unnatural. But with MoCap, we can capture the authenticity of movement. If we can improve this fluency, we can provide young learners better quality and accessible language learning materials. We want children to better understand and not be thrown off by jerky movements. We want knowledge and we want learning to happen. We're on a mission to improve this technology, and we will share our breakthroughs with others working in avatar technology to create better systems. We are making progress.

My time is running out, but I'm going to show you a short clip. It's called My Three Animals. One of our goals is to create an avatar that looks this good and then surpass it. This is the first ASL nursery rhyme created through Motion Capture. And this is before we received our own system. For this, we worked with a team in Paris, and they were very skilled and excited to work with us in creating this ASL nursery rhyme. With the knowledge we developed in this process, we can come back here and use our knowledge, experience, signers and culture, and create a revolution.

I want to show you what we did. We commissioned a very famous storyteller, and you might recognize this person through his signing style.

Every day my dog barks, barks, barks.
Every day my cat stares, stares, stares.
Every day my bird sings, sings, sings.
All three of them every day
beg, beg, beg, for what?
For food.

You can see the repetitive patterns in the signing. I've shown this to children, and they are engaged and fascinated with the signs and colors. The vision is to, with virtual humans and avatars, create signing creatures. Right now there are none.

We can start all of this work right here, at Gallaudet University. Here's that same message in 3-D. Hope you can understand. For more information, please come and visit us at our booth. Thank you.

Video available at https://youtu.be/Dn-9bzS-kxk

TL2: Dr. Melissa Herzig

Good evening. You've heard about the three other hubs, BL2, EL2, ML2. Now I'll talk you through the fourth hub, TL2. Our booth is right over there in the corner. There's a lot of information. I will go through my presentation quickly because we're almost out of time, but there's more information at our booth.

The goal of TL2 is to take the incredible findings from all of the VL2 hubs and share that with the public. There are resources, there are assessment tools, there are apps, all of these things that are being created here but cannot stay within our labs or on the campus of Gallaudet. That's where I come in to disseminate all of this wonderful research and incredible products to the community.

I also listen to the community, their concerns and interests, so that we can create research questions that will benefit the community. It's a two-way street. That community includes families, schools, medical professionals and many others such as policy makers. We try to reach out to as many people as possible. We disseminate that information in several different ways. We also have mechanisms in place to ensure that what we're disseminating is appropriate and of high quality, that we're not sending things out without integrity or proper evaluation. We're very careful in that regard. We're also looking at the next generation of future scholars, ensuring that we are creating a pipeline to develop that next generation to go out into the world and create more scientific findings.

Back to the first point: dissemination. That is done in multiple ways. We make resources, tangible products that you can see, touch, share, forward, or receive. We also make use of social media and I travel and present and do outreach, which I'll explain more about. As you've already heard from my colleagues, the findings from the labs here are translated into products that get shared with the nation. You heard about the apps, the Storybook Creator program that I worked closely with Melissa Malzkuhn in sharing how people should use it.

It's not enough to send these resources out into the world. It's my responsibility to guide people and offer resources in how to develop their own stories. I also work with families on how to use these resources and how to incorporate fingerspelling when they're reading aloud with their children, as an example. For the assessment tools, you already heard from Dr. Allen about that and we've also created research briefs. We have 11. Actually the 11th is our newest and it will be released this week, but we have 10 research briefs that are already out there. There are examples at our booth in the corner that you can check out for yourself. They are available in both English and ASL as well as other spoken languages. So if you need them, you can contact me or you can download them yourselves online in a PDF format.

We also have created a parent information package. This was developed three years ago and it came out of asking the community what information they liked, what information they needed more of, and we have tweaked it as a result of that feedback, and it is an iterative process. We turn to the community to ask for their feedback and we take that feedback seriously. The parent information package has a website as well as tangible paper resources. Again there is an example on our booth if you want to check that out later.

There is scientific information that's absolutely key and, again, we don't just deliver that information without delivering information on how parents can make the best decisions for

their children. Meeting successful deaf adults, hearing those stories on the website, meeting parents who have gone through a similar experience, who have raised a deaf child and understanding how they've navigated that journey. Those videos are also available on the website. We also include information about the apps in that parent information package.

Now as concerns social media and community engagement, as I said, I do a lot of that around the country. There are many new exciting developments coming and if you're interested in keeping abreast of what we're developing please follow our Twitter feed and like our page on Facebook. You can sign up at our booth with your email address, and you can subscribe to our newsletter and sign up to be on our listserv.

As I said, I also travel around the country doing outreach, giving presentations at schools, conferences having to do with early intervention, or medical professional gatherings to explain what we're developing here and how it can enhance people's work. You can see on the slide where I've been. So I don't just explain the science and then leave a community. I also talk to the community about what they're doing with the resources they've received. We want to understand that theory to practice translation. That's really my passion and my heart. I want to know how they're using the information in the classroom. What are the best practices? I do consulting work as a result of that as well. There are schools out there that are hoping to become more bilingual, and I'm there as a consultant or as a support for that process, supporting best practices in pedagogy.

Now you heard that in our first five years, we focused on basic science and then TL2 was founded in about year six because some common themes were emerging. At that time NSF, the National Science Foundation, felt strongly that this information had to be disseminated. That led directly to the founding of TL2 and my position to disseminate that information, but the NSF wanted to make sure that there was monitoring in place, that the information that was being shared was accurate and of high quality.

So we set in place two mechanisms, SignWise and the Review Evaluation Committee. We bring in resources like the assessment tools or the apps that have been created and we run them through a quality assurance and evaluation process prior to dissemination. Not only that, after dissemination we ask the community how they have used these products and that helps us improve in an iterative process.

We established SignWise partly because nowadays people can publish themselves, ebooks or other kinds of media. People can create resources themselves and post them to websites. There's just a plethora of information online. That's wonderful because we have fantastic access to technology today like the Storybook Creator program we've heard about. That is something that can be used as a template and people can just create their own stories using the code that is already present in the template. That's enormously beneficial for the community, but who has oversight in making sure that the product is high quality? Are there signing errors or is it a non-fluent signer? Children will ultimately suffer if the models are not of high quality. We want to make sure that what we're sending out is of the highest quality, especially when we're using these tools as language acquisition tools for children.

We take that responsibility very seriously to ensure that we have high-quality products. We have a committee who came together to establish the criteria for assessing these products. Some of those committee members are here. There are representatives from the Clerc Center.

We have representatives from the American Society for Deaf Children. That is a parents organization. We have representatives from the NAD, from the ASL and Deaf Studies Department and the Department of Education at Gallaudet. We came together and discussed what researched-based criteria makes a product good quality, including accuracy in ASL and clarity in fluency. We also established criteria for reliability and credibility of the products. We look into who the developers are, what their authority is for teaching sign language, and if there is a deaf person on the team. For example, if they're teaching baby signs and they say learning baby sign will help improve IQ, that's false advertising. If they don't state that the signs are from sign language or from the language of the deaf community, they will not meet the criteria for credibility. Those are part of the criteria that we're looking at.

Now review and evaluation is also very important. If a product like VCSL, an ASL assessment tool, comes in, we look at people who have expertise in linguistics and psychology and education and bring that expertise to bear on the products. So they can say that this is a good product as is or could use some improvement in specific areas. This is how we make sure that the information that is getting disseminated is of high quality and is accurate.

We also want to make sure that our students are continuing in science, that we are seeding the pipeline for future scholars. We have research assistantships both at the undergraduate and graduate level working in our labs, learning and developing their skills. Like in the Motion Light Lab, learning how to develop those apps which will serve them well in future endeavors to have that technology under their belts. We have assistants working in BL2, helping to analyze the data, and for EL2 as well. In fact all of the hubs have opportunities for assistantships, and we have a postdoc fellow from Italy, Barbara Manini, who is helping our students as well. We also have the PEN Program, the PhD in Educational Neuroscience program, encouraging students to study brain and cognitive neuroscience. Our students ask questions related to cognitive neuroscience and how it relates to learning. These students have the responsibility to look at the findings and think about how to translate them and communicate them to society.

That is the goal of TL2, to impact society based on those research findings. We need to share our research.

Video available at https://youtu.be/q63DBzkOlvI

Ph.D. in Educational Neuroscience: Geo Kartheiser and Adam Stone

Geo: Hello everybody. My name is Geo Kartheiser. I'm a third-year PhD student. Actually, now I'm technically a fourth-year PhD student in Educational Neuroscience, which we call the PEN program under Doctor Professor Petitto. She's my primary adviser.

Adam: Hello. I'm Adam Stone, and like him, I'm also entering my fourth year now in the PhD in Educational Neuroscience program and Dr. Petitto is also my advisor.

Geo: Three years ago, Gallaudet made history. They established the PEN program, and now three years later in the blink of an eye here we are today. The family has grown. We have the steering committee listed up here. Then we have three faculty, new faculty, and each of them have their own lab. Beneath that, you can see we have four PhD students; two fourth-year, one third-year, and then one new second-year. Our family has grown quite fast, and it gets stronger by the day.

Adam: Many people may be at a loss to know what exactly educational neuroscience is. There are three important principals guiding this area of study. We are looking at the science of learning, human learning throughout life from the cradle to the grave, right? Educational Neuroscience hones in on that early period of life and up to about infancy to age 15 and is looking at how language is acquired when a child enters the world and has to learn language and learn to read. How are these tasks accomplished? How are they learning all of the domains of science and math and all of these kinds of cognition?

Geo: PEN also is committed to a two-way communication and growth. What we mean by that is that the community supports us. They come to us, they participate in our science, they help us collect data, we analyze it, we publish it then and then we give it back to the community. They judge the value that we offer to them. We make an immediate application to their daily lives through our research.

Adam: We're fortunate in that Gallaudet gives us a unique lens into visual language, hence the Visual Language and Visual Learning Center being here, but we have to ask questions about what is happening in the brain, what is optimal for learning and gives us a much better picture of how we interact in our lives and go about our lives day-to-day.

Geo: Over the course of the three years, the PEN students have accomplished quite a lot of accolades. We've listed a few up here on the screen.

Adam: First of all, the National Institute of Health awarded us an F31 award of fellowship there which is very difficult to get, incredibly competitive. As a first in Gallaudet history, Geo, in his work, was awarded the F31. I've submitted mine with revisions and so far has been very high-scoring, and we're very hopeful.

Geo: We've submitted several papers for publication for peer review in journals, and we also have a few manuscripts that are in revision right now to be sent soon.

Adam: In addition to that, we have attended a number of educational conferences, neuroscience conferences and have been able to partake in this at a national and international level.

Geo: We, the PEN students, get a lot of sophisticated training here. It's not for the intention of staying, but in fact to go to other places; to go to Hong Kong, to go to universities. For example, Yale or UCSD where they do neuroimaging as well. Eventually the goal is to get further training.

Adam: In the three years since the PEN program was established, we've drawn the eye of the world and in fact been emulated by people looking to model their own programs after Gallaudet's. Gallaudet's program is the first of its kind in the world and is indeed a model that is highly sought after the world over.

Geo: Our program has continued to grow, and we're thrilled to tell you that we've accepted three new students this fall and we will continue to draw in the top-tier students from all over the nation and from different universities all over the US. We provide both undergraduate and graduate training in very sophisticated neuroimaging science. We look forward to the next generation that will bring here to Gallaudet.

Video available at https://youtu.be/WxVSAVbjfJs

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