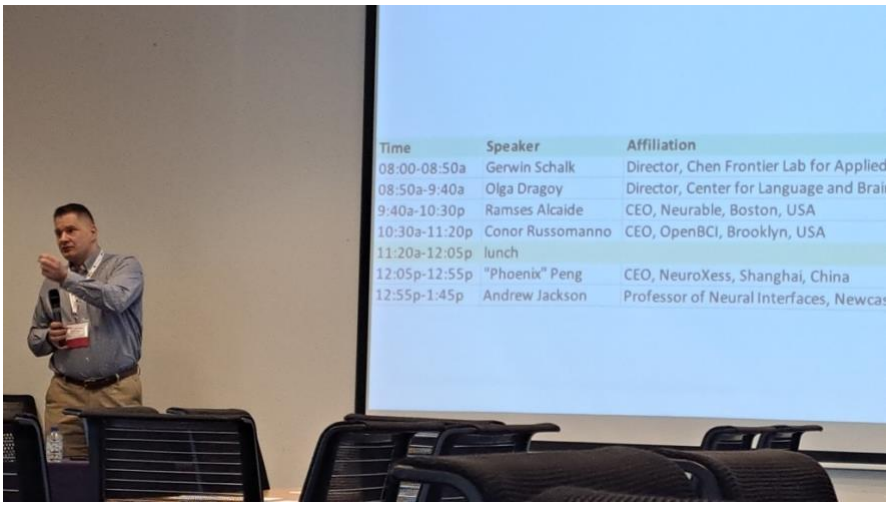
Satellite Event Summary

"SE1: Neurotechnologies for Mass Populations"
June 6, 2023
8:00 AM – 1:45 PM

Part of the 10th International BCI Meeting 2023
Dolce La Hulpe Hotel and Conference Center
Sonian Forest, Belgium

Overview

The Satellite Event (SE1) was held in the Cocobolo room in the Dolce La Hulpe Hotel and Conference Center in the Sonian Forest in Belgium. SE1 drew heavily on a workshop in Shanghai in September 2022 and a paper led by Prof. Schalk (Schalk et al., in review). SE1 featured six speakers who represented groups from China, the US, UK, and Russia. These groups included three from the commercial sector, two academic entities, and the Tianqiao and Chrissy Chen Institute (TCCI). Each speaker had 50 minutes for the talk plus discussion. The image below shows the schedule, speakers, and affiliations.



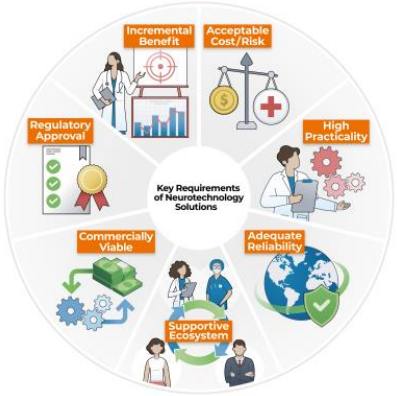
Gerwin Schalk

Biography:

Prof. Gerwin Schalk obtained his M.S. in Electrical Engineering and Computer Science from Graz University of Technology in Austria, his M.S. in Information Technology from Rensselaer Polytechnic Institute (RPI) in Troy, New York, and his Ph.D. in Computer and Systems Engineering from RPI. He is interested in integrating scientific, engineering, and clinical concepts to advance our understanding of the brain and to use this new understanding to develop novel neurotechnologies that improve people's lives.

He authored or co-authored >130 peer-reviewed publications, one book and 17 chapters, has >24000 total citations and an H factor of 64, and has given more than 230 invited lectures world-wide. His work has been extensively showcased by the media including features on CNN, NBC, CBS, Science Channel, and articles in New York Times Magazine, Discover Magazine, Forbes, Technology Review, and Wired. He is also listed in Who's Who in the World and Who's Who in America and received several awards for his work.

Talk summary:



Prof. Schalk presented material from his upcoming paper (Schalk et al., in review) that explores barriers to translation of neurotechnologies. Like this paper, Schalk began by noting that clinical therapies based on neurotechnologies are much less prominent than neurotechnological insights and demonstrations. Schalk then reviewed key requirements for successful commercialization of neurotechnologies such as incremental benefit, a supportive ecosystem, and regulatory approval. He noted that DBS is often viewed as an example of a successful neurotechnology even though only about 3% of patients with Parkinson's Disease use DBS. The Freehand Neuroprosthesis is another neurotechnology that can provide considerable benefits to users. However, this device was not commercially viable even though it has been successfully implanted in hundreds of patients. Schalk presented slides about barriers to translation of neurotechnologies involving the Anna Karenina Principle, the chicken and egg problem of invasive neurotechnologies, challenges, and requirements.

Schalk explained that brain imaging methods are poor at providing accurate information quickly. Instead, they can provide inaccurate information quickly or accurate information slowly. Thus, communication and control applications that rely on rapidly obtaining accurate information will probably fail. Schalk sees more opportunity in diagnostic and monitoring applications that don't require rapid signaling.

Prof. Schalk then switched to introducing the Smart EEG system developed by TCCI. This 2-channel system could be used to collect other electrophysiological signals but has been primarily explored with EEG. He presented some technical details, followed by results he obtained from using this system to record his own sleep. Schalk showed how snoring, movement, EEG, and other signals indicated periods of reduced breathing due to obstructive sleep apnea.

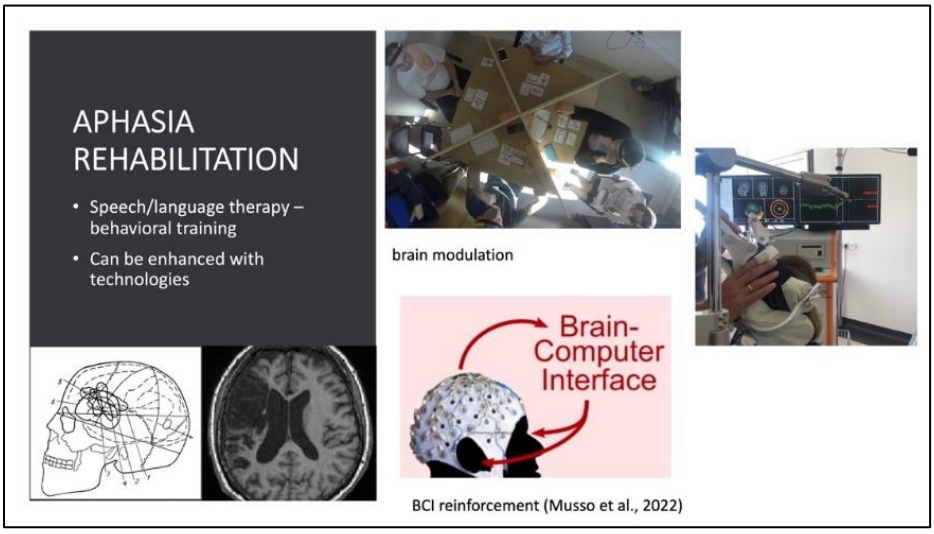
Olga Dragoy

Biography:

Dr. Dragoy is a neurolinguist and a clinical linguist. She earned her PhD in Linguistics in 2007 at Lomonosov Moscow State University (Russia). To adjust her academic trajectory, in 2008 she also got a joint degree of the Universities of Potsdam, Groningen and Milan-Bicocca - in clinical linguistics. After a few postdoctoral training programs at the University of Groningen (the Netherlands) and the VA Center for Aphasia and Related Disorders (CA, US), since 2013, she is the Director of the Center for Language and Brain, HSE University (Moscow, Russia). In 2020, she defended a Doctor of Sciences (Dr. habil.) dissertation “Aspects of time: tense and aspect processing across typical and atypical language speakers”. Dr. Dragoy’s work focuses on poststroke aphasia, developmental language disorders, language mapping during awake neurosurgeries, and neuroimaging of language. She is an Associate Editor of *Cortex*.

Talk summary:

Dr. Dragoy gave a talk titled "(Neuro)technologies in Aphasia Rehabilitation”. Aphasia (language impairment) is common after stroke, brain trauma and other neurogenic causes. It affects all modes of communication: speaking, comprehension, reading and writing. With 180,000 (US) and 300,000 (EU) new aphasia cases each year, aphasia rehabilitation attracts precious scientific and clinical resources. Dr. Dragoy first introduced general principles of speech and language therapy, with a disappointing conclusion that, while conventional interventions improve language outcomes, the effect size is small. Technology-based approaches provide attractive opportunities to enhance the efficiency of aphasia treatment. Dr. Dragoy provided some examples of available solutions, discussed why they cannot be translated into clinical routine now, and what is needed prior to this clinical translation.



Andrew Jackson

Biography:

Andrew Jackson obtained his PhD from University College London (2002). After post-doctoral research at the University of Washington, he established his laboratory at Newcastle University in 2006 where he is now Professor of Neural Interfaces. He has a longstanding interest in the neuroscientific principles that can be leveraged by bidirectional interfaces between the brain and technology. His lab explores closed-loop neural interfaces to manipulate connectivity, dynamics, and plasticity in the nervous system, such as artificial brain-spine connections to restore voluntary movement and closed-loop optogenetic stimulation to suppress epileptic seizures. Most recently, he applied closed-loop principles to real-time synthesis of brain-controlled music, developing a new approach to non-invasive neuromodulation. Together with UK colleagues, he established the Closed-loop Neural Interface Technologies (closeNIT) Network (https://research.ncl.ac.uk/close-nit/) to help foster collaboration in these areas.

Talk summary:

Dr. Jackson spoke about his newer work involving "brain responsive music." He explained that he had been interested in both neurotechnology and music for a long time and that music appeals to mass populations.

Music, he said, is very powerful and ancient. He argued that music predates people and is our oldest non-invasive brain stimulation technology. Music can motivate people to love, war, and more. 90% of the world uses music to influence their brains for 18 hours per week on average. Furthermore, human ears are very sensitive to music. Musicians can notice a 10 millisecond delay from playing a note to an auditory output, and most people notice when only a few samples of audio data are missing.

Conventional music is open-loop brain stimulation, and Dr. Jackson wanted to extend his experience with closed-loop stimulation to BCIs and music. He showed how people have presented white noise or clicks that are synchronized with brain oscillations, and he believes that synchronizing music with brain activity is a promising frontier. He's working on Neudio, which is a type of "personalized listening experience." However, he also warned against focusing too heavily on technical details. He felt that developers of consumer applications for BCIs should remember two points. First, BCIs are developed by engineers and scientists. Second, such people like robots and computers – and aren't necessarily good with music. He concluded by asking how we can use some technologies to enhance people during work, and then "de-enhance" them while relaxing to help people "live the good life."

Ramses Alcaide

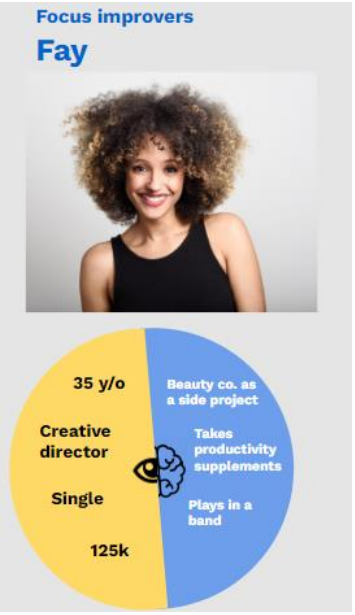
Biography:

Dr. Ramses Alcaide is an entrepreneur, neuroscientist, and inventor. He is currently the CEO and founder of Neurable, a leading non-invasive neural interface company that has raised over $20 million from world-class investors. A Forbes' Next 1000 recipient and holder of multiple academic distinctions (NSF, McNair, and Ford fellowships), Alcaide has been working at the forefront of neurotechnology for over a decade, specializing on brain-computer interfaces (BCI) for practical applications and longevity research.

Talk summary:

Neurable is a spinoff of the Direct Brain Interface (DBI) lab in the university of Michigan, which is led by one of the most well-known BCI experts, Prof. Jane Huggins. This background was obvious in his talk; he had a strong emphasis on user surveys and incorporating users' needs, abilities, and desires into their BCI tools. Dr. Alcaide commented that painkillers are more appealing than vitamins –a metaphor for how user needs/desires will motivate BCI sales. He stated there was "huge opportunity" with BCIs for broader user groups. As BCI platforms become more common, new ways to apply and extend them will emerge. He noted that the Apple watch was originally designed to track HR and movement but is becoming a broader medical platform. Similarly, BCIs will become much more ubiquitous and flexible. He presented the well-known Gartner hype cycle graph and stated that there will be a crash when people realize that BCI companies often hype but do not deliver.

Dr. Alcaide then presented his considerable work with interviews, screeners/surveys and analyses, presenting responses from over 1000 people. They asked why BCIs don't scale and identified four main reasons: function, cost, societal fit, comfort, and user experience. They identified four high-priority considerations: low cost, high performance, everyday look and feel, and valuable use cases that are better than existing solutions. He presented use cases that he discussed with the audience, which were meditation, sleep, hacking, and focus. He showed how different target personas' goals, backgrounds, and preferences could strongly influence the BCIs that appeal to them, such as the example of "Fay" shown in the image to the right.



Dr. Alcaide said that the approach that he described in a recent paper could identify when people will need a break well before they actually need one. As the talk neared its conclusion, he donned a headset that they developed and showed how it tracked his focus and relaxation. He then passed the headset around the audience.

His talk included a great quote about the limitations of user surveys. "If I had asked people what they wanted, they would have said faster horses." – Henry Ford.

Phoenix Peng

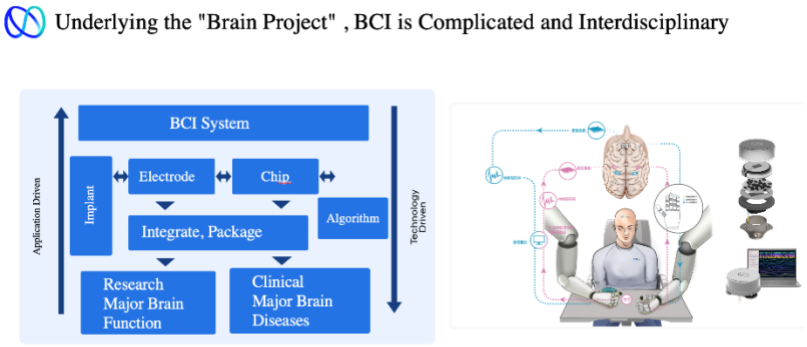
Biography:

Mr. Phoenix Peng is a successful serial entrepreneur driven by curiosity, with ventures spanning across Local Services, SaaS, Data mining, CRM, SNS, and other various enterprise applications. He is founder and CEO of Keruyun, which was acquired by Alibaba Group for nearly 1 billion CNY in 2019. In 2021, Mr. Peng co-founded NeuroXess and he has been its CEO until now. NeuroXess is a high-tech life science company focusing on flexible electrode BCI (Brain-computer interface) technologies to protect and explore the brain. The company has raised nearly 40 million US dollars in Angel and A round since its establishment less than 1.5 years ago. The two rounds of fund-raising are among the biggest early investments ever received for Brain-Computer Interface companies in China. Mr. Peng holds a M.S. degree from Hong Kong Polytechnic University and a B.S. degree from University of Science and Technology of China.

Talk summary:

Mr. Peng began by explaining developments underlying his interest in BCIs. China started a “brain project” 8 years ago. The China brain project involves 52B RMB over 10 years through the Chinese academy of sciences. Mr. Peng agrees with the implication that bedrocks this commitment: he, like the Chinese government, expects strong growth in BCI in China. Thanks to his background with the Internet, Mr. Peng believes BCI will be a new round of interaction. He said that NeurXess is his 5th startup and his favorite company. Mr. Peng sees the most promise in meditation and cognitive training, which are the main foci of NeurXess. Specifically, they support mindfulness meditation training and real-time multiplayer online interaction with medical rehabilitation and digital therapy as future use cases. They are most interested in digital therapy for Alzheimer’s Disease (AD), Autism Spectrum Disorder (ASD), and Attention Deficit Hyperactivity Disorder (ADHD).

He also presented some of their achievements so far. They have a brain bank with a massive amount of data and a minimally invasive silk-wrap implementation. The silk covering on the electrode makes it easier to implant. They want to develop an electrode implantation system that does not use needles. He explained that only one person in China has been implanted with a Blackrock system, so they see considerable opportunity in invasive systems. NeurXess also has the NeuroXPace BCI Project, which is a non-invasive BCI. This NeuroXPace system is compatible with Pico and Oculus and is easy to don and doff. They plan on launching in China first and will then pursue other regions.



BCI (Brain Computer Interface) creates a channel that connects the brain with external devices such as computers. Through this channel, users can express their thoughts or control their devices directly using their mind without language or movements

Conor Russomanno

Biography:

Conor Russomanno is the founder and CEO of OpenBCI, a company working to build ethical brain-computer interfaces. He became fascinated with the relationship between the human brain and mind after suffering concussions playing college football and rugby. While pursuing an MFA in Design & Technology at Parsons School of Design, he spent two years creating DIY brain-sensing headsets and neuro-interactive games, animations, and stories. In 2013, he began work on what would later become OpenBCI, which has since designed and distributed more than 40,000 tools for neuroscience to more than 100 countries around the world. One of Russomanno's leading innovations is the award-winning Galea headset, a hardware and software platform that merges next-generation biometrics with mixed reality.

Russomanno's work has been featured in media outlets such as Bloomberg, Scientific American and Wired. He was recognized in the Forbes "30 Under 30" in 2018 and has served as an adjunct professor and research affiliate at Parsons, NYU and MIT. At the 2023 TED conference, he presented a talk on OpenBCI and Assistive Neurotechnology.

Talk summary:

His PhD thesis (2013) was titled Designing Practical BCIs. Dr. Russomanno said that some of his work emerged from another terminal degree he earned, which is an MFA in design. He said that wearability and functionality are inversely proportional. Hardware drives software and vice versa. His Galea system was meant as a tool and not a device.

He explained how he decided on which BCI to build. He has a friend with Spinal Muscle Atrophy (SMA). Conor showed his friend some examples of possible applications with a BCI and his friend wanted to fly a drone. He demonstrated this drone BCI during a TED talk.

Dr. Russomanno argued that there will not be “one headset to rule them all.” Many companies have tried and they all failed. The headset you use while walking on the street will differ from the one you use at work. Implanted and wearable devices will be used in tandem. It’s not an either/or issue. He also argued that AI alone is not the answer. He also felt that BCIs will become less obvious than they are today. Our relationship with computers used to be much more overt. Now, technology is manipulating our consciousness in many subtle ways.

He disagrees with Dr. Alcaide’s statement that painkillers are more appealing than vitamins. In the long term, we need vitamins to improve health rather than aspirin to kill pain. How do we get rid of painkillers with BCIs?

About the Author

Dr. Allison has been active in EEG research for over 20 years, most of which involved brain-computer interface (BCI) systems. He earned his PhD in Cognitive Science in 2003 at UC San Diego, where he focused on BCIs based on visual attention (primarily P300) and imagined movement. He has since worked with several top researchers and institutes, including Prof. Wolpaw at the New York State Dept of Health, Prof. Polich at The Scripps Research Institute, and Profs. Pfurtscheller and Neuper at Graz University of Technology. He returned to his alma mater and is again with the Cognitive Science Dept. at UCSD. He is a Founding Board Member of the BCI Society and editor of the BCI Journal.

Dr. Allison's recent work involves extending BCI technology to help new groups. This includes persons seeking motor rehabilitation after a stroke and persons with disorders of consciousness (DOC). Dr. Allison is very, very well aware of the prevalent belief that BCIs for mainstream users are the wave of the future, and has led many symposia about the topic, and talked to very many businesses with similar dreams and (today) nothing.

Dr. Brendan Allison holds a Ph.D at UC San Diego. He wrote this meeting report as part of the Tianqiao and Chrissy Chen Institute Science Writers Fellowship which aims to extend the conversation beyond the meeting with the hopes of sparking new ideas and collaborations.