Complexity Community Sharing Session

15 Nov (Wed) 11.00am – 1.00pm
Seminar Room 102
Blk 1 Innovation Centre, Level 1 (opposite The Hive), NTU
16 Nanyang Drive, Singapore 637722

Using single particles of light to tap into the power quantum mechanics offers in complexity science

Dr. Nora Tischler

Technologies that exploit quantum mechanical effects promise to enhance tasks in several different areas. A celebrated example is the speed-up that is possible for factoring numbers. In 2012, a new task was found for which quantum information science provides an advantage: the simulation of stochastic, i.e. partially random, processes.

Stochastic process models are used to describe a wide range of natural and social phenomena, including for example the weather and the stock market. The simulation of such processes provides valuable information about the dynamics of complex systems. However, for highly complex processes, a large amount of information about the system's past needs to be stored in order to simulate its future - a quantity formally measured by its statistical complexity. This translates to a large memory requirement, which may limit the feasibility of such a simulation. It is here that quantum mechanics promises an advantage. Simulators based on quantum information processing can outperform classical simulators by reducing the memory requirement below the ultimate classical limits.

In this talk, I will provide a general introduction to this relatively new area of research, and give an overview of the work that our experimental group has done in collaboration with the group of Mile Gu. Our simulators, which use single particles of light, provide the first experimental demonstrations of the memory advantage offered by quantum resources.

Nora Tischler *turned to quantum physics research after her undergraduate studies in mathematics and physics. She obtained a PhD jointly at the University of Vienna, Austria, and Macquarie University, Australia, under the supervision of Anton Zeilinger and Gabriel Molina-Terriza. She currently holds a postdoctoral research fellowship at Griffith University in Australia, where she works in experimental quantum optics and quantum information science under Geoff Pryde. Her work focuses on the creation of non-classical states of light, and the use of such states for quantum-enhanced tasks, such as in complexity science. Nora's other research interests include nano-optics and metaknowledge.*

On the Complexities of the Least-known Component of the Cinderella Skill

Asst. Prof Vahid Aryadoust

Despite its significance in different aspects of our life, listening comprehension continues to be the least-researched language ability, thus the famous nickname "the Cinderella skill". The available listening research has identified two main cognitive mechanisms which are implemented during the processing of verbal messages. One is bottom-up processing where smaller units are decoded and merged into larger units and the other one is top-down which helps to bridge the gaps between idea units and propositions through applying world knowledge and experiences. The outcome of this process is a mental representation of the verbal message which is called the situation model. An important component of situation models is mental imagery whose generation, features, and dimensions are, nevertheless, not well-known. Specifically, there has been a dearth of research on how mental imageries form during listening; what attributes differentiate them across listeners; and whether their generation helps listeners to listen better.

The current study elaborates on the properties of mental imagery in listening. Based on an extensive literature search, a measurement instrument was developed to quantify various dimensions of mental imagery and group listeners based on the properties of their mental imagery. 40 listeners were interviewed about the mental imageries generated in their mind after listening to several medium-length listening texts. The participants were interviewed by two experts about the various aspects of their mental imageries. Using Adobe Photoshop®, the experts employed the forensic arts technique to illustrate approximate representations of the mental imageries with the aid of the participants. This resulted in the formation of more than 300 illustrated mental imageries, which were subsequently analyzed by two experts independently, using the aforementioned measurement instrument. Next, a quantitative clustering technique was used to group the illustrated mental imageries based on their quantified properties. The study further found that, in (high-stakes) listening assessments, the concept of listening and its underlying structure are narrowly defined. Further findings and implications are discussed.

Vahid Aryadoust is Assistant Professor of language assessment literacy at the National Institute of Education. His research focuses on neurocognitive mechanisms of comprehension and quantitative modeling of assessment performances. He has published his research in, for example, Language Assessment Quarterly, Language Testing, Assessing Writing, Educational Psychology, Computer Assisted Language Learning, etc. His latest book is a two-volume edited book on quantitative data analysis techniques for language assessment to be published by Routledge.

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