Students explore the use of AI to treat speech disfluency

February 27 2024, by Selah Katona

Assistant Professor Michael Guerzhoy, top left, meets virtually with a team of undergraduate students who are developing a reinforcement learning-based system to help clinicians predict medication outcomes and adjust dosage accordingly. Credit: Michael Guerzhoy

Artificial intelligence, including machine learning systems, could help

mental health clinicians optimize treatments for speech disfluency, or interruptions in the regular flow of speech.

Michael Guerzhoy, an assistant professor, teaching stream, in the division of engineering science and the department of mechanical and industrial engineering in the University of Toronto's Faculty of Applied Science & Engineering, and a team of undergraduate students are developing a "reinforcement-learning-based" system that uses machine-learning algorithms to help clinicians predict medication outcomes and adjust dosage accordingly.

By contrast, many clinicians currently adjust medications based on expensive and sparse observations, making it difficult to identify if a specific drug is working optimally. That's because patients respond to medication differently and its effects can be subtle or only visible over a long period of time. The effects can also be difficult to distinguish from other factors affecting patient behaviors.

Guerzhoy says complex symptoms like speech disfluency—characterized by chronic and repeated problems with continuous speech—can be particularly challenging to treat.

"Studies show that there is a correlation between mental health conditions like anxiety and depression and speech disfluency," he says. "I believe that patient care can be substantially improved in situations where low-cost frequent observations are possible through making use of reinforcement learning systems to help prescribe and adjust medications."

The team outlined their research in a recent paper presented at the Machine Learning for Cognitive and Mental Health Workshop at the Conference of the Association for the Advancement of Artificial Intelligence held Feb. 20–27 in Vancouver, Canada. It is currently

available on the *arXiv* preprint server.

The first component of the system features a module that detects and evaluates speech disfluency on a large data set. The second is a reinforcement learning algorithm that automatically sources and recommends medication combinations. To support the two modules, the team built a plausible patient-simulation system.

Guerzhoy compared this system to the idea of a computer playing chess. "We all know that computers are excellent at playing chess," he says. "Our hope is that these computer-based reinforcement learning models will help clinicians become sort of chess grandmasters in their field."

By exploring the potential of automating and fine-tuning medication regimes for patients, the team hopes to provide a pathway to improve the way we treat mental health. Harnessing AI to pick up on small changes in behavior in more frequent increments would give clinicians another tool in their toolkit, says Guerzhoy, especially since the high cost of sessions is a significant factor in a patient's treatment.

Guerzhoy emphasized the crucial role played by the team of undergraduate students, which included: Michael Akzam, Micol Altomare, Lauren Altomare, Nimit Amikumar Bhanshali, Kaison Cheung, Jiacheng Chen, Andreas Constas, Pavlos Constas, Vhea He, Aditya Khan, Asad Khan, Heraa Murqi, Matthew Honorio Oliveira, Youssef Rachad, Vikram Rawal and Najma Sultani—all undergraduate students at U of T—and Carrie Chen from Cornell University.

"Having such a large team of undergraduate students involved that are passionate about the research was essential."

More information: Pavlos Constas et al, Toward a Reinforcement-Learning-Based System for Adjusting Medication to Minimize Speech

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