# Neuroscience Seminars at York University

## CIAN Seminars: Dr. Sabine Muzellec

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Written by Valentina Dodaro

The beginning of February marks a new month of the exploration and discussion of breakthrough research in the world of vision science. Dr. Sabine Muzellec received her PhD in Computer Science from the University of Toulouse, France (in collaboration with Brown University, USA). Her doctoral research is focused on the development of brain-inspired computer vision models that incorporate circuit-level oscillatory dynamics. Her more current research is focused on the development of biologically grounded models of visual processing in both neurotypical and neurodivergent populations.

Dr. Sabine Muzellec. Photo Credit: Noah Carson

Systems neuroscience is a subdiscipline of neuroscience involving the study of neural circuits and networks. It is these neural circuits and networks that are responsible for the complex behaviours, cognitive functions and perceptions our brains produce. Systems neuroscience relies heavily on large-scale computational models to understand how neurons give rise to behaviour.

These computational models, artificial neural networks (ANN), are used and intended to predict brain function, but how do we know if these models accurately behave like the brain? ANNs are currently evaluated based on forward predictivity, a measure of how accurately features of ANNs can predict neural activity. This method is one-directional. Dr. Muzellec addresses this gap by introducing reverse predictivity. A system quantifying how well neural population activity predicts individual ANNunits.

This bidirectional framework was applied to the inferior temporal cortex of a macaque monkey and revealed representational mismatches that forward predictivity alone failed to detect. In addition to this discovery Dr. Muzellec uncovered that factors that improve forward predictivity such as optimising single-task performance and increasing model capacity reduced reverse predictivity. Avoiding this decline in overall performance and improving bidirectional predictability can be achieved by training ANNs with multiple, behaviorally meaningful tasks. Dr. Muzellec's discussion and results indicate bidirectional evaluation is advantageous and necessary during the assessment and development of brain-like ANN models. The inclusion of reverse predictivity to create bidirectional evaluation can guide the design of more biologically grounded models, ensuring a more accurate and comprehensive alignment between artificial models and real brain function

**References**

Muzellec, Sabine. (2026, February 6). *Can the Brain Predict the Model of the Brain? Rethinking Brain–Model Alignment*. CIAN, York University. https://www.yorku.ca/cvr/all-events/