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Mathematical tools improve theory and prediction in psychiatry

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Recent years have seen an explosion in the use of mathematical models to integrate insights emerging from studies of the brain and behavior. This approach has been used to develop new theoretical perspectives that can enrich data analysis, which researchers hope will help explain mechanisms behind complex psychiatric diseases and improve treatment for patients. *Biological Psychiatry* presents a special issue titled "Computational Psychiatry" dedicated to these exciting advancements.

The issue was organized by guest editors Dr. Tiago Maia of University of Lisbon, Dr. Michael Frank of Brown University, and Dr. Quentin Huys of University of Zurich and ETH Zurich.

"The state-of-the-art in research in psychiatry consists of a bewildering variety of approaches and findings that, unfortunately, often do not coalesce into a coherent whole," said Dr. Maia. But advancements in mathematical theory-based approaches are now making it possible to provide a more unified explanation with the power to predict phenomena. "This approach has been a cornerstone of monumental achievements in theoretical physics that have had tremendous practical impact," said Dr. Maia. But developing this type of theoretical understanding is not something the psychiatry field has emphasized. "I see theory-based computational psychiatry as a long-overdue effort to finally bring to psychiatry the same rigorous mathematical tools that have so successfully shaped fields such as physics—enriched now with the capacity for computational simulations, which vastly expand the range of problems that can be addressed mathematically."

According to Dr. Huys, although the clinical utility of mathematical models in mental health remains to be proven, great excitement around computational psychiatry reflects the belief in its potential. Particularly because "computational techniques are ideally suited to understand and integrate how phenomena from the subcellular to the society lead to mental illness." In addition, the techniques provide a way to deal with the increasing amounts of data and the complexity of psychiatric illnesses.

"What I find really exciting about this special issue is that it demonstrates that this approach is already starting to bear fruit in terms of improved understanding in psychiatry," said Dr. Maia. This is demonstrated in the studies reviewed in the special issue, which use computational models to examine brain processes, such as learning, emotion, dopamine signaling and information processing, and how processes interact in deficits underlying psychiatric disease. The special issue also addresses the potential of mathematical frameworks for diagnosis and treatment.

"The studies included in this issue of *Biological Psychiatry* showcase the utility of this formal approach and that it can enrich understanding and guide principled questions in need of further investigation, spanning a range of issues of central importance," said Dr. Frank.

More information: The special issue is "Computational Psychiatry," Biological Psychiatry, volume 82, issue 6 (September 2017), www.sobp.org/journal

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