Grasemann et al. BMC Neuroscience 2010, 11(Suppl 1):P99
http://www.biomedcentral.com/1471-2202/11/S1/P99

BMC Neuroscience

POSTER PRESENTATION Open Access

Evaluating computational models of language disturbance in schizophrenia

Uli Grasemann[1*], Ralph E Hoffman[2], Ralitza Gueorguieva[2], Donald Quinlan[2], Douglas Lane[3], Risto Miikkulainen[1]

From Nineteenth Annual Computational Neuroscience Meeting: CNS*2010
San Antonio, TX, USA. 24-30 July 2010

Abnormal brain processes that underlie schizophrenia are incompletely understood, and no current laboratory or imaging technique can reliably identify individuals with schizophrenia. Instead, diagnosis of this disorder relies on symptoms observed in clinical interviews using conversational language. The symptoms of schizophrenia are complex and span a wide range of altered behavior and perception, including delusions (fixed false beliefs) and derailment (fluent speech that fails to follow a coherent discourse plan).

Establishing the brain processes underlying the symptoms of schizophrenia would greatly advance our understanding of this disorder. Yet after almost a century of clinical research, they remain incompletely understood. Only recently, theories have begun to emerge that have the potential to explain how abnormalities at the brain level might lead to the emergence of symptoms. One recent theory that has been widely endorsed in the psychiatric literature, put forth by Kapur [1], is based on the view that dopamine (DA) mediates the significance, or salience, of subjective experience. Kapur proposes that in schizophrenia, an overabundance of midbrain DA activity leads to a pathological enhancement of salience, which in turn causes psychotic symptoms. Delusions, for example, are explained as secondary reactions to an altered experience of the world — i.e. as an attempt by the brain to make sense of the excessive significance assigned to insignificant events.

The theory that some symptoms of schizophrenia are caused by excessive salience forms the theoretical basis of the present computational study. Using DISCERN [2], a neural network-based model of human story understanding and recall, excessive salience (and thus excessive DA release) was simulated using artificially high network learning rates. This "hyperlearning" hypothesis converges with other recent evidence linking abnormal response to prediction error to psychosis and delusions [3,4]. See [5] for a detailed description of both DISCERN and the hyperlearning simulation.

The language disturbances caused by the hyperlearning simulation were compared to those caused by other simulated pathologies designed to model alternative hypotheses on the causes of schizophrenia, including loss of connectivity, working memory distortion, and overactivation of semantic memory, among others. The different simulated pathologies were evaluated quantitatively with respect to their ability to match patient data from a parallel clinical study of story recall in patients with schizophrenia-spectrum disorders.

Author details
[1]Department of Computer Science, University of Texas at Austin, USA .
[2]Department of Psychiatry, Yale University School of Medicine, USA .
[3]Geriatrics and Extended Care Service, VA Puget Sound Healthcare System, USA.

Published: 20 July 2010

References

1. Kapur S: **Psychosis as a state of aberrant salience: a framework linking biology, phenomenology, and pharmacology in schizophrenia.** *Am J Psychiat* 2003, **160(1)**:13-23.
2. Miikkulainen R: **Subsymbolic natural language processing: An integrated model of scripts, lexicon, and memory.** MIT Press 1993.
3. Corlett P R, *et al*: **Frontal responses during learning predict vulnerability to the psychotogenic effects of ketamine, linking cognition brain activity, and psychosis.** *Arch Gen Psychiatry* 2006, **63**:611-21.
4. Corlett P R, *et al*: **Disrupted prediction-error signal in psychosis: evidence for an associative account of delusions.** *Brain* 2007, **130**:2387-400.
5. Grasemann U, Miikkulainen R, Hoffman R E: **Hyperlearning: A connectionist model of psychosis in schizophrenia.** *Proc of CogSci'09* 2009.

doi:10.1186/1471-2202-11-S1-P99
Cite this article as: Grasemann *et al.*: Evaluating computational models of language disturbance in schizophrenia. *BMC Neuroscience* 2010 **11** (Suppl 1):P99.

* Correspondence: uli@cs.utexas.edu
[1]Department of Computer Science, University of Texas at Austin, USA