MULTISCALE MODELING OF HUMAN ADDICTION: A COMPUTATIONAL APPROACH TO PREDICT DRUG-SEEKING BEHAVIOR

A Dissertation Outline Presented

by

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Computer Science

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ABSTRACT

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This thesis proposes a computational multiscale framework for predicting behavioral tendencies related to addiction. The expected contributions of this investigation are: (1) the translation into a rigorous multiscale modeling and simulation framework of the biological properties underlying addiction; (2) the system's proof of expandability; (3) the qualitative validation of the model; (4) the analysis of the model's dynamics in terms of computational recovery; (5) the sensitivity analysis and control of the model; and (6) the introduction of a computational hypothesis for "maturing out of addiction" phenomena. The first contribution provides a rigorous, heuristic, and exploratory framework to conduct interdisciplinary researches about addiction. The second contribution augments the proposed model in its levels of observations, while enhancing biological plausibility. The third contribution, validation, is a fundamental step to any computational neuroscience models. The fourth contribution uses dynamical system tools to confirm the validity of simulated results with respect to biological theories, and to justify the possibility for a computational recovery. The fifth contribution enhances a sensitivity analysis procedure to identify intrinsic biases within the model, which are successively analyzed and controlled. The sixth contribution is the ultimate step in the framework's development: a pertinent model should be able to provide computational assessments of new hypotheses before animal experimentations are performed.