

1135-92-404

Jacob P. Duncan* (jduncan@saintmarys.edu), **Monica McGrath** and **Teresa M. Aubele-Futch**. *Breaking the Vicious Limit Cycle: Addiction Relapse-Recovery As a Fast-Slow Dynamical System*. Preliminary report.

Symptoms of addictive disorders often manifest as periodic episodes of sudden relapse followed by relatively long periods of recovery. For certain types of addiction, a relapse is precipitated by a state of elevated well-being wherein cravings supersede cessation efforts. A relapse satiates cravings temporarily, but is usually followed by a state of depression, which slowly improves as cravings reintensify. To analyze the underlying mechanisms driving relapse-recovery cycles, we construct a fast-slow dynamical system model of the interaction between an addict's propensity to relapse and their current disposition, i.e., craving and mood. The model captures the dynamics of addiction relapse and recovery phenomenologically by admitting relaxation oscillations, which we prove exist by exploiting timescale separation. We derive predictions of cycle period and amplitude to measure relapse frequency and intensity, respectively. As a parameter identified as being responsive to treatment is varied, the system transitions from a state of periodic relapse-recovery to a relapse-free state through reverse Hopf bifurcation. We calculate the threshold value of the treatment parameter, which corresponds to the equilibrium point passing through the fold of the critical manifold. (Received August 31, 2017)