Environmental Enrichment and Learning-Related Neuroplasticity

**Outcome:** CELEST Researchers at Boston University (Kantak, Man, Nic Dhonnchadha, Gauthier and Lin) discovered that giving cocaine-addicted rats several brief exposures to an enriched environment (“rat camp”) changed brain function and improved a type of learning that helps guard against relapse to cocaine use.

**Impact/Benefits:** Brief interventions with environmental enrichment may be a powerful add-on to cognitive behavioral therapy for preventing relapse in cocaine-dependent people.

**Explanation/Background:** Experience is a powerful way to change how the brain functions. Exposure to an enriched environment (opportunity for physical exercise, social interaction and exploration of novel objects) is one such condition that produces experience-dependent brain changes that can improve learning. Our group in CELEST took rats that were trained to press a lever to obtain cocaine (cocaine self-administration) and exposed them to enriched environments in 4-hr blocks at the same time they received weekly sessions of extinction training. During extinction training, rats learned that pressing the lever did not produce cocaine. Control rats had the same training but did not receive environmental enrichment. This experiment had three important outcomes. First, environmental enrichment improved extinction learning, shown by rats decreasing their lever pressing faster across the weekly extinction sessions. Secondly, environmental enrichment increased the expression of two forms of the GluR1 glutamate receptor that are critical for extinction learning. Thirdly, combining environmental enrichment with extinction training slowed down the rate of relapse behavior when cocaine was once again made available for self-administration.

**Caption:** Environmental enrichment combined with weekly extinction training sessions in cocaine-addicted rats slows down cocaine relapse behavior for at least 13 sessions (left) and increased the expression of two forms of the GluR1 glutamate receptor that are critical for extinction learning (right). These neuroplasticity changes occurred in several brain regions important for learning and memory.