Multivariate Concentric Square Field unveils behavioral exploratory categories of locomotor activity in mouse model of Down syndrome

Kailey E. Stancombe[1], Charles R. Goodlett[1], Robert J. Stewart[1], Megan Stringer[1], and Randall J. Roper[2]
[1]Department of Psychology, IUPUI School of Science, [2]Department of Biology, IUPUI School of Science

Down Syndrome (DS), trisomy 21(Ts21), is a genetic condition in which a third copy of chromosome 21 is present, and results in neurodevelopmental deficits including intellectual disability. DS has been modeled in mice; Ts65Dn mouse model displays many of the phenotypes associated with DS, including cognitive deficits. We previously studied behavioral phenotypes of Ts65Dn mice and observed significantly increased locomotor activity in a novel arena (an "open field"). In those studies, treatment of the Ts65Dn mice with ~10 mg/kg/day of epigallocatechin-3-gallate (EGCG), a selective inhibitor of the DYRK1A kinase (one of the genes implicated in the neurodevelopmental deficits in DS and in Ts65Dn mice), failed to attenuate hyperactivity. Locomotor activity in an open field is a basic measure of general exploration in a simple environment, and was only moderately sensitive to the hyperactivity of the Ts65Dn mice. The aim of the current study was to use a more advanced analysis of behavioral patterns of exploration in a more complex, multi-partitioned arena, termed the Multivariate Concentric Square Field (MCSF). The advantage of MCSF is that it provides more elaborate measures of exploratory behavior by examining different categories of exploration: general activity, exploratory activity, risk assessment, risk taking and shelter seeking behavior. Trisomic mice and euploid littermates were treated with a continuous high dose (~100 mg/kg/day) of EGCG or water (controls) beginning at weaning. At seven weeks of age, they were tested in the MCSF on two consecutive days. Our current results indicate that Ts65Dn mice displayed more exploratory behavior compared to controls, and the EGCG treatment may have normalized exploratory behavior toward that of controls. Identifying altered patterns of exploratory behavior in the Ts65Dn mouse and the normalizing effects of EGCG treatment may help provide a therapeutic approach to DS.

Mentors: Charles R. Goodlett, Department of Psychology, IUPUI School of Science, IUPUI; Rob Stewart, Department of Psychology, IUPUI School of Science, IUPUI; Randall J. Roper, Department of Biology, IUPUI School of Science; Megan Stringer, Department of Psychology, IUPUI School of Science