The Effects of High and Low Levels of Estrogen on Executive Function in Exercising and Non-Exercising Ovariectomized Female Rats

Katherine J. Stansfield, Meghan C. Eddy, and John T. Green

A significant amount of research in humans and rodents demonstrates a beneficial influence of exercise on cognitive performance. Previous results from our lab show that exercise improves executive function in cycling female rats, but not in ovariectomized (OVX) female rats (Eddy et al., 2013), suggesting that sex hormones play an important role in exercise-associated benefits in executive function. The current study examined the effects of high and low levels of estrogen on executive function in both exercising and non-exercising OVX female rats. Low levels of estrogen were produced by a surgical implantation of an estrogen-filled silastic tube in the nape of the neck. All rats received the implant, and those in the "high estrogen level" group additionally received subcutaneous injections of 17-beta estradiol (E2) every 4th day to mimic ovulation of a female rat. Testing was conducted using a maze consisting of 4 arms: black/rough, black/smooth, white/rough, white/smooth. During each trial, one arm was blocked to form a T and the rat was placed in the stem. In Set 1, rats started with either a color discrimination (black vs. white) or a texture discrimination (rough vs. smooth). In Set 2 (24 hours after Set 1), rats were assigned the opposite discrimination. Our results suggest that either exercise with low levels of estrogen, or high levels of estrogen regardless of exercise facilitate performance on Set 2. It is interesting to compare our results with those of Eddy et al. (2013), in which exercise facilitated Set 1 but not Set 2 in intact but not OVX female rats. In addition, an independent study project by Kelly Andrews (2011) revealed that OVX female rats with estrogen replacement showed improvement on Set 2 compared to OVX rats without estrogen replacement, suggesting that estrogen alone might have an effect on executive function.

References

Andrews, K. (2011). Department of Psychology, University of Vermont.

Eddy, Rifken, Toufexis, & Green (2013). Gonadal hormones and voluntary exercise interact to improve discrimination ability in a set-shift task. *Behavioral Neuroscience, 127*, 744-754.