Sex and prenatal hormone exposure affect cognitive performance

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Yerkes researchers are using their findings to better understand sex differences in cognitive performance, which may lead to increased understanding of the difference in neuropsychological disorders men and women experience.

In one of the first research studies to assess sex differences in cognitive performance in nonhuman primates, researchers at the Yerkes National Primate Research Center have found the tendency to use landmarks for navigation is typical only of females.

This finding, which corroborates findings in rodents and humans and is available in the online edition of *Hormones and Behavior*, suggests there is not just a difference in how well females and males solve spatial problems, but also in which types of cues they use to solve such problems. Researchers are applying this knowledge to gain a better understanding of how the brain develops and functions.

Lead researcher Rebecca Herman, PhD, says the very fact females and males use different strategies suggests there are subtle sex differences in the way the brain develops. As an example of these strategies, Herman said men, when finding a location, generally use north and south as well as distance estimates whereas women prefer physical cues such as street names, signs and buildings. Herman and her collaborator Kim Wallen, PhD, believe a better understanding of how spatial memory develops in healthy women and men may provide insights into abnormal brain development and neuropsychological disorders that show sex differences

in prevalence or symptoms, such as attention deficit hyperactivity disorder, Alzheimer's disease and autism.

As part of the study, Herman and Wallen compared normal female and male rhesus macaques to those who differed in their prenatal exposure to androgens in order to understand if sex differences were explained by differences in hormone exposure in utero. Some females and males received a drug that blocks the actions of androgens while a separate group of females received the male androgen testosterone. "There are a number of developmental disorders associated with abnormal levels of hormones. Through a better understanding of how the human brain develops and functions differently in women and men, researchers may be able to develop better treatments for these disorders," said Herman.

All animals were studied once they reached adulthood. Researchers observed as the monkeys navigated an open area to locate highly valued food items in goal boxes. The researchers varied the consistency of the food locations (spatial information) and the presence of colored markers (landmarks) on baited goal boxes so they could assess the monkeys' memory and use of spatial arrangement and markers.

"When both spatial and marker cues were available, performance did not differ by sex or prenatal treatment," said Herman. "When salient landmarks directly indicate correct locations but spatial information is unreliable, females perform better than males," she continued. "Male subjects whose testosterone exposure had been blocked early in gestation were more able to use the landmarks to navigate than were control males. They performed more like females. This suggests that prenatal testosterone likely plays a role in establishing the sex difference in using landmarks for navigation," said Herman. The researchers' next steps are to study if males' performance differs as their circulating testosterone levels change normally.

Source: Emory University