In mice, a new statistical analysis shows a sex hormone influences a drive to explore

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Exploratory experiment. By observing videos of mice as they explore a multi-armed maze, Rockefeller scientists conclude that specific sex hormones are linked to exploratory behavior. A mathematical analysis used to discern precise differences in the rodents' behavior could also be useful in other experimental situations, the researchers say.

Exhaustive searching may not guarantee a compatible mate, but that doesn't stop most people from trying. Now, new research from Rockefeller University suggests that estrogens may be a driving force. Research in mice, led by George Reeke and Donald Pfaff, has shown that this family of sex hormones affects the exploratory behavior of female rodents.

The researchers used female mice whose ovaries had been removed to eliminate any natural source of estrogens. Some of those mice were then

given estradiol, the most potent member of the estrogen family. Mice from the two groups were placed individually in a four-arm maze where their behavior and movements were measured and compared. Using a sophisticated analytical method, the researchers were able to discern differences in behavior.

“We found that estradiol increased the ability of the female mice to discriminate between an empty maze arm and one that had a male mouse at the far end,” says Pfaff. “It even partially prevented the loss of their capacity to discriminate between the arms after the male mice had been removed from the maze.”

From a study of videos of the female mice in the maze, two different behaviors became apparent. Sometimes the mice only briefly entered an arm of the maze, essentially poking their heads in without actually entering. The researchers categorized this as “sampling” behavior. But when the mice fully entered an arm of the maze, this was categorized as “committed” behavior. Such data display an unexpected distribution of arm entry distances that contains two peaks, referred to as a “bimodal” distribution.

Standard statistical methods were unable to take into account these two “modes” of behavior. Allan Coop, first author of the paper and a research associate in the Reeke lab, used a more advanced type of analysis to quantify sampling behavior and committed behavior in relation to one another. Between the two modes of behavior he could locate a partition point, where the probability that a mouse was either sampling or committed was the lowest. By looking at how that point moved under different conditions, Coop showed that the presence of estradiol changed the way the female mice behaved. Specifically, estradiol significantly increased the total distance the mice traveled in an arm when they committed to it.

“The experiments highlight a class of behaviors in animals characterized as ‘risk assessment,’” says Pfaff. “The mouse essentially has to calculate the risk to reward ratio, balancing out sexual attraction and the possibility of finding a mate with the fear of the unknown. Allan’s data indicate that estrogen tips the balance and encourages the female mouse to complete an entry, motivating her towards finding a mate.”

This type of precise analysis can be used to test other variables that may affect behavior. “Whether you are testing a knock-out mouse or the effects of a drug,” says Coop, “this analysis can give you a precise measurement of behavioral differences. We are eager to collaborate and apply this method to different situations.”

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