

## **The Walter Guthrie case: handling the outliers?**

Walter Guthrie is a fifth-year graduate student in an experimental psychology program at the City College Graduate School. He is in the midst of his last year of data collection for his dissertation research. He is working in a well-known and respected laboratory that has studied physiological mechanisms of learning for many years.

Guthrie has been trying to understand the relationships between corticosterone, learning, and memory in different animal species. He has focused his experiments on three well-studied species – stump-tailed rats, rough-legged pigeons, and gold-toothed anoles. In one of his last experiments, Guthrie plans to implant adult males and females of each species with small silastic tubes of corticosterone, to control the amount of circulating corticosterone in the subjects. He then will expose each individual to a series of learning trials and long-term memory tests. After the behavioral testing, the tubes are easily removed from the animals and they show no long-term effects of the manipulation. All of his experiments are conducted under study protocols approved by City College's Animal Care and Use Committee.

Guthrie prepares a set of tubes and implants them into his study subjects. He discovers on the day of implanting that he has miscalculated the number of tubes he needed, and is short of tubes for 12 anoles. He carefully makes an additional set of tubes, following the same procedures he has always followed, and implants the last 12 anoles later that day.

As he is running the subjects in the trials, he can tell that the experiment is going well. The animals are all behaving normally and appear extremely healthy, and he is obtaining quality data. After completing the trials, he removes the silastic tubes – the animals recover quickly and appear normal in the weeks and months that follow the study.

When Guthrie begins analyzing the data, he notices that data for eight of the anoles appear to be strong outliers relative to the bulk of the anoles. He runs both parametric and non-parametric significance tests of the results, and finds no effect of corticosterone level on anole behavior. He also finds no difference between anoles and the other two species in the influence of corticosterone on behavior. When he removes these eight outliers from the data set, he finds significant differences for both the corticosterone and species comparisons. He traces these eight data points back to the individual subjects, and finds that six of them are from that group of 12 anoles for which he had to make an additional set of tubes.

Guthrie thinks that he must have made a mistake during the preparation of the tubes for the last set of 12 anoles, and wonders if he should remove these individuals from the data set. He confers with a postdoctoral researcher in the lab, who tells him he should leave them out of the study completely, and not mention them at all in the methods section of his dissertation. Another senior graduate student in a different lab thinks Guthrie should leave the data for those 12 anoles in the study, since there is no reason to believe Guthrie made a mistake in preparing the tubes.

**Should Walter Guthrie remove the outliers? Why or why not?**