BIOL 3117 Assignment 4

Infection Dection in Meadow Voles (*Microtus pennsylvanicus*)

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Statistical Analysis

Experiment 1 seeks to identify whether infection influences attraction to male nests by female meadow voles. Female voles were allowed to approach a male nest that had been sprayed with either water, the scent of a non-infected male or the scent of a male that had been infected with either a nematode worm (Heligmosomoides polygyrus), a coccidian protozoan (Eimeria vermiformis) or the influenza virus. This experimental design is testing two factors; 1.) Whether a female vole can detect and be influenced by the scent of infection in male nests and 2.) Does the type of infectious agent play a role in the influence? Since there is only one dependant variable being measured, the approach distance of a female vole, and normality can be assumed due the Central Limit Theorem ($N > 30$), a Two-way ANOVA is most appropriate.

Experiment 2 is interested in whether a female vole can identify the level of infection in a male by smelling male urine left of nest material. In this case, there is only one factor (the level of infection in the male) and one dependant variable (how close a female approached male nest material). Since $N = 40$, the Central Limit Theorem applies. Taking all this into consideration, a One-way ANOVA is most appropriate as there are more than two sample groups.

Results

There was a significant 2-way interaction of infectious agent and chemical stimuli on the attraction of female voles to male nests ($F_{4,36} = 43.986$, $p < 0.001$). Nests sprayed with urine that had been infected with nematodes attracted females 6.5 times closer than nests sprayed with urine infected with a protozoan or virus ($p < 0.05$; Fig 1). There was no difference in the approach distance of females to nests sprayed with urine infected with viruses or protozoans ($p > 0.05$; Fig 1). Female voles came 5.4 times closer to nests sprayed with uninfected urine or water than to nests sprayed with infected urine ($p < 0.05$). There was no difference in the approach distance of females to nests sprayed with uninfected urine or water. There was also no difference among other treatment combinations (all $p > 0.05$).

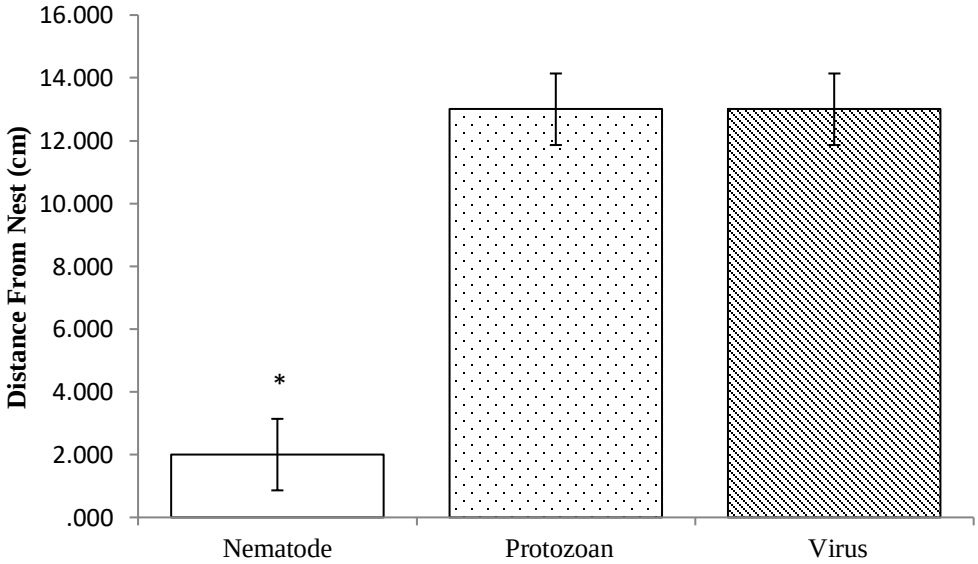

Figure 1. Mean ± 95% C.I. of the closest distance a female vole approached a nest sprayed with infected male vole urine. * denotes significance at $p \leq 0.05$.

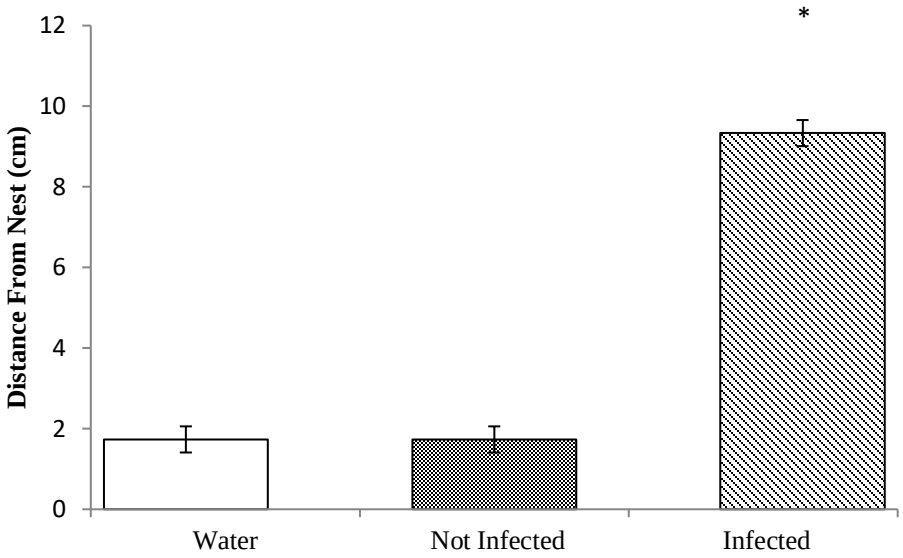

Figure 2. Mean ± SEM of the distance female voles approached male nests that had been sprayed with water, uninfected urine or infected urine (not taking into account what the infection is). * denotes a significant difference at $p \leq 0.05$.

There is a significant difference in the approach distance of female voles to male nests sprayed with various concentrations of nematode infected urine ($F_{3,36} = 62.933$, $p < 0.001$). Females approached nests with no infected urine present 6.06 times closer than nests with high concentrations of nematodes in the urine ($p < 0.001$) and 3.78 times closer than nests with medium concentrations ($p < 0.001$). Also, Females approached nests with low concentrations 4.85 times closer than nests with high concentrations ($p < 0.001$) and 3.03 times closer than nests with medium concentrations ($p < 0.001$). Finally, females approached nests with medium concentrations 1.6 times closer than nests with high concentrations ($p < 0.001$, Fig 3)

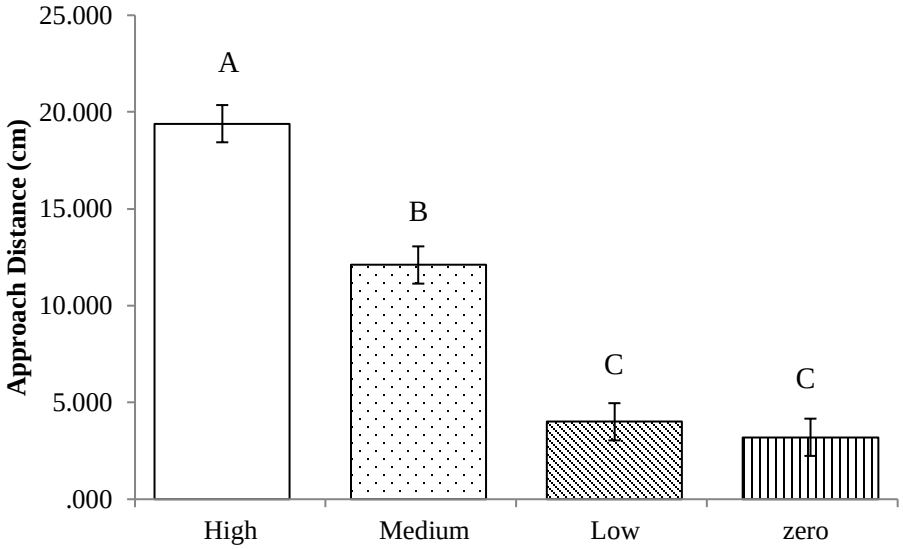

Figure 3. Mean ± SEM of approach distances of female voles that were allowed to approach a male nest that had been sprayed with urine containing high, medium, low or zero concentrations of infectious nematodes. Different letters over bars denote a significant difference at $p < 0.001$ (see text for details).

Discussion

It is clear from Figure 2 that female voles can detect the presence of infectious agents in males, which supports the findings of previous experiments (Kavaliers and Colwell 1992). The role of this identification is almost exclusively a sexual feature; being able to identify the health of a male allows a female to make a judgement about the fitness of potential offspring produced with that particular male. Since reproduction plays a relatively large role in the life of voles (Sanders 1988), the ability to determine the level of infected-ness would come as a natural refinement of already present senses and would serve to further enhance the criteria available to select a mate from.

Of the three infectious agents, female voles came closest to nests that had been scented with nematode infected urine. This suggests that nematode infection is not as great a concern as the protozoans or viruses. Female voles are generally less susceptible to infection than males (Klein et al. 1999a) and therefore may be able to handle a nematode infection better, causing this type of infection to not be as large as a concern. This would also imply that female voles are not only looking out for potential future offspring when they detect parasite concentrations in males, but also for their own health. Another point of consideration is that according to Klein et al. 1999b, the life cycle of parasites is taken into consideration by females and this particular nematode may have a life cycle that is somehow favourable to the female.

Kavaliers, M. and Colwell, D.D. (1995a) Discrimination by female mice between the odours of parasitized and non-parasitized males, Proc. R. Soc. London Ser. B 261, 31–35

Klein, S.L.et al. (1999a) Role of steroid hormones in Trichinella spiralis infection among voles, American Journal of Physiology. 1999 Nov; 277(5 Pt 2)

Klein, S.L. et al (1999b) Trichinella spiralis infection in voles alters female odor preference but not partner preference, Behavioral Ecology and Sociobiology, 45(5), 323-329.