

Relative Dependence of Neural Plasticity on Age and Activity in the Bumblebee (*Bombus huntii*)



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Introduction

Neural Plasticity is one of the most fascinating and complex aspects of neuroscience. Due to the complexity of neural plasticity mechanisms, simple models are used to study neural plasticity.

The bumblebee, *Bombus huntii* provides an ideal model organism with which to study neural plasticity, particularly the way it is affected by age and activity¹. The Mushroom Body is the portion of the *B. huntii* brain that is responsible for higher order sensory integration and experience related learning so it will be the focus of this study².

Methods

- Dissect, slice and mount sections of *B. huntii* brains on slides.
- Stain and photograph the mounted sections.
- Using the program Imagetools, measure the total volume of the Neuropil and Kenyon cells for each brain.
- Compare volume results to ages and activity levels of bees.
- Determine if activity rate contributes to changes in structure of *B. huntii* brain, particularly the ratio of Synapse to cell body in the Mushroom Bodies.



Figure 1. Cross section of the *B. huntii* brain..

Objective

- To determine if changes in brain structure in adult worker bumblebees are due to the contributions of age dependent neural plasticity, activity dependent neural plasticity, or a combination of both?

Results

The prediction that activity rate plays a role in plasticity in the *B. huntii* brain, is supported by this data.

From two sessions of in hive observations, it appears there is no definitive correlation between age and average number of foraging trips per hour (Figure 2). Thus, foraging rate is not a product of age related plasticity and is exhibiting independent effects.

Increased activity rate appears to be correlated with a greater ratio of Neuropil to Kenyon cells (Figure 3). As foraging trips per hour increases, The Neuropil volume of *B. huntii* occupies a larger portion of brain space than Kenyon cell volume.

Activity rate seems to be playing a role in the way the *B. huntii* brain grows and learns, meaning that the activity of the insect is shaping it's neural development.

References

- 1.) Farris, Sarah M., Gene E. Robinson, and Susan E. Fahrbach. "Experience and Age Related Outgrowth of Intrinsic Neurons in the Mushroom Bodies of the Adult Worker Bumblebee." *The Journal of Neuroscience* 21.16 (2001): 6395-404.
- 2.) Durst, C., S. Eichmueller, and R. Menzel. "Development and Experience Lead to Increased Volume of Subcompartments of the Bumblebee Mushroom Body." *Behavioral and Neural Biology* 62.3 (1994): 259-63.

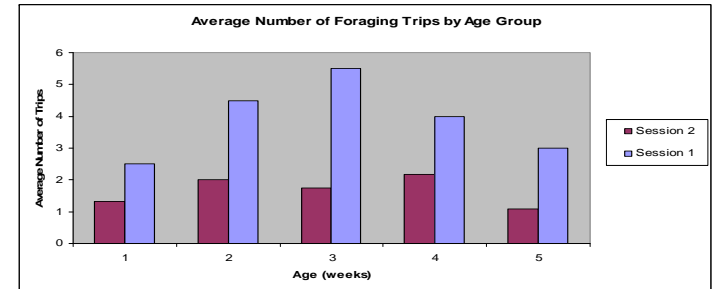


Figure 2. Foraging trip data for 2 observation sessions.

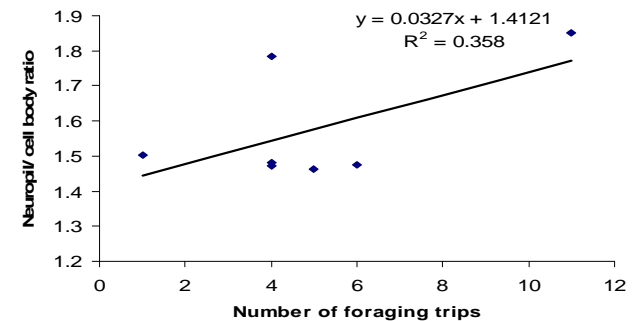


Figure 3. Neuropil to Kenyon Cell Ratio as foraging trips per hour increases.

Future Research

Future research in this area would benefit from a larger sample size to further confirm these results, as well as an attempt to establish the relative contributions that age and activity level have on neural plasticity in *B. huntii*.

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