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# Investigating Odor Detection Distance with Peanut Butter

**Karen A. McMahon**

The University of Tulsa, Biological Science, 800 S. Tucker Dr, Tulsa OK 74104 USA
**(karen-mcmahon@utulsa.edu)**

In 2013, researchers proposed a simple odor detection test using peanut butter for the early detection of Alzheimer's disease. It was reasoned that there would be a significant decrease in odor detection in the left nostril compared to the right because in patients with Alzheimer's disease portions of the olfactory cortex are the first areas to exhibit pathology with the left hemisphere of the cerebral cortex exhibiting greater degeneration than the right (Stamps et al, 2013). This study was the inspiration for an olfaction exercise for the Human Anatomy Laboratory (Biol 2151) in the fall 2016 semester at the University of Tulsa. Students are introduced to hypothesis testing, experimental design, and discussions of neurological anatomy and pathology.

**Keywords**: olfaction, odor detection distance, Alzheimer's disease

## Introduction

Previous studies have established that portions of the olfactory cortex in the brain, preferentially the left hemisphere, are the first areas of the brain to exhibit degeneration from Alzheimer's disease (AD), often before cognitive impairment becomes evident.

Since the olfactory epithelium projects to the same side of the olfactory cortex, patients with AD would be expected to demonstrate an asymmetry in odor detection with the odor detection distance of the left nostril significantly lower (a difference of 4 cm or greater) than that of the right nostril.

# Student Outline

## Objectives

- Create a hypothesis about odor detection distances for selected populations in the class and design an experiment to test this hypothesis.
- Understand how Alzheimer's disease can affect olfaction and result in asymmetry of odor detection distances between the left and right nostrils.
- Understand how impaired odor detection distances in the left nostril can be used as an early clinical test for Alzheimer's disease.

## Materials

Plastic baggies (sandwich size, 16.5 cm x 14.9cm)
Jar of brand peanut butter (454g)
Plastic teaspoons
Rulers (30 cm)
Timers (optional)

## Protocol

1. Develop a testable hypothesis for odor detection distances for selected populations in the class.
Examples of proposed hypotheses:

- there will be no significant difference in the mean odor detection distances between male and female students
- handedness will be correlated with odor detection distances, e.g. right handed individuals will have a greater odor detection distance for the right nostril and left handed students will have a greater odor detection distance for the left nostril

2. Group into pairs and obtain the needed materials: ruler, timer, peanut butter on a spoon and sealed in a plastic baggie.
3. Pick a place in the classroom or adjacent hallways apart from other student pairs to limit odor contamination.
4. Select a subject and an experimenter. The subject sits with eyes closed and selects a nostril (right or left) to test first. At the start of the test, subject closes the unselected nostril by pressing a finger against the outer (lateral)wall.
5. The experimenter places a 30 cm ruler with the 0 end alongside the nostril being tested in the subject. At the 30 cm end of the ruler, the experimenter places the teaspoon with peanut butter (Fig. 1.)
6. The experimenter moves the teaspoon slowly (approximately 1 cm along the ruler with each exhale of the subject) until the subject detects the odor of peanut butter. The experimenter records the odor detection distance for the nostril.
7. Return the peanut butter spoon to the plastic baggie and seal it. Wait 90 seconds before testing the second nostril of the subject.
8. The experimenter now becomes the subject with the first subject taking over the role of experimenter. Follow the protocol and determine the odor detection distances for each nostril in the second subject.
10. Collect all data from the class and calculate the mean odor detection distances for the left and right nostrils and the difference in mean odor detection distances between the left and right nostrils (L-R).
11. Analyze the data. Is the hypothesis supported? Why or why not?

**Figure 1**. A student determines the odor detection distances for the right nostril of the subject using peanut butter as the olfactant.

## Materials

Sealable plastic baggies (sandwich size, 16.5 cm x 14.9cm)
Jar of peanut butter (454g)
Plastic teaspoons
Rulers (30 cm)

## Notes for the Instructor

I have also used small balls of cotton to close the unselected nostril during testing.

## Acknowledgments

I would like to the students of the Human Anatomy Laboratory (Biol 2151) at the University of Tulsa who participated as subjects in this study.

## Cited References

Stamps JJ, Bartoshuk, LM, Heilman, KM. 2013. A brief olfactory test for Alzheimer's disease. October 14; J Neurol Sci. 333(0): doi:10.1016/j.jns.2013.06.033.

## About the Author

Karen McMahon is an instructor of biological science at the University of Tulsa and editor of the ABLE Proceedings. She is constantly inspired by the creativity and dedication of ABLE members and looks forward to the ABLE Annual Conference all year long.

## Appendix A
## Sample Student Data

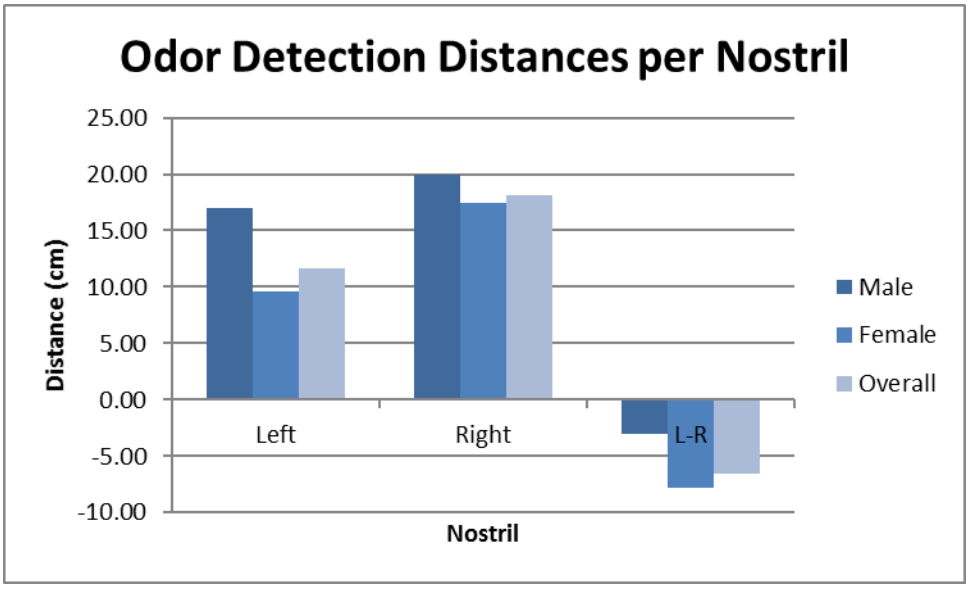


**Figure 2.** Student data from the summer 2017 Biol 2151 Human Anatomy Laboratory at the University of Tulsa. Odor detection distances were hypothesized to be lower for male students as compared to female students; L-R odor detection distance asymmetry was slightly less for male students (N= 11; males –3; females 8).

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