



CALIFORNIA STATE SCIENCE FAIR 2005 PROJECT SUMMARY

Name(s) Christina G. Boardman	Project Number S0304
Project Title Lemon Aid: Can Lemon Scent Improve How Fast Your Brain Processes Information?	
Objectives/Goals My objective was to determine if brain processing speed could be improved if pure lemon scent is administered to grade-school age students. I was also interested to see if there were any differences in improvement between learning disabled and general education students.	Abstract I administered to students ages 7 to 11 a test to measure brain processing speed. I gave a series of tests, first without and then with pure lemon scent; next without and then with a placebo; and finally, giving the lemon scent first and then removing it. I subjected the tests to statistical analyses. Materials were: multiple tests, pencils, a stopwatch, pure lemon essence, a placebo, and kleenex.
Methods/Materials For 100% of tests with lemon scent, in whichever sequence the lemon was given, the students' processing speed improved. In 20% of tests in which only a placebo was administered, students' processing speed declined. Improvement with lemon scent was always greater than improvement shown (if any) with a placebo or because of *learning the test* through repeat taking of the test sequence. Both learning disabled and general education students improved at comparable rates, on average; however, lemon scent brought learning disabled students into the processing speed range of the general education students	Results The results supported my hypothesis, showing that brain processing speed can be significantly improved by administering pure lemon scent, beyond any improvement shown through *learning the test* or from a placebo effect. These results support the growing science of brain functions being explored through fMRIs (functional Magnetic Resonate Imaging); the expanding science of the olfactory function and its relationship to the brain, for which the 2004 Nobel Prize in medicine was awarded; and the important exploration of the brain and learning, especially as affects learning disabilities.
Conclusions/Discussion Brain processing speed can be significantly improved in grade-school-age students when pure lemon scent is administered.	
Summary Statement Brain processing speed can be significantly improved in grade-school-age students when pure lemon scent is administered.	
Help Received Dr. Susan Bookheimer, UCLA Brain Mapping Institute, gave me e-mail advice on reversing test sequencing, and when I visited following completion of my tests, helped with statistical analysis and with information on the olfactory areas of the brain.	