

EMISSION OF RADIO FREQUENCY RADIATION BY CELLULAR PHONES

<STUDENT NAME(S)>

DEN 399 RESEARCH PROPOSAL— MAY 1, 200X

Abstract:

This project will involve studying how much radio frequency a human brain is exposed to due to varying degrees of usage of a digital cellular phone; the biological effects caused by such exposure will not be dealt with. The project is estimated to take two semesters to complete. The first semester will be spent researching, calibrating instruments, and creating a computer-modeling program. The actual experiment, which will be completed in the second semester, will use a simulated brain, popular models of digital cellular phones held at a constant angle to the simulated head, and a probe hooked to a computer to create models of the absorption for varying times of exposure. These models and an analysis of the findings for different phones and different exposures will be methods of reporting results.

Research Objective:

To measure the amount of radio frequency (RF) waves entering the brain from a digital cellular phone due to varying lengths of usage of the phone. These results could have a health-related impact if RF waves are determined to cause brain cancer or result in other harmful effects.

Summary of Previous Studies:

The biological effects of RF radiation in the range of 915 to 2450 MHz have been researched since World War II; this frequency is close to that of cellular phones. In fact, a review of the issue presented in November of 1999 included more than 200 ongoing and recently completed studies in this area. However, the research has been rather inconclusive as to the

danger or safety of cell phones. In addition, little of the current research deals with the pulse-modulated signals generated by digital phones.

In a 1996 study, Kenneth Rothman, a senior epidemiologist at the Epidemiology Research Institute in Newton Lower Fall, Massachusetts, reviewed over 250,000 health records of cellular phone users. He found that there was no difference in mortality between users of mobile phones (which have a lower RF exposure since the antenna is mounted on the vehicle rather than the phone) and hand-held phones. A follow-up study by Rothman looked at the causes of death among 300,000 cellular phone users and concluded that, "The only category of cause of death for which there was an indication of increasing risk with increasing minutes of use was motor vehicle collisions," as reported in the *Journal of the American Medical Association* in November 1999. Similarly, a study of 209 Swedish brain tumor patients contrasted with 425 healthy controls led by Lennart Hardell at the Orebro Medical Centre in Orebro, Sweden, was also negative in nearly all aspects.

Animal studies have also not established a link to cancer from RF exposure. A Motorola-funded study conducted by W.R. "Ross" Adey in 1999 concluded that exposing rats to 837 MHz RF energy similar to signals transmitted by some digital phones, does not cause or promote brain cancer. In April 2000, Adey, now at the University of California at Riverside, reported that the same conclusion holds for continuous wave RF like that used by analog phones. However, not all animal studies have turned out negative. In 1995, The University of Washington's Henry Lai reported breaks in a rat's brain cell DNA after exposure to RF radiation equaling 1 W/kg of body weight. These breaks are an indicator of a possible carcinogen. While Lai defends his conclusions, attempts to replicate the experiment have failed. Both a Motorola-funded group headed by Joseph Roti Roti at Washington University in St. Louis and a Belgian government-

funded group headed by Luc Vershaeve reported no DNA strand breaks. A still unpublished study by Joshua Muscat, research scientist at the American Health Foundation in New York City, prompted the United States Wireless Technology Research chief George Carlo to say, “those who use wireless phones have a higher chance of dying from brain cancer,” in a Canadian TV interview in late 1999. However, Muscat’s own conclusions were that the study “did not find evidence that cell phone use increases the risk of brain cancer...” though “there remains some ambiguity” in the interpretation of an evident increase in a particular kind of brain cancer.

While no clear evidence has been observed to link RF exposure to brain cancer, many feel that exercising caution is a good practice. A British government group of experts chaired by Sir William Stewart suggests that although no health effect has been observed, “it is not possible at present to say that exposure to RF radiation is totally without potential adverse health effects...” Further studies are needed in order for the effects to be fully understood.

Experimental Procedures to Be Used:

The experiment will consist of comparing the amount and location of radio frequency waves entering the brain from two different popular digital cellular telephones. A solution and container will be made or bought to simulate the brain, and the phone will be placed next to the simulated brain on a stand constructed to hold the phone at a constant angle. This angle will be determined with further research into how most humans hold the phone. A probe connected to a computer modeling program will be used to take measurements of the radio frequency at various points in the brain simulator; readings of the probe will be taken for each phone in increments of 1, 5, 10, 20, 30, 60, 90, and 120 minutes of continuous use.

Since there are three team members, the project will be divided up into three distinct parts. One person will concentrate on the computer aspect of the experiment by creating and/or

learning to use the modeling program and ensuring that readings are stored correctly. One team member will concentrate on one of the digital phones, performing all of the tests for that particular phone; the other person will concentrate on the other digital phone.

Experimental Apparatus:

- Computer
- Two Digital Cell phones (Most popular models to be determined by further research)
- Simulated Liquid
 - Liquid is a 'tissue equivalent'
 - Has a similar complex to brain tissue at values of 900MHz to 1800 MHz
- Probe to measure level of radio frequency radiation exposure
- Customized software
 - Similar to software in KSU physics labs
 - Would assist in presentation of data and calibration of electric field probe
- Cell phone holder used to simulate the human hand holding a phone
 - Custom built model may be used
 - Commercial cell phone holder may be used (cost \$12.00)

Anticipated Method of Reporting Results:

At least five trials would be run for each digital cell phone and data at various times would be taken. The amount of radio frequency waves absorbed by the brain would be measured in Watts/Kilogram. The data for each phone would be averaged and placed in a table. The emphasis would be on the points at times 1, 5, 10, 20, 30, 60, 90 and 120 minutes. Additional times of interest may be added after analyzing the results. If additional times prove necessary, the data may need to be retaken. The computer software would then assist in creating a model of the absorption by the brain for various times of exposure and a line graph containing each separate cell phone's set of data. This would allow a comparison of which phone had the higher values and at what point. The maximum value of each cell phone is also a point of interest. This value may also be compared to the previously existing standard for the amount of radio frequency waves allowed in the body; this value is currently 1.6 Watts/Kilogram.

Time Estimate:

This project will take an estimated three hours per week for two semesters. The following is a plan of work for each semester.

Fall Semester:

- Complete literature review of past research
- Learn to correctly use brain simulation liquid and electric field probe
- Perform calibrations of probe to prepare for actual measurements
- Research computer software and models available to analyze data and modify to suit this project's purpose if necessary
- Make detailed plan of exactly when and what tests will be performed

Spring Semester:

- Perform tests for approximately ten weeks
- Analyze data in following three weeks
- Write report in next two weeks
- Present findings during last week

References:

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