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Behavioral Effects of Ultra High Frequency Radio Waves: Abstracts

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November, 1966

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I. Effects of Microwave Radiation on Activity Level of Rats: Psychological Reports, 1962, 11, 192.

Fifteen 35-day-old Sprague-Dawley rats were randomly assigned to three radiation treatment groups: 60 min., 30 min., or 0 min. daily radiation exposure. For 20 consecutive days the rats were exposed to low intensity microwave radiation by means of a sweep generator continuously sweeping the frequencies 450 to 965 megacycles (mc) for the specified lengths of time. A discone antenna which was resonant on the frequencies used was located in the center of the circle of 5 cages, 3 in. from each one, and directed the UHF waves to subjects in their photocell activity cages, their spontaneous activity level being measured immediately after such exposure.

An analysis of variance design (Type I Mixed design) was used in analyzing the data. Analyses revealed a significant difference between days ($F = 1.68$, $df = 19/152$, probability $< .05$) and a significant interaction between days and radiation treatment for the last 12 days of the experimental procedure. ($F = 2.07$, $df = 11/88$, probability $< .05$). Analyses of interaction simple effects revealed that the 60 min. experimental group was significantly less active than the control group during the last four days of experimentation.

These results suggest an effect on spontaneous activity level as a result of microwave radiation, this effect requiring repeated exposure before becoming apparent.

II. Behavioral Effects of Stimulation by UHF Radio Fields: Psychological Reports, 1965, 17, 595-602.

(See enclosed reprint)

20 male albino rats were used as subjects in determining behavioral effects of ultra high frequency radiation. Experimental subjects were exposed to low intensity (50,000 microvolts), low frequency (300 mc to 920 mc) UHF radio waves for 47 consecutive days. Radiated rats were more active than non-radiated rats for a brief period during the early part of the experiment, but became less active as the days of radiation increased. The UHF group was more emotional than the non-UHF group and showed a gradual increase in the latency of recovery from electroshock convulsion. No differences were found for weight, audiogenic seizures, and water consumption.

Results suggest that (a) some time is required for UHF to have a consistent effect on behavior, and (b) the effects on behavior may be non-thermal and possibly related to neurophysiological substrates.

III. Replications of Experiment II, "Behavioral Effects of Stimulation by UHF Radio Fields":

Two replications of Experiment II were carried out. The conditions and procedures in Experiment II were duplicated exactly except for the following exceptions:

A. Replication I:

For the first replication, the only changed condition from Experiment II was the use of a 140 db intensity level instead of a 90 db intensity level in testing for audiogenic seizures.

Results:

1. Although no significant differences between radiated and non-radiated animals were found at a 90 db level (Experiment II), the use of a 140 db level (Replication I) produced significant differences. UHF animals had (a) a lower threshold for audiogenic seizures and (b) a longer duration of audiogenic seizures.

2. All other behavioral changes observed in Experiment II were observed in Replication I.

B. Replication II:

The only conditions changed in Replication II as contrasted to Experiment II were (a) the use of a 140 db level for audiogenic seizures, and (b) the addition of another variable, age of organism. While only 30-day-old rats were used in Experiment II and Replication I, both 30-day-old and 180-day-old rats were used in Replication II.

Results:

1. The older 180-day-old rats were affected by UHF waves as well as the younger 30-day-old rats. The only difference observed between the younger and older rats was that the effects were observed to occur later with the older rats; i. e., older rats required from 7 to 12 additional days of repeated exposure to UHF for the effects to become apparent.

2. All other behavioral changes observed in Experiment II and Replication I were duplicated in Replication II. Since Replication II was similar to Replication I in using a 140 db level for audiogenic seizures instead of a 90 db level (as in Experiment II) results for audiogenic seizures were similar in Replication II and Replication I.

IV. Exploration of Different Ranges of UHF Frequencies and After Effects:

In order to determine possible differential behavior effects with different ranges and portions (high or low frequency) of ranges, four separate experiments were set up.

<u>Stages</u>	<u>Groups</u>	<u>Range of Frequencies</u>	<u>Sweep of Frequencies</u>
I	UHF non-UHF	130 mc -----	320 mc - 450 mc -----
II	UHF non-UHF	130 mc -----	770 mc - 900 mc -----
III	UHF non-UHF	400 mc -----	500 mc - 900 mc -----
IV	UHF non-UHF	400 mc -----	320 mc - 720 mc -----

The power (50,000mV) applied to the experimental groups was held constant for all four stages. Activity measures were made daily in photocell activity cages for 60 consecutive days.

Investigation of after-effects:

After-effects were investigated for each of the four stages. After 60 days of radiation, the UHF group was randomly divided in half. One-half of the original UHF group remained under the UHF radiation conditions for 15 additional days, while the other half of the group was removed from radiation for 15 additional days. The following represents the after-effects conditions:

<u>Groups</u>	<u>Days 1-60</u>	<u>Days 61-75</u>
Experimental I	UHF	UHF
Experimental II	UHF	no UHF
Control	no UHF	no UHF

Results:

Complete results may not be reported at this time since analyses of the data are now being made. Results from Stages I, II, and III indicate that:

1. Frequencies toward the lower end of the UHF band have a greater effect on activity than those at the higher end.
2. After 60 days of radiation, the effects on activity are not permanent but tend to persist for four to six days. Experimental group II approaches the activity of the Control group by day four, but does not differ from Experimental group I until day six.

V. Present Status

A. The experiments reported in topics III and IV are now either in press or in preparation.

- B. Two main directions of experimentation are being undertaken:
1. Drug experiments to reveal possible indirect evidence that acetylcholine accumulation may be the physiological variable underlying the behavioral effects. (This investigation will proceed under a small N.S.F. Institutional Grant, #12-5202.)
 2. Investigation of other behavioral effects; e.g., adaptability of behavior as measured by the Krech Unsolvability Maze.

VI. Summary

1. UHF of low intensity (50,000mV) and low frequencies (300-945mc) has the following effects on the behavior of rats:
 - a. Activity: An initial brief period of hyperactivity followed later (day 30) by a long-term hypoactive response which persists throughout continued exposures to radiation.
 - b. Emotionality: Increase of emotionality of UHF group relative to non-UHF group.
 - c. Susceptibility to seizures: UHF animals have a lower threshold for seizures and a longer duration of seizures.
2. Older rats as well as younger rats are affected by UHF radiation, but the former must be exposed to radiation for a greater number of days in order for the effect to become apparent.
3. Frequencies toward the lower end of the UHF band have a greater effect on activity than those at the higher end.
4. The effects on activity are not permanent after 60 days of radiation, but effects do tend to persist for several days after radiation.
5. Results suggest that (a) some time is required for UHF to have a consistent effect on behavior, and (b) the effects on behavior may be non-thermal.