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INVESTIGATION OF POTENTIAL BEHAVIORAL EFFECTS OF  
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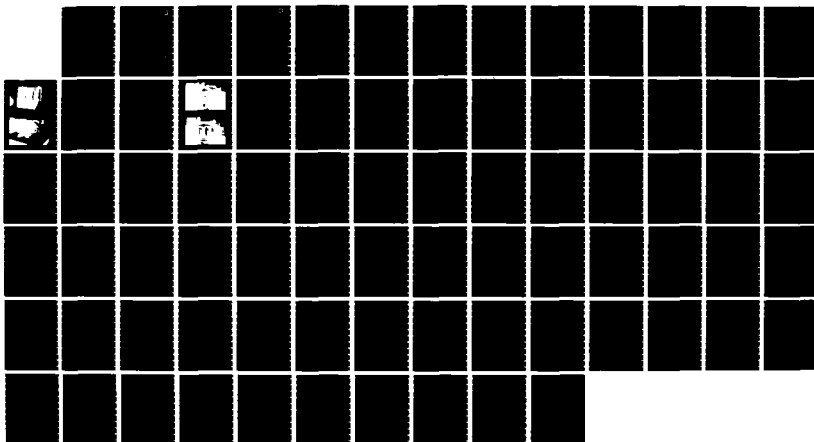
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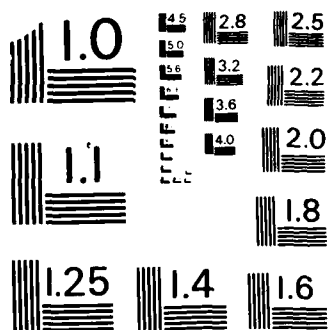
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# INVESTIGATION OF POTENTIAL BEHAVIORAL EFFECTS OF EXPOSURE TO 60 HZ ELECTROMAGNETIC FIELDS

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Naval Medical Research  
and Development Command  
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## **TECHNICAL REVIEW AND APPROVAL**

### **NMRI 85-63**

The experiments reported herein were conducted according to the principles set forth in the current edition of the "Guide for the Care and Use of Laboratory Animals," Institute of Laboratory Animal Resources, National Research Council.

This technical report has been reviewed by the NMRI scientific and public affairs staff and is approved for publication. It is releasable to the National Technical Information Service where it will be available to the general public, including foreign nations.



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December 1985



## INVESTIGATION OF POTENTIAL BEHAVIORAL EFFECTS OF EXPOSURE TO 60 HZ ELECTROMAGNETIC FIELDS

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19 ABSTRACT (Continue on reverse if necessary and identify by block number) In order to analyze potential behavioral effects that may be produced by exposures to 60 Hz electric and magnetic fields, animals were exposed to a range of linearly polarized magnetic fields of .5 to 5 gauss, with and without the combination of a 1 kv/m electric field. The animals performed on a multiple fixed-ratio (FR) differential-reinforcement-of-low-rate (DRL) reinforcement schedule that required responding on a lever to produce food pellets. The effects of the above fields were also studied on the multiple FR DRL schedule performance of animals administered representative drugs from two psychoactive drug classes, amphetamine and chlordiazepoxide. Under the present experimental exposure conditions and durations, exposures to the 60 Hz electromagnetic fields produced no systematic changes in the behavior of the animals on the multiple FR DRL schedule. No systematic effects were observed on the behavioral effects of either amphetamine or chlordiazepoxide, at the doses explored, by any of the exposures to the magnetic fields alone or in combination with the electric field.					
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## 19. ABSTRACT (cont'd)

/ When animals were exposed to a low-level (.5 gauss) 60 Hz magnetic field combined with a low-level static magnetic field (about half the earth's field) they consistently exhibited changes in the rate and pattern of responding during the DRL component of the multiple FR DRL reinforcement schedule. By contrast, no measurable changes were evidenced following exposures to the static field alone or to the oscillating field alone. The observed changes in performance on the DRL schedule indicate that under very precise conditions, extremely weak 60 Hz magnetic fields may have an effect on the behavior of animals. The data suggest that static magnetic fields, similar in strength to the earth's magnetic field, can alter the effects of weak alternating fields on an animal's behavior.

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## 1. INTRODUCTION AND PURPOSE:

In recent years studies have been published that indicate alterations of behavior as a result of exposure to electromagnetic fields. Evidence for behavioral change following exposure to electromagnetic fields in the microwave frequencies is well established (24). The evidence for behavioral effects of exposure to extremely low-frequency (ELF) fields, however, is inconsistent and less well documented. The presence of 60 Hz electric and magnetic fields in the environment produced by high voltage overhead power transmission lines represents a source of concern for populations continually exposed to those fields. In response to the establishment of a research program by New York State to determine potential biohazards arising from exposure to the electric and magnetic fields produced by overhead transmission lines, the present research studies are concerned with the detection and analysis of potential behavioral effects which may be produced by such fields.

The types of behaviors that have been studied in relation to low frequency electromagnetic field effects ranges from activity measures to schedule-controlled operant behavior. In a study of activity level (29) mice were exposed to 60 Hz magnetic fields with an average flux density of  $1.7 \text{ mWb/m}^2$  for 48 hours. Activity counts with the field on were elevated as compared to pre and post exposure conditions and a sham exposed control group. In another study of activity level (28), however, rats that were raised in an electric field apparatus and exposed to 25 kv/m at 60 Hz for five weeks showed no significant changes in activity level as compared to a sham exposed control group.

In the area of schedule-controlled operant behavior a series of experiments reported by deLorge (6,7,8) and deLorge and Marr (10) failed to detect any reliable behavioral changes as a result of low-intensity low-frequency electromagnetic fields. These investigators reported data from rhesus monkeys, pigeons and rats exposed to fields ranging from 7 to 75 Hz with magnetic and electrical field densities of 2 or 10 g and 7.4 or 100 V/m, respectively. The behavioral phenomena investigated included tests of an animal's ability to detect ELF fields; ELF effects on reaction time, matching to-sample, and temporal discrimination performances; and effects on fixed-interval and concurrent chain schedules of reinforcement. In some cases the animals were exposed for very brief time periods and in other instances exposure lasted for days. The authors reported no detectable change in

behavior under any of the conditions studied. Two studies investigating the effects of ELF fields with monkeys performing on differential-reinforcement-of-low-rate (DRL) schedules reported shifts in inter-response time (IRT) distributions as a result of electromagnetic field exposure. In one study exposure to a 2.8 V/m 7-Hz field for 4 hours resulted in shifts toward shorter IRT's (14). The authors later extended the study and found similar changes with fields of 10 and 56 V/m at 7 Hz and 75 Hz, respectively (15). One other study (9) reported inconsistent differences in IRT distributions as a result of 2 hr daily exposures to either a 15 or 45 Hz magnetic field for 5 days. In the case of 45 Hz fields 3 of 4 animals showed significant shifts in IRT distributions and with the 15 Hz field 2 of 4 animals showed significant IRT shifts. The magnetic field strength was between  $8.2$  and  $9.3 \times 10^{-4}$  T.

The literature indicates that behavioral effects of ELF fields have not been studied intensely and that the existing findings are inconsistent. The purpose of this aspect of the research studies was to investigate the interaction between ELF fields and schedule-controlled behavior following ELF exposures.

A wide range of studies have indicated possible biological interactions between agents that affect the central nervous system of an organism and exposure to electromagnetic fields. Pharmacological compounds which have their major central nervous system actions on behavior may have their effect modified by exposure to electromagnetic fields modulated at extremely low frequencies. Any possible effect of exposure to levels of electromagnetic radiation that may change the safety range and efficacy of standard drugs and medications used by a populace exposed to the electromagnetic fields produced by overhead transmission lines is potentially hazardous. There is a need for a beginning of a systematic evaluation of the possible behavioral effects of pharmacological and chemical agents in an environment of electric and magnetic fields produced by 60-Hz high voltage overhead power transmission lines.

In recent years an increasing number of studies have reported interactions between drugs that effect the central nervous system and exposure to electromagnetic radiation in the microwave frequencies (1,5,12,13,16,22,30,31). Galloway (12) and Galloway and Waxler (13) reported that fenfluramine and p-chlorophenylalamine combined with 383 or or 2450 MHz microwave exposure produced changes in the conditioned behavior of monkeys greater than drug or microwave effects alone. Cleary and Wagemann (5) showed that the duration of

pentobarbital-induced sleeping time in rabbits was decreased by exposure to 1.7 and 2.45 GHz microwave radiation. Lai, et al. (19) reported that the time to onset of loss of righting reflex in rats produced by phenobarbital was shortened by 45 min-exposure to 2450 MHz microwave at  $1 \text{ mW/cm}^2$ . Wesler and Frey (33) indicated that low intensity microwaves interact with the effects of apomorphine on the behavior of rats. Evidence of the combined effects of microwave radiation and d-amphetamine was reported by Thomas and Maitland (31) on the behavior of rats conditioned to respond on a DRL schedule. Thomas, Burch, and Yeandle (30) reported that a 30-min exposure to low-level microwave radiation in the near field potentiated the rate-increasing effects of chlordiazepoxide on the responding of rats maintained by a fixed-interval schedule of reinforcement. Sessions (26) reported that the interaction of chlordiazepoxide with microwaves on fixed-interval behavior was not obtained in a waveguide exposure system and Lundstrom et al. (23) indicated that the interaction was not obtained in a far-field condition. Johnson et al (17) found an interaction between diazepam and microwaves on the behavior of rats. Thomas, Schrot, and Banvard (32), however, found that the dose-effect function of diazepam and chlorpromazine was not altered by exposure to microwaves.

Although, the above current literature indicates that under many conditions the effects of various drugs are modified by exposure to electromagnetic radiation in the microwave frequencies, the actions of drugs in the presence of low-frequency (60 Hz) electromagnetic fields are practically unknown. The objective of this aspect of the research was to extend previous findings on the interaction between drugs and microwave exposures on schedule-controlled behavior to very-low frequency electromagnetic exposures. Specifically, the purpose was to determine if exposure to 60 Hz electromagnetic fields, similar to those generated under power lines, in any way changes or modifies the effects of two psychoactive pharmacological compounds, amphetamine and chlordiazepoxide, on behavior.

It has been suggested that the biological response of organisms to low-frequency alternating magnetic fields may be modified by weak static magnetic fields, similar to that of the earth's magnetic field. The suggestion implies that low-static fields may be directly involved in a wide range of responses to low-level electrical magnetic fields that are frequency dependent. Blackman et al. (4) reported that particular combinations of low-frequency magnetic fields and static fields on the order of the earth's

magnetic field enhance the efflux of calcium ions from in vitro chick brain. The purpose of this aspect of the research was to determine whether combined static and oscillating magnetic fields could alter behavioral responses in vivo.

## II. METHODS:

### A. Subjects:

The animals used in the present research were male Long-Evans hooded rats, approximately 200 days old at the start of conditioning and weighing about 340 g. The animals were maintained at approximately 80% of their free-feeding weights throughout the studies by food presented during experimental sessions and by post-session supplemental feeding. They were individually housed in a temperature-controlled room with a 12-h light/dark cycle that began at 0600 h. Water was continuously available in the home cage.

### B. Behavioral Baselines:

The animals performed daily in a rodent test chamber enclosed in a sound-attenuated housing. The test chamber contained a small response lever mounted on the front wall, two pilot lights above the lever, a house light, a speaker, and a hopper connected by a short tube to a feeder located behind the front wall that could dispense 45 mg food pellets. Experimental sessions usually lasted for one hour each day and were conducted five days per week (Monday through Friday). Programming and recording of sessions were accomplished automatically by a computer control system. Three identical test chamber/computer systems were used concurrently. The animals were trained on a multiple fixed-ratio (FR) differential-reinforcement-of-low-rate (DRL) reinforcement schedule that required responding on the response lever to produce food pellets (11). The multiple schedule was such that when a red pilot light above the lever was illuminated and a tone was present, a FR or counting schedule was in effect (11). On this schedule a rat was required to press the lever 30 times (FR 30) to produce a pellet. A FR schedule generates a rather high and constant rate of responding. When a green pilot light above the lever was illuminated and no tone was present, a DRL or timing schedule was in effect (11). On the DRL schedule a pellet was produced by a response on the lever that followed a preceding lever response by at least 18 seconds (DRL 18). A limited hold contingency was added to the DRL such that a response could not produce a pellet if it followed a preceding response by more than 24 seconds (limited-hold of six seconds). The DRL schedule generally produces a low and steady response rate with the highest frequency of inter-response times distributed around the DRL value. The FR and DRL schedules alternated unsystematically with each other during a session and each schedule was in effect for three minutes at a time. A 30 second time-out

period, during which all lights in the chamber were off, separated the termination of one schedule and the beginning of the next. A response on the lever during the time-out extended the period by 30 seconds. The total number of responses emitted during each of the multiple schedule components was recorded for each subject throughout a daily session. Daily response rates were calculated by dividing the total responses in each component by the amount of session time spent in each component. Response rates (responses per second) served as the main behavioral data throughout the series of studies. In addition, the temporal distribution of responses was recorded for the DRL schedule to allow an analysis of the patterning of responses in time. Cumulative response records were also recorded for each animal for each daily session. Several months of exposure to daily sessions of the multiple FR DRL schedule established stable baseline and control rates and patterns of responding. During experimental manipulations, the behavioral data was evaluated by comparing the same animal's response rate and pattern of responding on the FR and DRL schedules during baseline or control sessions with its performance during field exposure sessions.

#### C. Exposure Facilities:

The facility for exposing the animals to 60 Hz electric and magnetic fields consisted of four identical exposure systems. Each system contained two parallel 21.5 cm x 30.4 cm plates with a 10.1 cm spacing for generation of the electric field. The plates were located along the axis of three magnetic field coils separated from each other by about 13.5 cm. The coil diameters were about 31.5 cm. The magnetic field produced in the exposure system was a linearly polarized field. During field exposures the rats were constrained in a plexiglas enclosure located near the center of the bottom plate. The inside height of the enclosure was about 5.3 cm. The 60 Hz magnetic field was directed horizontally along an animal's long axis. The power-supplies of the electromagnetic fields were enclosed in a closed, lockable console such that technicians handling the animals and conducting the behavior experiments were unaware of the specific exposure conditions. The total earth's field in the area of the exposure systems was measured at  $4.04 \times 10^{-5}$  tesla. The 60 Hz background was estimated to be  $< 1 \times 10^{-7}$  tesla rms. Detailed description of field characteristics within the exposure and control areas may be found in a report to the National Bureau of Standards (25). Photographs of an exposure facility may be seen in Figures 1 and 2.

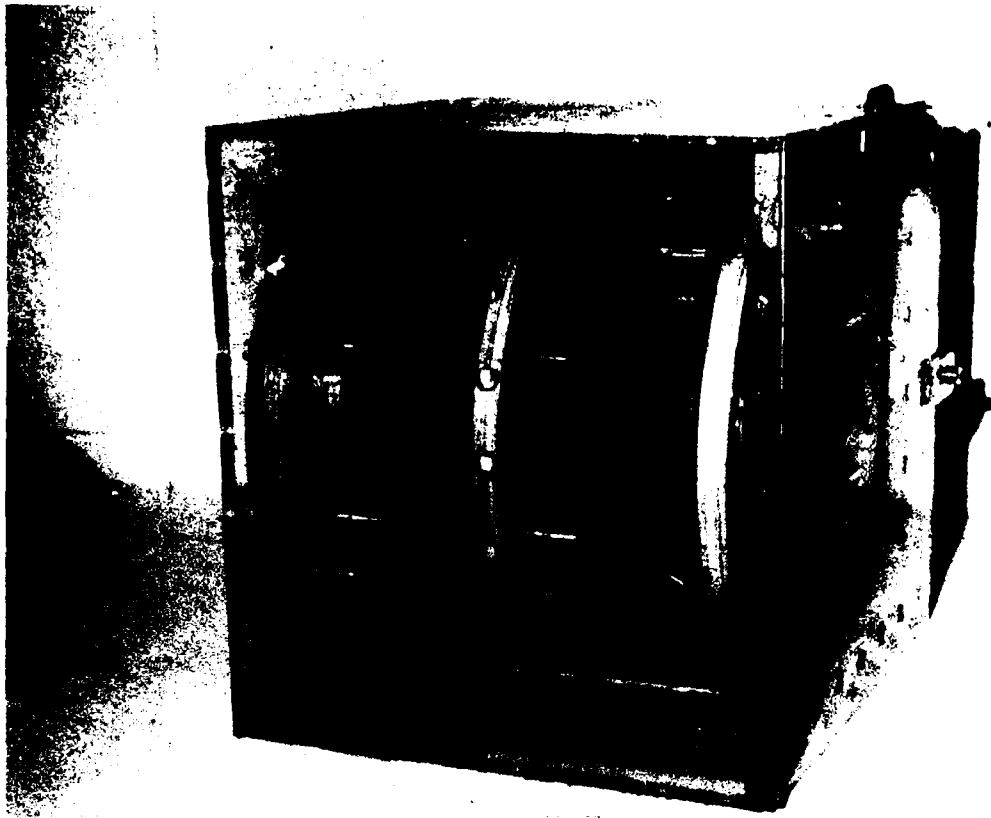


FIGURE 1

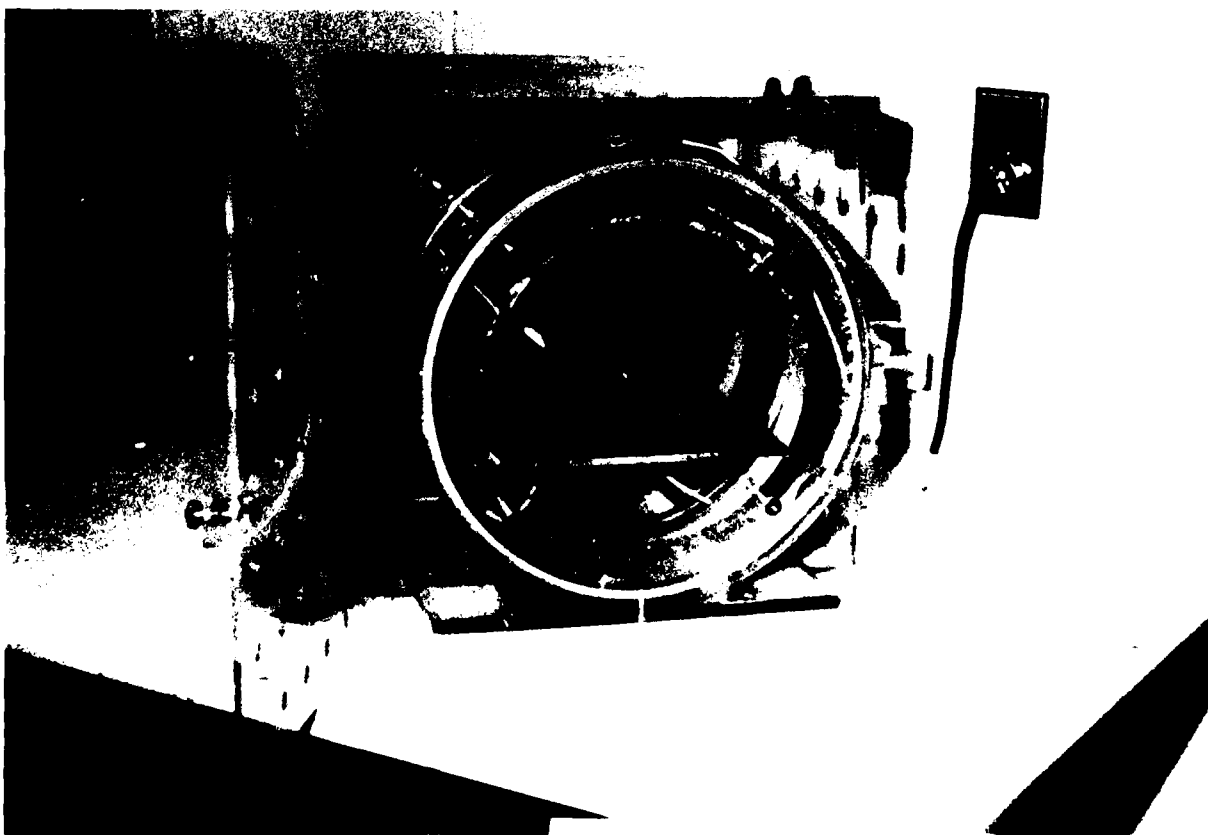


FIGURE 2

Over the course of several months, the animals were exposed for 30 minutes at a time immediately preceding a one hour session to specific electromagnetic fields. Animals were exposed to a particular 30 minute electromagnetic field configuration for a minimum of two replications. Each animal was usually exposed to a field no more than twice during a week (usually Tuesday and Friday), with baseline sessions preceding and following the exposures. Before the effects of the magnetic fields were studied, the animals were adapted over a number of weeks to the plexiglas housing by being placed in it for 30 minutes before a session until baseline performance with and without the housing was the same. During the course of the studies the animals were also placed in the holder for 30 minutes before a session with no fields present as a sham control.

D. Behavioral Effects of Electromagnetic Fields:

One group of five animals (designated as rats 1, 2, 3, 4, and 5) was exposed first to linearly polarized magnetic fields and then to a combination of magnetic fields and an electric field. The effects of linearly polarized magnetic fields alone on the multiple FR DRL schedule were investigated at .5, 1, 3, and 5 gauss. The effects of the magnetic fields combined with an electric field of 1 kv/m were also investigated at .5, 1, 3, and 5 gauss. The exact order and dates of exposure conditions for each subject are indicated in Tables 1 through 5.

As no systematic behavioral effects were observed for any of the above exposure conditions, the five subjects were further exposed to magnetic fields of both 1 and 3 gauss combined with a 1 kv/m electric field for an exposure duration of one hour. The animals were also further exposed to a combination of 3 gauss and 1 kv/m 30 minutes daily for one week. (See Tables 1 through 5).

E. Behavioral Effects of Drugs and Electromagnetic Fields:

Two groups of animals were used to investigate the potential interactions between two psychoactive drug classes and electromagnetic fields. One group of five animals (designated as rats 6, 7, 8, 9, and 10) was administered d-amphetamine sulfate at a dose of 1 mg/kg. A second group of five animals (designated as rats 11, 12, 13, 14, and 15) was administered chlordiazepoxide hydrochloride at a dose of 10 mg/kg. Rat 14 was removed from the experiments early due to the development of chronic dental problems.



Drugs were dissolved in saline in a volume of 0.1 ml/100 g of body weight and were administered intraperitoneally 30 minutes before the start of an experimental session. The drugs were administered initially without the presence of electromagnetic fields in the exposure facility. The animals were then given the drugs while exposed to the electromagnetic fields. The animals were exposed to a particular field configuration immediately after drug administration during the 30 minute period before an experimental session. The behavioral drug effects combined with the magnetic and electric fields were measured during the experimental session immediately after termination of the 30 minute field exposure. Saline control sessions and drug only control sessions were occasionally run. The two drugs were administered both alone and in combination with a range of field exposures. The effects of linearly polarized magnetic fields combined with either amphetamine or chlordiazepoxide were investigated at .5, 1, 3, and 5 gauss. Also, the behavioral effects produced by exposure to magnetic fields of .5, 1, 3, and 5 gauss combined with an electric field of 1 kv/m were explored with both drugs. The particular sequence of exposure to drugs and field conditions are presented for the amphetamine group in Tables 18 through 22 and for the chlordiazepoxide group in Tables 35 through 38.

F. Behavioral Effects of Combined Static and Oscillating Magnetic Fields:

A second set of magnetic coils with a vertical axis surrounding the exposure facility was constructed and added to the exposure apparatus described in Section C. above. A photograph of the second set of magnetic coils may be seen in Figure 3. The entire exposure facility with the additional coils in place is shown in Figure 4. The exposure equipment consisted of two Helmholtz coil arrays, one with a horizontal component and one with a vertical component. The outer coil set was used to apply a vertical magnetostatic field opposite in direction to the vertical component of the local geomagnetic field, and perpendicular to the linearly polarized 60 Hz field. The mean coil diameter of the outer array was 51.75 cm and the coil separation was 25.1 cm. The first group of animals (1, 2, 3, 4, and 5) were exposed for 30 minutes at a time immediately preceding a one hour experimental session to a combination of low-level magnetic fields in the two coil array apparatus. The magnetic field consisted of two components: an oscillating field and a static field. The oscillating field was a 60 Hz magnetic field



FIGURE 3

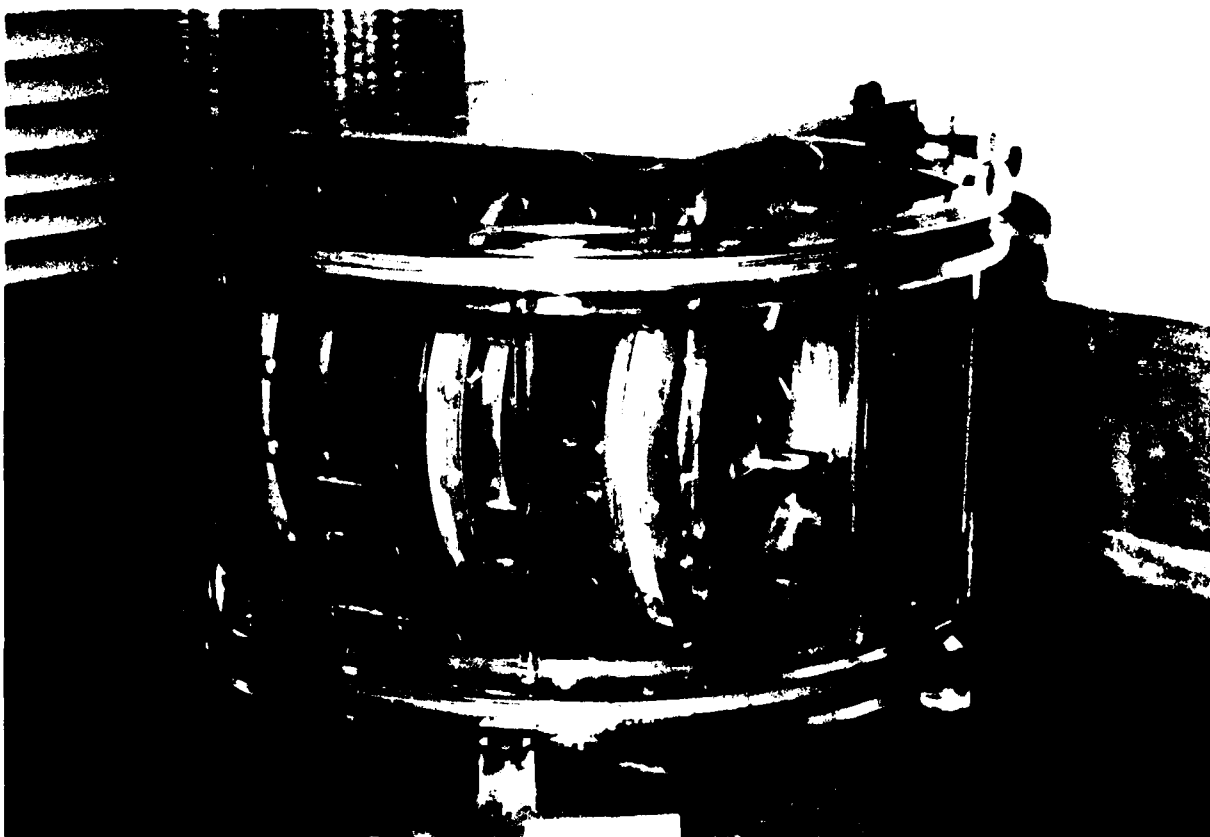


FIGURE 4

directed horizontally along each animal's long axis. The amplitude of the 60 Hz field was set at .5 gauss. Concurrently, the animals were exposed to a static magnetic field with an amplitude of 260 milligauss produced by the second set of Helmholtz coils located outside of the oscillating coils. Animals were exposed to the 30 minute combined magnetic field configuration for five replications. Each animal was exposed to the field no more than twice during a week, with baseline sessions preceding and following. The animals were additionally exposed to the static field alone without the 60 Hz oscillating field for five replications and to further replications of the .5 gauss 60 Hz field vector alone. Sham exposures consisted of no current being applied to the magnetic coils. The particular order of and dates exposure to the different magnetic field regimens are presented for each of the five subjects in Tables 49 through 53.

### III. RESULTS:

#### A. Behavioral Baselines:

Several months of training and exposure to daily sessions (five days per week) on the multiple FR DRL schedule produced stable baseline response rates and patterns of responding. A representative baseline performance may be seen for one subject in Figure 11,B. The FR schedule generated a high response rate with occasional brief pauses following delivery of food pellets. The DRL schedule generated a low response rate, with the highest occurrence of inter-response times near the 18 second DRL value. The overall mean baseline response rate of all subjects on the FR schedule was 3.545 responses per second. The mean response rate of all subjects on the DRL schedule was 0.055 responses per second. Individual subject's baseline response rates may be found in Tables 1 to 5, 18 to 22, 35 to 38, and 49 to 53. For all electromagnetic field exposure conditions, the behavioral data was evaluated by comparing an individual subject's response rate and pattern of responding on the FR and DRL schedules during field exposure sessions with its performance during baseline sessions.

#### B. Behavioral Effects of Electromagnetic Fields:

The effects of linearly polarized magnetic fields alone were investigated for five animals (rats 1, 2, 3, 4, and 5) at .5, 1, 3, and 5 gauss. No systematic behavioral changes on the multiple schedule were observed at any of the four field intensities. Individual response rate data may be found in Tables 1 to 5. Data in those tables is presented in both absolute response rate format and percent of baseline control (% cont) format. Magnetic fields combined with an electric field of 1 kv/m were also investigated at .5, 1, 3, and 5 gauss. Again, no systematic behavioral effects were observed for any of the exposure conditions. Response rate data for the individual subjects

exposed to the combined fields are also shown in Tables 1 to 5. The five subjects were then exposed to magnetic fields of both 1 and 3 gauss combined with a 1 kv/m electric field for a one hour exposure. The subjects were also exposed to combined fields of 3 gauss and 1 kv/m for 30 minutes a day for five consecutive days. Response rates, as shown in Tables 1 to 5, indicated no systematic evidence for behavioral effects produced by any of the above exposures to 60 Hz fields.

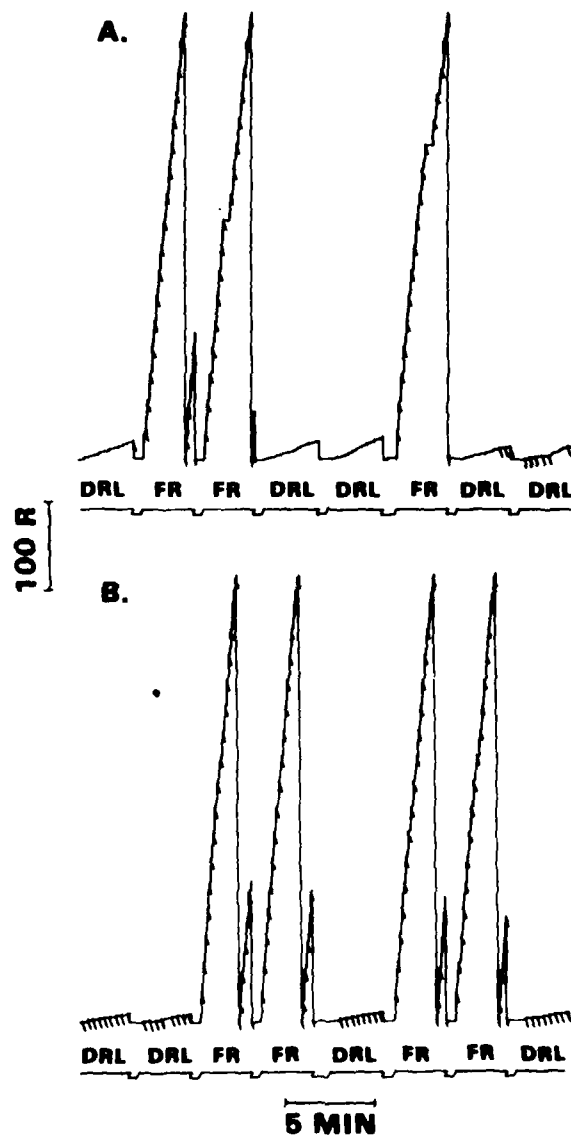


FIGURE 11

In order to allow a better visual comparison of the effects of the different exposure conditions, each condition was averaged and the means and standard deviations of each condition for each animal are presented in Tables 6 through 10. Summary response rates (means of each condition averaged for all five animals) are shown in Table 11. Tables 12 through 17 and Figures 5 and 6 present the above data calculated as percent of control response rates. Figure 5 shows response rates on the FR and DRL schedules at each of four magnetic field levels. Figure 6 shows response rates on the two schedules when the same magnetic fields were combined with a 1 kv/m electric field. The averaged and percent control response rates clearly indicate that under the present experimental exposure conditions and durations, exposures to the 60 Hz electromagnetic fields produced no systematic changes in the behavior of the animals on the multiple FR DRL schedule.

C. Behavioral Effects of Drugs and Electromagnetic Fields:

The effects of linearly polarized magnetic fields combined with 1 mg/kg d-amphetamine were investigated for five animals (rats 6, 7, 8, 9, and 10) at .5, 1, 3, and 5 gauss. Individual response rate data are presented in Tables 18 through 22. Tables 23 through 28 present the average response rates for the five animals for each of the drug, amphetamine, and field exposure conditions. Tables 29 through 30 and Figures 7 and 8 show the above same data calculated as percent of control response rates. There was a clear indication of a drug effect, particularly seen as an increased rate of responding on the DRL schedule above control values and a slightly decreased rate of responding on the FR schedule. There was no systematic observed effect produced by exposure to the magnetic fields on the behavioral effects of d-amphetamine. Also, there was no modification of the behavioral effects of d-amphetamine produced by exposure to magnetic fields of .5, 1, 3, and 5 gauss combined with an electric field of 1 kv/m (Figure 8).

Magnetic fields of .5, 1, 3, and 5 gauss were investigated for four animals (11, 12, 13, and 15) combined with 10 mg/kg chlordiazepoxide. Response rates for individual animals on the multiple schedule are shown in Tables 35 through 38. The average response rates of the four animals for each of the drug, chlordiazepoxide, and field exposure conditions are shown in Tables 39 through 43. The data for each of the drug and field exposure conditions calculated as percent of control response rates is presented in Tables 44 to 48 and Figures 9 and 10. Chlordiazepoxide alone produced an

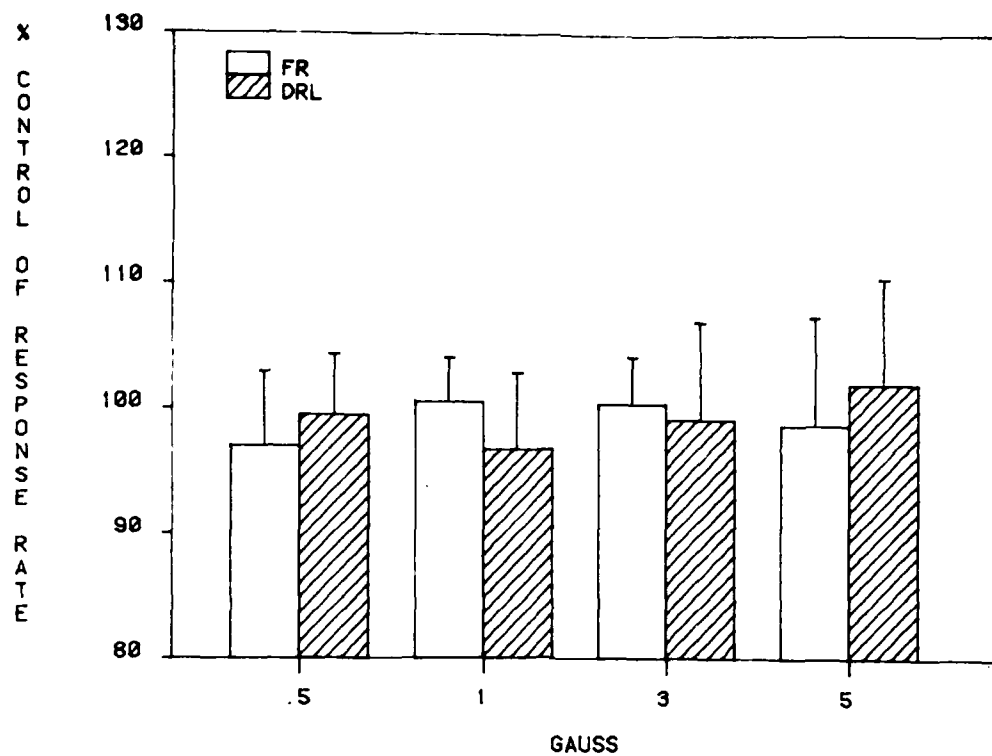


FIGURE 5

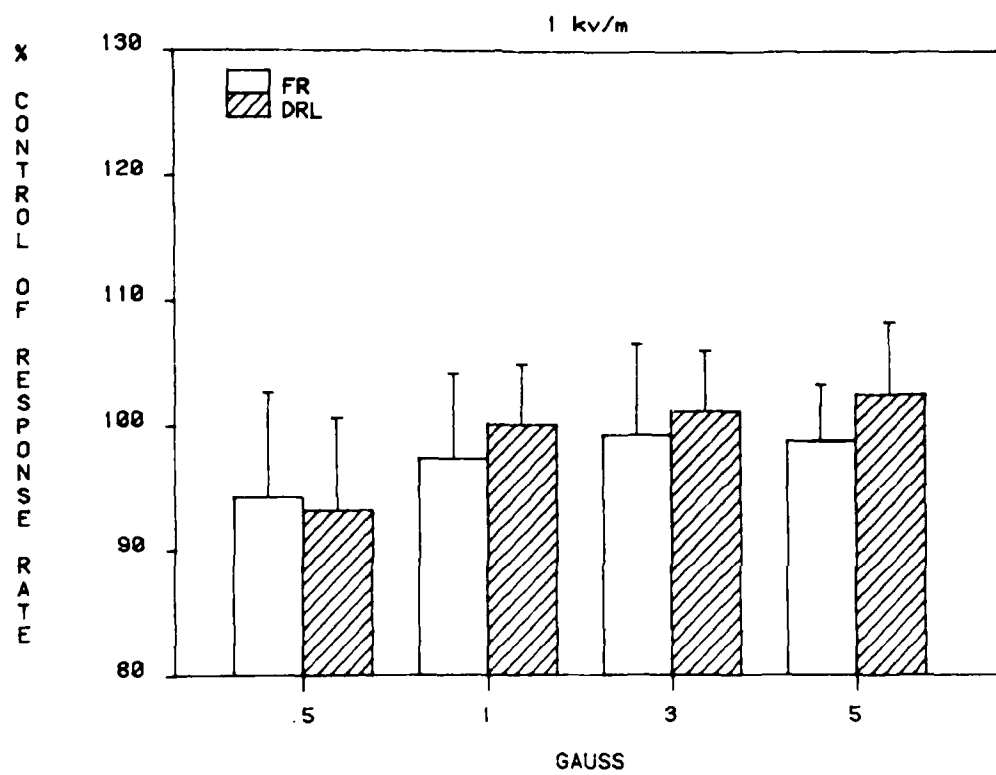


FIGURE 6

# AMPHETAMINE

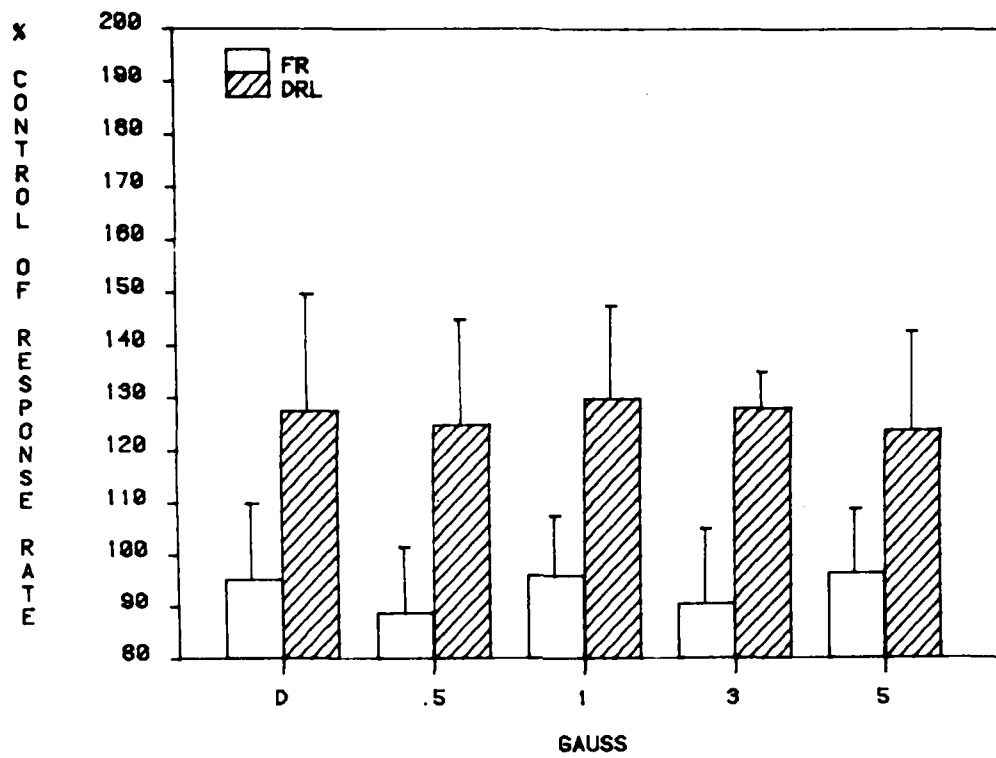


FIGURE 7

# AMPHETAMINE 1 kv/m

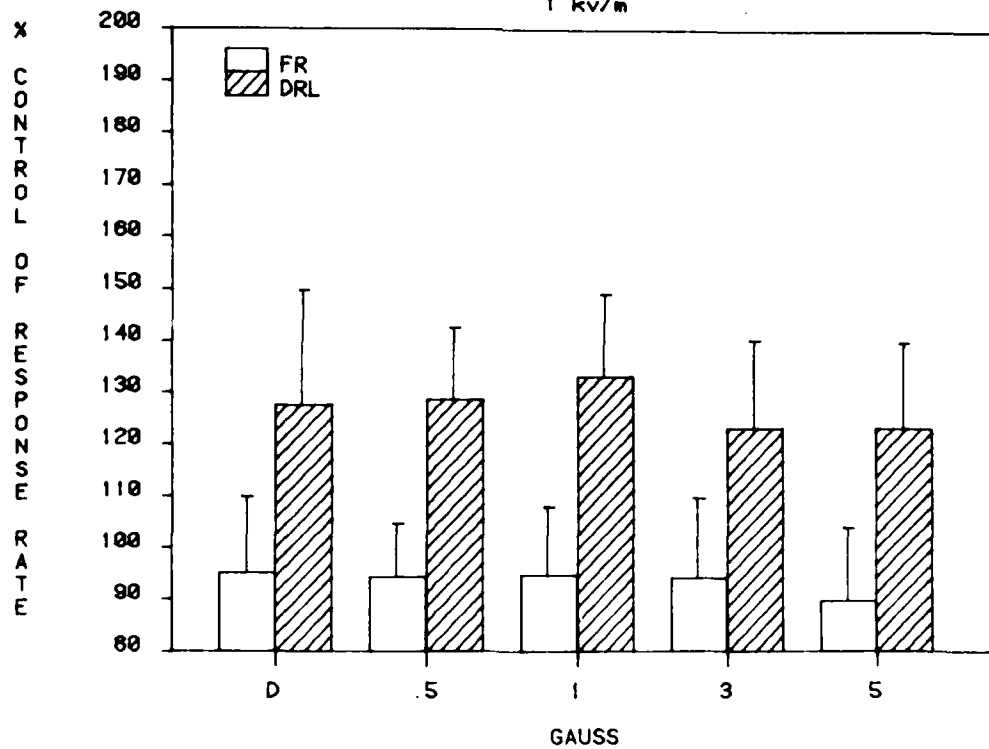


FIGURE 8



# CHLORDIAZEPOXIDE

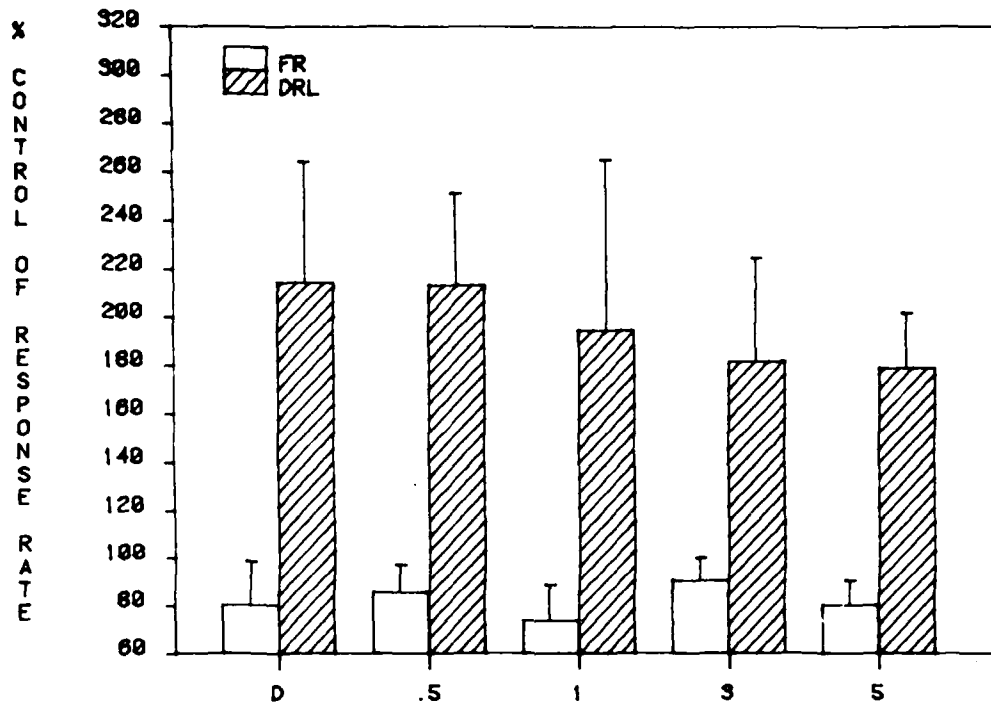


FIGURE 9

# CHLORDIAZEPOXIDE 1 kv/m

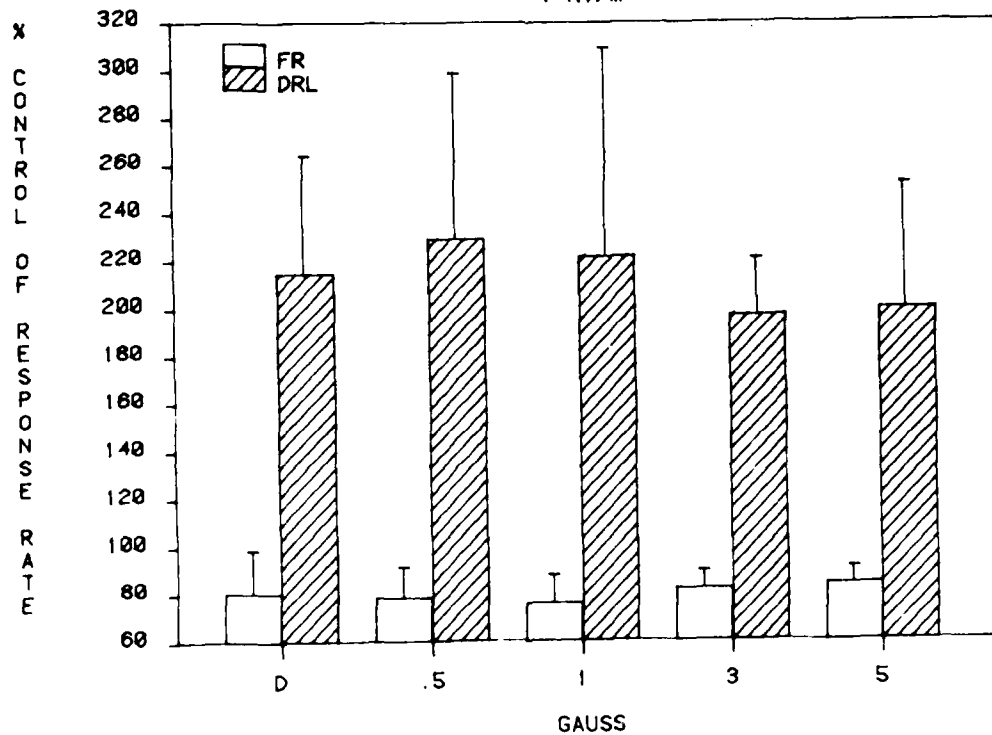


FIGURE 10

elevated response rate on the DRL schedule and a decreased response rate on the FR schedule. Exposures to the four magnetic field intensities did not alter the behavioral effects of the drug (Figure 1). Exposures to the same four magnetic field intensities combined with an electric field of 1 kv/m also did not alter the behavioral effects of chlordiazepoxide (Figure 10).

The results indicate no systematic effect on the behavioral pharmacology of either amphetamine or chlordiazepoxide, at the doses explored, by any of the exposures to the magnetic fields alone or in combination with an electric field. In no instance did the behavioral effects of either drug combined with the 60 Hz fields clearly appear any different on the FR or DRL schedule than the behavioral effects produced by the drugs themselves.

#### D. Behavioral Effects of Combined Static and Oscillating Magnetic Fields:

The first group of five subjects (rats 1, 2, 3, 4, and 5) were exposed to a combination of low-level magnetic fields, consisting of an oscillating 60 Hz field and a static field. Exposures to the combined static and oscillating fields consistently produced a systematic modification in both the rate and pattern of responding on the DRL schedule. Performance on the FR schedule was not systematically affected by the field exposures. No changes in behavior on the multiple FR DRL schedule were observed when the animals were exposed to the applied 60 Hz oscillating magnetic field alone. Similarly, systematic disturbances of behavior were never observed when the animals were exposed to the static field alone. The observed changes in DRL behavior occurred only under the condition of exposure to the combined static and oscillating fields.

Figure 12 shows the relative changes in response rates on the DRL and FR schedules for sham exposures, oscillating field alone exposures, static field alone exposures, and combined magnetic field exposures for each animal. The individual response rate data for each animal for each exposure condition is shown in Tables 49-53 and the summary data upon which Figure 12 is based are shown in Tables 54 through 58. Tables 49-53 show the response rate data for each of the four exposure conditions (sham, oscillating, static, and combined fields) for each animal. Under each of the exposure conditions, the response rate data for five replications are shown as well as the response rates from a baseline control session immediately preceding each field exposure condition. The above individual animal response rate data expressed as percent control

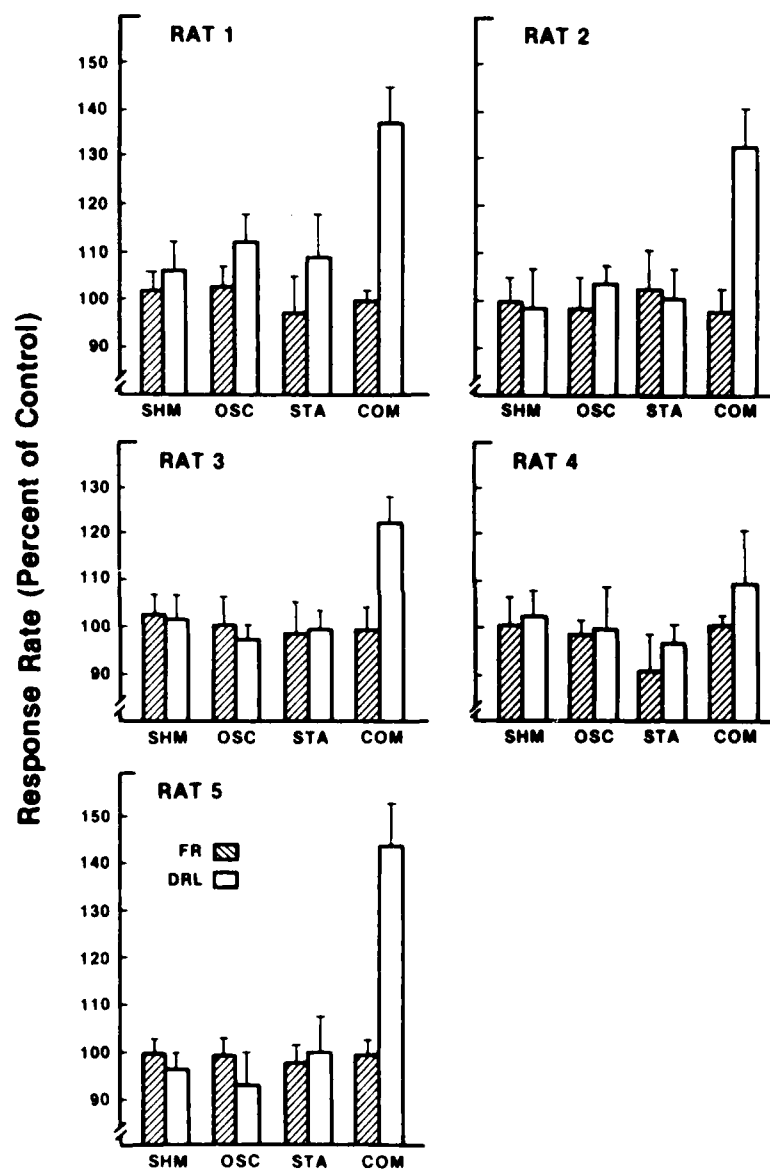


FIGURE 12

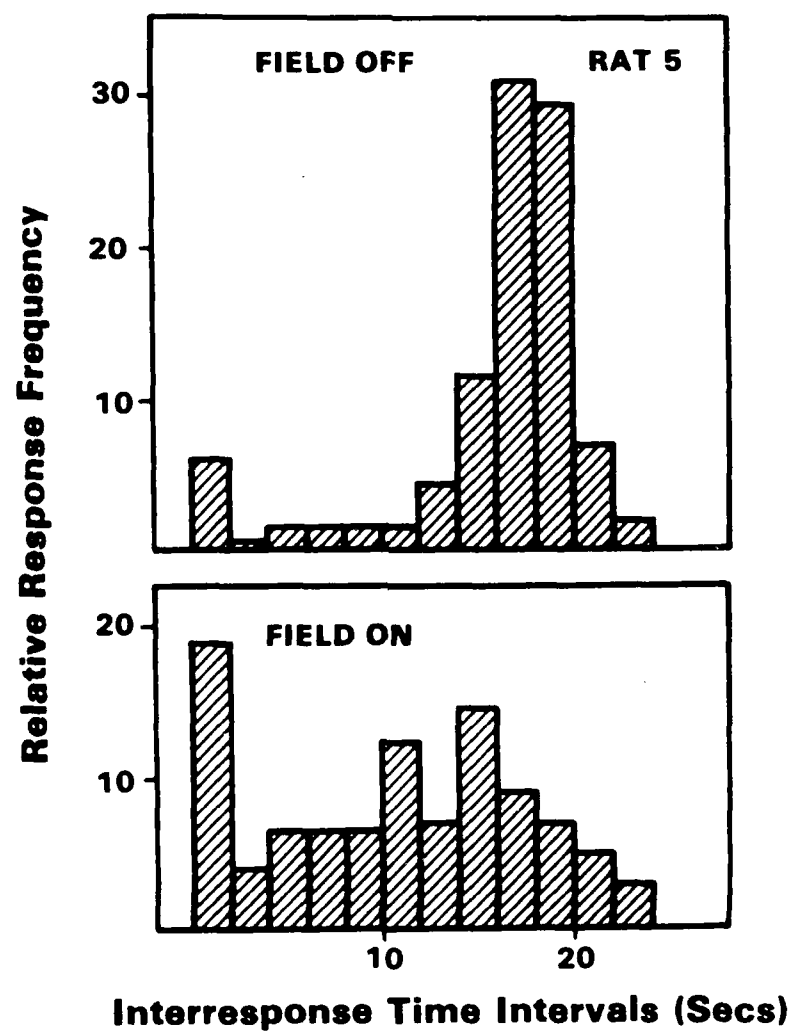


FIGURE 13

(percent of the mean of all baseline control sessions preceding field exposure sessions) for the four exposure conditions is presented in Tables 54 through 58. The five animals showed a consistent and reproducible increase in the rate of responding on the DRL schedule as a result of exposure to the magnetic fields. Figure 13 shows the changes that occurred in the temporal pattern of behavior for one animal as a function of combined magnetic field exposure. The top section of Figure 13 shows that under baseline conditions the largest number of responses followed a preceding response by about 16 to 20 seconds, indicating a rather precise temporal discrimination. Following exposure to the combined magnetic field condition, shown in the bottom section of Figure 13, the response distribution was flattened and shifted toward shorter inter-response times. This shift reflects the increased response rate shown in Figure 6; the flattening of the distribution indicates a reduction in temporal discrimination. Figure 11 shows two cumulative-response records for a combined magnetic field exposure session (A) and a baseline session (B) for one animal. Higher inappropriate rates of responding can be seen during much of the DRL segments for the combined field exposure session. The higher response rates that occur during the magnetic field session were also associated with a marked decline in food pellet frequency (indicated by a reduction in the number of pips during the DRL segments due to the occurrence of the large number of responses that were not correctly spaced). The observed behavioral changes that did occur were transitory, disappearing in less than 24 hours. A comparison of the two cumulative records in Figure 11 shows that there were no systematic differences in the FR performance as a result of combined static and oscillating magnetic field exposures.

#### IV. SUMMARY OF RESEARCH FINDINGS:

Under the specific field exposure configurations and durations of the present experimental conditions, exposures to 60 Hz magnetic fields at intensities of .5 to 5 gauss with and without the combination of a 1 kv/m 60 Hz electric field produced no systematic changes in the behavior of animals on a multiple schedule. Exposures to the 60 Hz electromagnetic fields produced no clear effect on either response rates or patterns of responding on the multiple FR DRL schedule. The 60 Hz electromagnetic fields were also investigated on the multiple schedule performance of animals administered representative drugs from two psychoactive drug classes; amphetamine at a dose of 1 mg/kg and chlordiazepoxide at 10 mg/kg. No systematic effects were observed on the behavioral pharmacology of either amphetamine or chlordiazepoxide by exposures to the 60 Hz magnetic fields alone or in combination with a 60 Hz electric field.

The behavior of animals on the multiple FR DRL schedule was affected by exposure to a 60 Hz magnetic field when it was combined with a low-level magnetostatic field. When the animals were exposed to a low-level (.5 gauss) 60 Hz magnetic field in combination with a low-level static magnetic field (about half the earth's field) consistent changes were exhibited in the rate of pattern of responding during the DRL component of the multiple FR DRL reinforcement schedule. As pointed out above, no changes in behavior on the multiple schedule were observed when the animals were exposed to the 60 Hz magnetic field alone. Indeed, systematic behavioral effects were never produced by the 60 Hz magnetic field alone for a range of field intensities, from .5 to 5 gauss, or for extended exposure durations up to a week. Similarly, systematic disturbances of behavior were never observed when the animals were exposed to the static magnetic field alone. The observed changes in behavior occurred only following exposure to the combined static and oscillating fields. The behavior changes on the DRL schedule indicate that under very precise conditions, extremely weak 60 Hz magnetic fields may have a significant biological effect. The results of the present research suggest that static magnetic fields, similar in strength to the earth's magnetic field, can alter the effects of low strength alternating fields on the behavior of animals.

The behavioral changes that were observed to occur in animals appears to be reversible, lasting for at least one hour following exposure but not for 24

hours. The field configuration required to produce the changes in behavior consists of a combination of static and oscillating fields, an observation strongly suggesting a resonance phenomenon. Using a well-established experimental protocol (2,3), Blackman et al. (4) found that certain combinations of low-frequency (15-45 Hz) magnetic fields and static fields (25-76  $\mu$ T) enhance the efflux of calcium ions from in vitro chick brain. A number of these combinations correspond to the cyclotron resonance condition of free, circulating ions (20). Liboff (21) indicated that the helical geometry of transmembrane ionic channels represents a particularly appropriate configuration in which to obtain a cyclotron resonance mechanism. The cyclotron resonance condition is given by the gyrofrequency where  $(q/m)$  is the

$$\nu = \frac{1}{2\pi} \left( \frac{q}{m} \right) B_0$$

ionic charge-to-mass ratio and  $B_0$  is the local magnetostatic field. The field configuration required to effect these changes in behavior consists of a combination of static and oscillating fields, an observation strongly suggesting a resonance phenomenon. The specific combination of field and frequency that was effective is consistent with the cyclotron resonance condition for unhydrated lithium ions. The fact that the behavioral changes occurred only for combined fields, and that the particular successful combination enjoys a close correspondence to the singly charged lithium ion constitutes a fairly strong argument that a mechanism akin to cyclotron resonance is involved in the observed behavioral changes. Furthermore, it is well-established (18) that lithium plays a role in brain biochemistry. When administered as a carbonate, it can be used to treat bipolar affective disorders in humans. Presumably, enhanced lithium concentration increases the sensitivity of serotonin receptors and alpha-adrenergic receptors. The manner in which lithium affects operant behavior in rats is not clear, although some lithium-dependent behavioral changes have been reported (27). It is conceivable that the results obtained in the present work may be related to the resonant efflux of lithium ions from cells in rat brains. It is not necessary to restrict the resonance possibility to merely lithium. There are combinations of fields that theoretically correspond to all the physiologically significant ions ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ ,  $\text{Ca}^{++}$ ,  $\text{Mg}^{++}$ ), different states of hydration, higher harmonics, etc. It would be reasonable to design future experiments concerned with

electromagnetically induced changes in behavior around such biochemical parameters, rather than merely levels of intensity.

Quite apart from the question of resonance, the present results tend to imply a functional dependence of behavior on the geomagnetic field. This field, over the earth's surface, varies from  $0.25 \times 10^{-4}$  to  $0.70 \times 10^{-4}$  T. There is a good likelihood of occasional human exposures to the particular combination of a 60 Hz field and a  $0.26 \times 10^{-4}$  T magnetostatic field, especially at low geomagnetic latitudes. Further, if a cyclotron resonance type of mechanism is associated with the observed changes in operant behavior, there will be other critical combinations of the geomagnetic field with the 60 Hz background.



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#### FIGURE LEGENDS:

- Figure 1. Photograph of exposure system. Side view with door closed. The set of three coils was used to apply a horizontal oscillating magnetic field parallel to the rat's long axis. Note that the coils are in a three fold configuration, 2N, N, 2N, with N=24 times. Coil diameters are 31.0 cm, and separation of one coil from the next is 13.3 cm.
- Figure 2. Inner view of exposure system with door open. The hemicylindrical plastic rat holder is shown in part at the center. The two horizontal aluminum electrodes were for application of vertical electric fields. The plates are 21.5 cm x 30.4 cm each with a 10.1 cm spacing between the two.
- Figure 3. Photograph of outer set of coils. This set was used to apply a vertical static magnetic field opposite in direction to the vertical component of the local geomagnetic field, and perpendicular to the linearly polarized 60 Hz field. These coils approximate a Helmholtz configuration. The mean coil diameter is 15.75 cm and the coil separation is 25.1 cm. There are 70 turns in each coil.
- Figure 4. Photograph of exposure system with outer set of coils in place.
- Figure 5. Changes in rate of responding (% control) on FR and DRL schedules for four magnetic field values. The data is based on the means of each condition averaged for five animals. Brackets indicate standard deviations.
- Figure 6. Changes in response rates (% control) on FR and DRL schedules for four magnetic field values combined with a 1 kv/m electric field. Data consists of the means of each condition averaged for five animals. Brackets indicate standard deviations.
- Figure 7. Changes in response rates (% control) on FR and DRL schedules produced by 1 mg/kg d-amphetamine. Effects of drug alone are shown at D. Effects of the drug on behavior are shown for four magnetic field values. Data is based on the means of each condition averaged for five animals and brackets indicate standard deviations.

Figure 8. Changes in response rates (% control) on FR and DRL schedules produced by 1 mg/kg d-amphetamine. Drug only is shown at D. Effects of the drug are shown for four magnetic field values combined with a 1 kv/m electric field. Data consists of the means of each condition averaged for five animals and brackets indicate standard deviations.

Figure 9. Changes in rate of responding (% control) on FR and DRL schedules produced by 10 mg/kg chlordiazepoxide. Effects of the drug alone on the two schedules are shown at D. Drug-induced response rate changes are shown for four magnetic field intensities. Data is based on the means of each condition averaged for four animals. Brackets indicate standard deviations.

Figure 10. Changes in response rates (% control) on FR and DRL schedules produced by 10 mg/kg chlordiazepoxide. Effects of the drug alone on the two schedules are shown at D. Drug induced response rate changes are shown for four magnetic field intensities combined with a 1 kv/m electric field. Data is based on the means of each condition averaged across four animals and brackets indicate standard deviations.

Figure 11. Cumulative response records of one animal for portions of a magnetic field exposure session (A) and a baseline session (B). Each recording response stepped the recording pen upward. Pips indicate delivery of a food pellet. The bottom pen was down during the timeout periods that separated successive FR and DRL schedules.

Figure 12. Changes in rates of responding (expressed as percent of the mean of all baseline control sessions preceding field exposure sessions) on both the DRL and FR schedules for the four exposure conditions. SHM is a sham exposure, OSC is exposure to the 60 Hz field alone, STA is exposure to a revised local field, and COM is exposure to the combined, "resonant" fields. In each case the value plotted is the mean of five sessions. Brackets indicate standard deviations.

Figure 13. Relative frequency distribution of time intervals between successive lever responses during DRL segments of one animal for a baseline control session (field off) and a magnetic field exposure session (field on). Each inter-response time interval is 2 sec wide and the last interval contains all responses that followed a preceding response by 22 sec or longer.

TABLE 1. Response Rates for Rat 1

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-6-84	Baseline	4.463	--	.076	--	.043	--
3-16-84	Baseline	4.917	--	.072	--	.021	--
3-20-84	Baseline	5.004	--	.070	--	.027	--
3-27-84	Baseline	4.515	--	.077	--	.020	--
4-10-84	Chamber	4.995	--	.078	--	.017	--
4-17-84	Chamber	5.013	--	.078	--	.017	--
4-24-84	Chamber	4.435	--	.068	--	.024	--
4-27-84	Chamber	4.880	--	.073	--	.018	--
5-1-84	.5g	4.639	95.6	.073	98.7	.022	95.7
5-4-84	1g	4.820	99.4	.068	91.9	.014	60.9
5-8-84	3g	4.822	99.4	.077	104.1	.023	100.0
5-12-84	5g	4.762	98.2	.070	94.6	.018	78.3
5-15-84	1g	4.621	95.3	.075	101.4	.017	73.9
5-18-84	3g	4.922	101.5	.068	91.9	.020	87.0
5-22-84	.5g	4.614	95.1	.070	94.6	.011	47.8
5-25-84	5g	4.645	95.8	.069	93.2	.030	130.4
5-28-84	Chamber	5.093	--	.078	--	.024	--
5-29-84	.5g + 1kv	4.645	95.8	.069	93.2	.020	87.0
6-1-84	1g + 1kv	4.938	101.8	.079	106.8	.016	69.6
6-5-84	3g + 1kv	5.263	108.5	.074	100.0	.035	152.2
6-12-84	3g + 1kv	4.871	100.4	.076	102.7	.020	87.0
6-19-84	1g + 1kv	4.815	99.3	.071	96.0	.017	73.9
6-22-84	.5g + 1kv	4.796	98.9	.062	83.8	.021	91.3
6-26-84	5g + 1kv	5.076	104.6	.075	101.4	.013	56.5
6-29-84	5g + 1kv	5.011	103.3	.065	87.8	.031	134.8
7-10-84	Chamber	4.957	--	.077	--	.022	--
7-17-84	1g + 1kv (1 hr)	4.611	95.1	.075	101.4	.033	143.5
7-19-84	3g + 1kv (1 hr)	4.669	96.2	.063	85.1	.025	108.7
7-24-84	1g + 1kv (1 hr)	4.650	95.9	.066	89.2	.024	104.4
7-27-84	3g + 1kv (1 hr)	4.727	97.4	.071	96.0	.011	47.8
8-3-84	Chamber	5.041	--	.074	--	.019	--
8-6-84	3g + 1kv	5.042	103.9	.070	94.6	.019	82.6
8-7-84	3g + 1kv	4.600	94.8	.073	98.7	.018	78.3
8-8-84	3g + 1kv	5.138	105.9	.070	94.6	.037	160.9
8-9-84	3g + 1kv	4.601	94.9	.065	87.8	.019	82.6
8-10-84	3g + 1kv	4.724	97.4	.072	97.3	.037	160.9
8-16-84	Chamber	4.909	--	.063	--	.022	--



TABLE 2. Response Rates for Rat 2

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	T0 Resp Rate	T0 Rate (% Cont)
3-6-84	Baseline	2.433	--	.055	--	.011	--
3-16-84	Baseline	2.730	--	.054	--	.019	--
3-20-84	Baseline	2.850	--	.051	--	.019	--
3-27-84	Baseline	2.776	--	.050	--	.011	--
4-10-84	Chamber	2.899	--	.054	--	.016	--
4-17-84	Chamber	2.729	--	.059	--	.022	--
4-24-84	Chamber	2.764	--	.050	--	.012	--
4-27-84	Chamber	3.052	--	.046	--	.007	--
5-1-84	.5g	3.055	108.0	.056	103.7	.011	61.1
5-4-84	1g	2.956	104.5	.048	88.9	.024	133.3
5-8-84	3g	2.945	104.1	.056	103.8	.028	155.6
5-11-84	5g	2.661	94.0	.059	109.3	.009	50.0
5-15-84	1g	2.740	96.8	.055	101.9	.003	16.6
5-18-84	3g	2.834	100.1	.048	88.9	.013	72.2
5-22-84	.5g	2.548	90.0	.058	107.4	.014	77.8
5-25-84	5g	2.989	105.6	.049	90.7	.017	94.4
5-28-84	Chamber	2.734	--	.057	--	.011	--
5-29-84	.5g + 1kv	2.505	88.5	.059	109.3	.007	38.9
6-1-84	1g + 1kv	2.912	102.9	.054	100.0	.026	144.4
6-5-84	3g + 1kv	2.973	105.1	.058	107.4	.012	66.7
6-12-84	3g + 1kv	2.892	102.2	.056	93.7	.015	83.3
6-19-84	1g + 1kv	2.575	91.0	.054	100.0	.011	61.1
6-22-84	.5g + 1kv	3.095	109.4	.052	96.3	.019	105.6
6-26-84	5g + 1kv	2.838	100.3	.056	103.8	.016	88.9
6-29-84	5g + 1kv	2.807	99.2	.055	101.9	.077	427.8
7-10-84	Chamber	2.812	--	.058	--	.028	--
7-17-84	1g + 1kv (1 hr)	2.651	93.7	.062	114.8	.048	266.7
7-19-84	3g + 1kv (1 hr)	2.734	96.6	.053	98.2	.037	205.6
7-24-84	1g + 1kv (1 hr)	2.838	100.3	.063	116.7	.053	294.4
7-27-84	3g + 1kv (1 hr)	3.041	107.5	.054	100.0	.020	111.1
8-3-84	Chamber	3.253	--	.057	--	.017	--
8-6-84	3g + 1kv	3.211	113.5	.060	111.1	.051	283.3
8-7-84	3g + 1kv	3.096	109.4	.051	94.4	.022	122.2
8-8-84	3g + 1kv	2.952	104.3	.053	98.2	.023	127.8
8-9-84	3g + 1kv	3.156	111.5	.054	100.0	.028	155.6
8-10-84	3g + 1kv	2.856	101.9	.057	105.4	.037	205.6
8-16-84	Chamber	2.933	--	.055	--	.033	--

TABLE 3. Response Rates for Rat 3

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-6-84	Baseline	2.600	--	.069	--	.018	--
3-16-84	Baseline	2.933	--	.075	--	.009	--
3-20-84	Baseline	2.742	--	.079	--	.028	--
3-27-84	Baseline	3.067	--	.067	--	.019	--
4-10-84	Chamber	3.004	--	.078	--	.024	--
4-17-84	Chamber	2.697	--	.071	--	.025	--
4-24-84	Chamber	2.913	--	.079	--	.007	--
4-27-84	Chamber	3.020	--	.069	--	.007	--
5-1-84	.5g	3.019	104.8	.072	100.0	.017	81.0
5-4-84	1g	2.846	98.8	.062	86.1	.023	109.5
5-8-84	3g	2.711	94.1	.062	86.1	.019	90.5
5-11-84	5g	2.925	101.5	.066	91.7	.018	85.7
5-15-84	1g	3.021	104.9	.077	106.9	.009	42.9
5-18-84	3g	2.903	100.8	.079	109.7	.029	138.1
5-22-84	.5g	2.571	89.2	.070	97.2	.007	33.3
5-25-84	5g	2.275	79.0	.079	109.7	.021	100.0
5-28-84	Chamber	2.936	--	.062	--	.019	--
5-29-84	.5g + 1kv	2.201	76.4	.067	93.1	.013	61.9
6-1-84	1g + 1kv	2.394	83.1	.065	90.3	.014	66.7
6-5-84	3g + 1kv	2.879	99.9	.077	106.9	.019	90.5
6-12-84	3g + 1kv	2.388	82.9	.070	97.2	.007	33.3
6-19-84	1g + 1kv	2.802	97.3	.070	97.2	.020	95.2
6-22-84	.5g + 1kv	2.615	90.8	.066	91.7	.025	119.0
6-26-84	5g + 1kv	2.973	103.2	.072	100.0	.014	66.7
6-29-84	5g + 1kv	2.818	97.8	.076	105.6	.014	66.7
7-10-84	Chamber	2.984	--	.074	--	.037	--
7-17-84	1g + 1kv (1 hr)	2.978	103.4	.073	101.4	.129	614.3
7-20-84	3g + 1kv (1 hr)	2.792	96.9	.065	90.3	.046	219.1
7-24-84	1g + 1kv (1 hr)	2.979	103.4	.067	93.1	.017	81.0
7-27-84	3g + 1kv (1 hr)	2.846	98.8	.075	104.2	.124	590.4
8-3-84	Chamber	2.920	--	.073	--	.025	--
8-6-84	3g + 1kv	2.817	97.8	.071	98.6	.025	119.1
8-7-84	3g + 1kv	2.901	100.7	.067	93.1	.023	109.5
8-8-84	3g + 1kv	2.912	101.1	.077	107.0	.031	147.6
8-9-84	3g + 1kv	2.757	95.7	.073	101.4	.026	123.8
8-10-84	3g + 1kv	2.732	94.8	.066	91.7	.016	76.2
8-16-84	Chamber	2.752	--	.073	--	.028	--

TABLE 4. Response Rates for Rat 4

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-6-84	Baseline	4.272	--	.060	--	.009	--
3-16-84	Baseline	4.334	--	.063	--	.020	--
3-20-84	Baseline	3.563	--	.060	--	.013	--
3-27-84	Baseline	3.883	--	.061	--	.014	--
4-10-84	Chamber	3.963	--	.064	--	.029	--
4-17-84	Chamber	3.916	--	.073	--	.022	--
4-25-84	Chamber	3.591	--	.061	--	.019	--
4-24-84	Chamber	3.568	--	.066	--	.029	--
5-1-84	.5g	3.676	98.1	.063	95.5	.026	123.8
5-4-84	1g	3.651	97.5	.062	93.9	.019	90.5
5-8-84	3g	3.651	97.5	.067	101.5	.010	47.6
5-11-84	5g	3.893	104.0	.073	110.6	.007	33.3
5-15-84	1g	3.840	102.6	.066	100.0	.017	81.0
5-18-84	3g	3.620	96.7	.063	95.5	.013	61.9
5-22-84	.5g	3.463	92.5	.067	101.5	.005	23.8
5-25-84	5g	3.462	92.5	.070	106.1	.021	100.0
5-28-84	Chamber	3.332	--	.072	--	.022	--
5-29-84	.5g + 1kv	3.642	97.3	.066	100.0	.016	76.2
6-1-84	1g + 1kv	3.381	90.3	.067	101.5	.019	90.5
6-5-84	3g + 1kv	3.513	93.9	.072	109.1	.016	76.2
6-12-84	3g + 1kv	3.470	92.7	.064	97.0	.019	90.5
6-19-84	1g + 1kv	3.638	97.2	.071	107.6	.016	76.2
6-22-84	.5g + 1kv	3.330	89.0	.061	92.4	.020	95.2
6-26-84	5g + 1kv	3.479	93.0	.068	103.0	.017	81.0
6-29-84	5g + 1kv	3.353	89.6	.069	104.6	.029	138.1
7-10-84	Chamber	3.191	--	.073	--	.020	--
7-17-84	1g + 1kv (1 hr)	3.130	83.6	.066	100.0	.015	71.4
7-20-84	3g + 1kv (1 hr)	3.476	92.9	.063	95.5	.037	176.2
7-24-84	1g + 1kv (1 hr)	3.615	96.6	.066	100.0	.003	14.3
7-27-84	3g + 1kv (1 hr)	3.522	94.1	.063	95.5	.013	61.9
8-3-84	Chamber	3.568	--	.066	--	.020	--
8-6-84	3g + 1kv	3.586	95.8	.072	109.1	.012	57.1
8-7-84	3g + 1kv	3.767	100.6	.068	103.0	.019	90.5
8-8-84	3g + 1kv	3.758	100.4	.068	103.0	.019	90.5
8-9-84	3g + 1kv	3.359	89.7	.074	112.1	.009	42.9
8-10-84	3g + 1kv	2.830	75.6	.067	101.5	.017	81.0
8-15-84	Chamber	3.740	--	.067	--	.031	--

TABLE 5. Response Rates for Rat 5

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-6-84	Baseline	3.671	--	.065	--	.020	--
3-16-84	Baseline	3.693	--	.055	--	.024	--
3-20-84	Baseline	3.827	--	.055	--	.011	--
3-27-84	Baseline	3.730	--	.057	--	.014	--
4-10-84	Chamber	3.880	--	.061	--	.021	--
4-17-84	Chamber	3.779	--	.051	--	.031	--
4-24-84	Chamber	3.702	--	.060	--	.015	--
4-25-84	Chamber	3.554	--	.054	--	.015	--
5-1-84	.5g	3.543	94.9	.053	91.4	.012	60.0
5-4-84	1g	3.747	100.4	.053	98.3	.018	90.0
5-8-84	3g	Data Lost					
7-13-84	3g	3.658	98.0	.064	110.3	.058	290.0
5-11-84	5g	4.154	111.3	.059	101.7	.032	160.0
5-15-84	1g	3.947	105.7	.057	98.3	.007	35.0
5-18-84	3g	4.042	108.3	.058	100.0	.016	80.0
5-22-84	.5g	3.782	101.3	.061	105.2	.024	120.0
5-25-84	5g	3.969	106.3	.066	113.8	.030	150.0
5-28-84	Chamber	3.754	--	.065	--	.021	--
5-29-84	.5g + 1kv	3.719	99.6	.052	89.7	.011	55.0
6-1-84	1g + 1kv	3.993	107.0	.057	98.3	.021	105.0
6-5-84	3g + 1kv	3.985	106.8	.057	98.3	.016	80.0
6-12-84	3g + 1kv	3.771	101.0	.058	100.0	.013	65.0
6-19-84	1g + 1kv	3.856	103.3	.060	103.5	.015	75.0
6-22-84	.5g + 1kv	3.620	97.0	.050	82.2	.021	105.0
6-26-84	5g + 1kv	3.714	99.5	.061	105.2	.018	90.0
6-29-84	5g + 1kv	3.619	97.0	.065	112.1	.065	325.0
7-10-84	Chamber	3.676	--	.059	--	.014	--
7-17-84	1g + 1kv (1 hr)	4.017	107.6	.063	108.6	.019	95.0
7-20-84	3g + 1kv (1 hr)	3.933	105.4	.054	93.1	.016	80.0
7-24-84	1g + 1kv (1 hr)	3.866	103.6	.056	96.6	.015	75.0
7-27-84	3g + 1kv (1 hr)	3.971	106.4	.060	103.5	.026	130.0
8-3-84	Chamber	3.792	--	.060	--	.030	--
8-6-84	3g + 1kv	3.731	100.0	.054	93.1	.033	165.0
8-7-84	3g + 1kv	3.793	101.6	.060	103.5	.028	140.0
8-8-84	3g + 1kv	3.388	90.8	.065	112.1	.037	185.0
8-9-84	3g + 1kv	3.928	105.2	.053	91.4	.022	110.0
8-10-84	3g + 1kv	3.571	95.7	.061	105.2	.022	110.0
8-16-84	Chamber	3.739	--	.059	--	.018	--

TABLE 6. Average Response Rates for Rat 1

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	4.725/.239	.074/.003	.028/.009
Chamber	4.915/.193	.074/.005	.020/.003
.5g	4.627/.013	.072/.002	.017/.006
1g	4.721/.100	.072/.004	.016/.002
3g	4.872/.050	.073/.005	.022/.002
5g	4.704/.059	.070/.001	.074/.006
.5 + 1kv	4.721/.076	.066/.004	.021/.001
1g + 1kv	4.877/.062	.075/.004	.017/.001
3g + 1kv	5.067/.196	.075/.001	.028/.008
5g + 1kv	5.044/.033	.070/.005	.022/.009
1g + 1kv (1 hr)	4.631/.020	.071/.005	.029/.005
3g + 1kv (1 hr)	4.698/.029	.067/.004	.018/.007
Controls (All)	4.851/.228	.074/.005	.023/.007

TABLE 7. Average Response Rates for Rat 2

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	2.697/.159	.053/.002	.015/.004
Chamber	2.897/.170	.055/.004	.020/.009
.5g	2.802/.254	.057/.001	.013/.002
1g	2.848/.108	.052/.004	.014/.011
3g	2.890/.056	.052/.004	.021/.008
5g	2.825/.164	.054/.005	.013/.004
.5 + 1kv	2.800/.295	.056/.004	.013/.006
1g + 1kv	2.744/.169	.054/.000	.019/.008
3g + 1kv	2.933/.041	.057/.001	.014/.002
5g + 1kv	2.823/.016	.056/.001	.047/.031
1g + 1kv (1 hr)	2.745/.094	.063/.001	.052/.003
3g + 1kv (1 hr)	2.886/.154	.054/.001	.029/.009
Controls (All)	2.830/.191	.054/.004	.018/.008

TABLE 8. Average Response Rates for Rat 3

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Baseline	2.836/.178	.073/.005	.019/.007
Chamber	2.909/.129	.074/.004	.016/.009
.5g	2.795/.224	.071/.001	.012/.005
1g	2.934/.088	.070/.008	.016/.007
3g	2.807/.096	.071/.009	.024/.005
5g	2.600/.325	.073/.007	.020/.002
.5 + 1kv	2.408/.207	.067/.001	.019/.006
1g + 1kv	2.598/.204	.068/.003	.017/.003
3g + 1kv	2.634/.246	.074/.004	.013/.006
5g + 1kv	2.896/.078	.074/.002	.014/.000
1g + 1kv (1 hr)	2.979/.001	.070/.003	.073/.056
3g + 1kv (1 hr)	2.819/.027	.070/.005	.085/.039
Controls (All)	2.881/.140	.072/.005	.021/.009

TABLE 9. Average Response Rates for Rat 4

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Baseline	4.013/.312	.061/.001	.014/.004
Chamber	3.760/.181	.066/.004	.025/.004
.5g	3.570/.107	.065/.002	.016/.011
1g	3.746/.095	.064/.002	.018/.001
3g	3.636/.016	.065/.002	.012/.002
5g	3.678/.216	.072/.002	.014/.007
.5 + 1kv	3.486/.156	.064/.003	.018/.002
1g + 1kv	3.510/.129	.069/.002	.018/.002
3g + 1kv	3.492/.022	.068/.004	.018/.002
5g + 1kv	3.416/.063	.069/.001	.023/.006
1g + 1kv (1 hr)	3.372/.243	.066/.000	.009/.006
3g + 1kv (1 hr)	3.499/.023	.063/.000	.025/.012
Controls (All)	3.743/.331	.066/.005	.021/.006

TABLE 10. Average Response Rates for Rat 5

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	3.730/.060	.058/.004	.017/.005
Chamber	3.729/.119	.057/.004	.021/.007
.5g	3.663/.120	.057/.004	.018/.006
1g	3.847/.010	.057/.000	.013/.006
3g	4.030/.372	.061/.003	.037/.021
5g	4.06 / .093	.063/.004	.031/.001
.5 + 1kv	3.670/.050	.051/.001	.016/.005
1g + 1kv	3.925/.069	.059/.002	.018/.003
3g + 1kv	3.878/.107	.058/.001	.015/.002
5g + 1kv	3.667/.048	.063/.002	.042/.024
1g + 1kv (1 hr)	3.942/.076	.060/.004	.017/.002
3g + 1kv (1 hr)	3.952/.019	.057/.003	.021/.005
Controls (All)	3.733/.081	.058/.004	.020/.006

TABLE 11. Summary Response Rates for 1, 2, 3, 4, and 5

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	3.600/.783	.064/.009	.019/.008
Chamber	3.612/.758	.065/.009	.021/.007
.5g	3.491/.696	.064/.007	.015/.007
1g	3.619/.692	.063/.009	.015/.006
3g	3.611/.757	.064/.009	.023/.013
5g	3.57 / .803	.066/.008	.020/.008
.5 + 1kv	3.417/.816	.060/.007	.017/.005
1g + 1kv	3.530/.843	.065/.008	.018/.004
3g + 1kv	3.601/.864	.066/.008	.017/.007
5g + 1kv	3.569/.804	.066/.007	.029/.022
1g + 1kv (1 hr)	3.534/.693	.066/.005	.036/.034
3g + 1kv (1 hr)	3.571/.704	.062/.007	.036/.031
Controls (All)	3.608/.767	.065/.009	.020/.007

TABLE 12. Average Percent Control Response Rtes for Rat 1

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
.5g	95.4/0.3	96.7/2.1	71.8/24.0
1g	97.4/2.1	96.7/4.8	67.4/6.5
3g	100.5/1.1	98.0/6.1	93.5/6.5
5g	97.0/1.2	93.9/0.7	104.4/26.1
.5 + 1kv	97.4/1.6	88.5/4.7	89.2/2.2
1g + 1kv	100.6/1.3	101.4/5.4	71.8/2.2
3g + 1kv	104.5/4.1	101.4/1.4	119.6/32.6
5g + 1kv	104.0/0.7	94.6/6.8	95.7/39.2
1g + 1kv (1 hr)	95.5/0.4	95.3/6.1	124.0/19.6
3g + 1kv (1 hr)	96.8/0.6	90.6/5.5	78.3/30.5

TABLE 13. Average Percent Control Response Rates for Rat 2

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
.5g	99.0/9.0	105.6/1.9	69.5/8.4
1g	100.7/3.9	95.4/6.5	75.0/58.4
3g	102.1/2.0	96.4/7.5	113.9/41.7
5g	99.8/5.8	99.8/5.8	72.2/22.2
.5 + 1kv	99.0/10.5	99.0/10.5	72.3/33.4
1g + 1kv	97.0/6.0	97.0/6.0	102.8/41.7
3g + 1kv	103.7/1.5	103.7/1.5	75.0/8.3
5g + 1kv	99.8/5.5	99.8/0.6	258.4/169.5
1g + 1kv (1 hr)	97.0/3.3	97.0/3.3	280.6/13.9
3g + 1kv (1 hr)	102.1/5.5	102.1/5.5	158.4/47.3



TABLE 14. Average Percent Control Response Rates for Rat 3

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
.5g	97.0/7.8	98.6/1.4	57.2/23.9
1g	101.9/3.1	96.5/10.4	76.2/33.3
3g	97.5/3.4	97.9/11.8	114.3/23.8
5g	90.3/11.3	100.7/9.0	92.9/7.2
.5 + 1kv	83.6/7.2	92.4/0.7	90.5/28.6
1g + 1kv	90.2/7.1	93.8/3.5	81.0/14.3
3g + 1kv	91.4/8.5	102.1/4.9	61.9/28.6
5g + 1kv	100.5/2.7	102.8/2.8	66.7/0.0
1g + 1kv (1 hr)	103.4/0.0	97.3/4.2	347.7/266.7
3g + 1kv (1 hr)	97.9/1.0	97.3/7.0	404.8/185.7

TABLE 15. Average Percent Control Response for Rat 4

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
.5g	95.3/2.8	98.5/3.0	73.8/50.0
1g	100.1/2.6	97.0/3.1	85.8/4.8
3g	97.1/0.4	98.5/3.0	54.8/7.2
5g	98.3/5.8	108.4/2.3	66.7/33.4
.5 + 1kv	93.2/4.2	96.2/3.8	85.7/9.5
1g + 1kv	93.8/3.5	104.6/3.1	83.4/7.2
3g + 1kv	93.3/0.6	103.1/6.1	83.4/7.2
5g + 1kv	91.3/1.7	103.8/0.8	109.6/28.6
1g + 1kv (1 hr)	90.1/6.5	100.0/0.0	42.9/28.6
3g + 1kv (1 hr)	93.5/0.6	95.5/0.0	119.1/57.2

TABLE 16. Average Percent Control Response Rates for Rat 5

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
.5g	98.1/3.2	98.3/6.9	90.0/30.0
1g	103.1/2.7	98.3/0.0	62.5/27.5
3g	103.2/5.2	105.2/5.2	185.0/10.5
5g	108.8/2.5	107.8/6.1	155.0/5.0
.5 + 1kv	98.3/1.3	86.0/3.8	80.0/25.0
1g + 1kv	105.2/1.9	100.9/2.6	90.0/15.0
3g + 1kv	103.9/2.9	99.2/0.9	72.5/7.5
5g + 1kv	98.3/1.3	108.7/3.5	207.5/117.5
1g + 1kv (1 hr)	105.6/2.0	102.6/6.0	85.0/10.0
3g + 1kv (1 hr)	105.9/0.5	98.3/5.2	105.0/25.0

TABLE 17. Summary of Average Percent Control Rates for 1, 2, 3, 4, and 5

Mean/S.D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
.5g	97.0/5.9	99.5/4.8	72.4/32.1
1g	100.6/3.5	96.8/6.1	73.4/33.6
3g	100.5/3.8	99.2/7.9	112.3/67.0
5g	98.8/8.7	102.1/8.4	98.2/38.3
.5 + 1kv	94.3/8.3	93.2/7.4	83.5/24.0
1g + 1kv	97.3/6.9	100.1/4.9	85.8/23.5
3g + 1kv	99.3/7.3	101.2/4.9	82.5/28.3
5g + 1kv	98.8/4.5	102.5/5.8	147.6/119.5
1g + 1kv (1 hr)	98.3/6.5	102.2/8.4	176.0/168.4
3g + 1kv (1 hr)	99.2/5.0	96.1/5.5	173.1/149.6

TABLE 18. Response Rates for Rat 6

<u>Date</u>	<u>Condition</u>	<u>FR Resp Rate</u>	<u>FR Rate (% Cont)</u>	<u>DRL Resp Rate</u>	<u>DRL Rate (% Cont)</u>	<u>TO Resp Rate</u>	<u>TO Rate (% Cont)</u>
3-16-84	Baseline	3.663	--	.080	--	.045	--
3-23-84	Baseline	3.467	--	.077	--	.039	--
3-27-84	Baseline	3.553	--	.082	--	.045	--
3-30-84	Chamber	3.408	--	.081	--	.041	--
4-3-84	Chamber	3.458	--	.077	--	.125	--
4-6-84	Chamber + Saline	3.379	--	.083	--	.043	--
4-10-84	Chamber + Saline	3.529	--	.077	--	.045	--
4-17-84	Chamber + Saline	3.560	--	.086	--	.044	--
4-24-84	Chamber + Saline	3.054	--	.082	--	.039	--
4-27-84	Chamber + Drug	3.903	113.0	.100	123.5	.047	94.0
5-1-84	Chamber + Drug	2.138	61.9	.096	118.5	.038	76.0
5-4-84	.5g + Drug	2.432	70.4	.090	111.1	.047	94.0
5-8-84	Chamber + Drug	2.656	76.9	.099	122.2	.045	90.0
5-11-84	1g + Drug	2.529	73.2	.104	128.4	.040	80.0
5-15-84	Chamber + Drug	2.448	70.9	.098	121.0	.051	102.0
5-18-84	3g + Drug	2.567	74.3	.117	144.4	.025	50.0
5-22-84	Chamber + Drug	2.765	80.1	.096	118.5	.045	90.0
5-25-84	5g + Drug	2.817	81.6	.099	122.2	.052	104.0
5-29-84	.5g + 1kv + Drug	2.536	73.4	.108	133.3	.036	72.0
6-1-84	1g + 1kv + Drug	2.750	79.6	.128	158.0	.038	76.0
6-5-84	3g + 1kv + Drug	2.899	83.9	.100	123.5	.059	118.0
6-12-84	3g + 1kv + Drug	2.689	77.9	.090	111.1	.050	100.0
6-15-84	Chamber + Saline	3.023	--	.080	--	.042	--
6-19-84	1g + 1kv + Drug	2.292	66.4	.105	129.6	.047	94.0
6-22-84	.5g + 1kv + Drug	2.637	76.4	.101	124.7	.047	94.0
6-26-84	5g + 1kv + Drug	2.814	81.5	.090	111.1	.041	82.0
6-29-84	5g + 1kv + Drug	2.595	75.1	.095	117.3	.049	98.0
7-10-84	Chamber + Drug	2.641	76.5	.090	111.1	.051	102.0
7-17-84	.5g + Drug	2.433	70.4	.090	111.1	.055	110.0
7-20-84	1g + Drug	2.865	83.0	.092	113.6	.051	102.0
7-24-84	3g + Drug	2.322	67.2	.128	158.0	.047	94.0
7-27-84	5g + Drug	2.883	83.5	.115	142.0	.047	94.0
8-7-84	Baseline + Saline	3.628	--	.080	--	.044	--
8-28-84	Chamber + Saline	3.730	--	.084	--	.049	--

TABLE 19. Response Rates for Rat 7

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-16-84	Baseline	3.421	--	.081	--	.040	--
3-23-84	Baseline	3.475	--	.086	--	.037	--
3-27-84	Baseline	3.181	--	.088	--	.036	--
3-30-84	Chamber	3.416	--	.088	--	.044	--
4-3-84	Chamber	3.527	--	.083	--	.043	--
4-6-84	Chamber + Saline	3.540	--	.085	--	.046	--
4-10-84	Chamber + Saline	3.553	--	.075	--	.036	--
4-17-84	Chamber + Saline	3.662	--	.084	--	.043	--
4-24-84	Chamber + Saline	3.509	--	.077	--	.039	--
4-27-84	Chamber + Drug	3.126	89.0	.089	107.2	.040	97.6
5-1-84	Chamber + Drug	2.841	80.9	.079	95.2	.046	112.2
5-4-84	.5g + Drug	3.607	102.7	.083	100.0	.036	87.8
5-8-84	Chamber + Drug	3.644	103.8	.074	89.2	.045	109.8
5-11-84	1g + Drug	3.950	112.5	.093	112.1	.041	100.0
5-15-84	Chamber + Drug	3.993	113.7	.082	98.8	.041	100.0
5-18-84	3g + Drug	3.484	99.2	.086	103.6	.053	129.3
5-22-84	Chamber + Drug	3.948	112.4	.086	103.6	.050	122.0
5-25-84	5g + Drug	3.379	96.2	.077	92.8	.039	95.1
5-29-84	.5g + 1kv + Drug	3.433	97.8	.088	106.0	.036	87.8
6-1-84	1g + 1kv + Drug	3.553	101.2	.096	115.7	.039	95.1
6-5-84	3g + 1kv + Drug	3.680	104.8	.086	103.6	.053	129.3
6-12-84	3g + 1kv + Drug	2.315	65.9	.075	90.4	.036	87.8
6-15-84	Chamber + Saline	3.550	--	.079	--	.036	--
6-19-84	1g + 1kv + Drug	3.285	93.6	.086	103.6	.049	119.5
6-22-84	.5g + 1kv + Drug	3.639	103.7	.085	102.4	.042	102.4
6-26-84	5g + 1kv + Drug	3.983	113.4	.086	103.6	.046	112.2
6-29-84	5g + 1kv + Drug	3.479	99.1	.083	100.0	.044	107.3
7-10-84	Chamber + Drug	3.568	101.6	.083	100.0	.055	134.2
7-17-84	.5g + Drug	3.285	93.6	.088	106.0	.045	109.8
7-20-84	1g + Drug	3.485	99.3	.094	113.3	.055	134.2
7-24-84	3g + Drug	3.983	113.4	.086	103.6	.053	129.3
7-27-84	5g + Drug	3.482	99.2	.080	96.4	.040	97.6
8-7-84	Baseline + Saline	3.881	--	.086	--	.045	--
8-28-84	Chamber + Saline	3.416	--	.088	--	.044	--

TABLE 20. Response Rates for Rat 8

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-16-84	Baseline	3.185	--	.077	--	.042	--
3-23-84	Baseline	3.273	--	.087	--	.044	--
3-27-84	Baseline	2.947	--	.087	--	.037	--
3-30-84	Chamber	3.098	--	.082	--	.032	--
4-3-84	Chamber	2.949	--	.079	--	.034	--
4-6-84	Chamber + Saline	3.031	--	.078	--	.034	--
4-10-84	Chamber + Saline	3.114	--	.078	--	.041	--
4-17-84	Chamber + Saline	3.475	--	.085	--	.072	--
4-24-84	Chamber + Saline	3.505	--	.089	--	.036	--
4-27-84	Chamber + Drug	3.192	98.6	.104	126.8	.035	83.3
5-1-84	Chamber + Drug	2.985	92.2	.114	139.0	.071	169.0
5-4-84	.5g + Drug	2.850	88.0	.123	150.0	.063	150.0
5-8-84	Chamber + Drug	3.091	95.5	.104	126.8	.038	90.5
5-11-84	1g + Drug	2.737	84.6	.100	122.0	.049	116.7
5-15-84	Chamber + Drug	2.904	89.7	.119	145.1	.047	111.9
5-18-84	3g + Drug	2.673	82.6	.124	151.2	.049	116.7
5-22-84	Chamber + Drug	3.090	95.5	.099	120.7	.050	119.0
5-25-84	5g + Drug	3.362	103.9	.099	120.7	.049	116.7
5-29-84	.5g + 1kv + Drug	3.178	98.2	.106	129.3	.065	154.8
6-1-84	1g + 1kv + Drug	3.171	98.0	.097	118.3	.041	96.6
6-5-84	3g + 1kv + Drug	3.390	104.7	.108	131.7	.035	83.3
6-12-84	3g + 1kv + Drug	3.090	95.5	.119	145.1	.050	119.0
6-15-84	Chamber + Saline	3.230	--	.077	--	.042	--
6-19-84	1g + 1kv + Drug	2.795	86.3	.120	146.3	.040	95.2
6-22-84	.5g + 1kv + Drug	3.101	95.8	.119	145.1	.036	85.7
6-26-84	5g + 1kv + Drug	2.304	71.2	.094	114.6	.044	104.8
6-29-84	5g + 1kv + Drug	2.511	77.6	.115	140.2	.044	104.8
7-10-84	Chamber + Drug	2.467	76.2	.116	141.5	.050	119.0
7-17-84	.5g + Drug	2.343	73.4	.102	124.4	.041	97.6
7-20-84	1g + Drug	3.003	92.8	.121	147.6	.051	121.4
7-24-84	3g + Drug	2.501	77.3	.093	113.4	.038	90.5
7-27-84	5g + Drug	2.875	88.8	.107	130.5	.038	90.5
8-7-84	Baseline + Saline	3.335	--	.089	--	.042	--
8-28-84	Chamber + Saline	3.696	--	.080	--	.045	--

TABLE 21. Response Rates for Rat 9

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-16-84	Baseline	3.745	--	.85	--	.062	--
3-23-84	Baseline	3.734	--	.090	--	.041	--
3-27-84	Baseline	3.156	--	.088	--	.036	--
3-30-84	Chamber	3.510	--	.091	--	.030	--
4-3-84	Chamber	3.375	--	.084	--	.047	--
4-6-84	Chamber + Saline	3.555	--	.082	--	.034	--
4-10-84	Chamber + Saline	3.659	--	.088	--	.043	--
4-17-84	Chamber + Saline	3.745	--	.082	--	.048	--
4-24-84	Chamber + Saline	3.508	--	.084	--	.045	--
4-27-84	Chamber + Drug	3.275	93.1	.115	133.7	.060	136.4
5-1-84	Chamber + Drug	3.737	106.3	.102	118.6	.051	115.9
5-4-84	.5g + Drug	3.747	106.5	.098	114.0	.050	113.6
5-8-84	Chamber + Drug	3.788	107.7	.111	129.1	.055	125.0
5-11-84	1g + Drug	3.762	107.0	.093	108.1	.068	154.6
5-15-84	Chamber + Drug	3.603	102.4	.095	110.5	.047	106.8
5-18-84	3g + Drug	3.634	103.3	.103	119.8	.077	175.0
5-22-84	Chamber + Drug	4.111	116.7	.120	139.5	.087	197.7
5-25-84	5g + Drug	4.009	114.0	.122	141.9	.058	131.8
5-29-84	.5g + 1kv + Drug	3.362	95.6	.112	130.2	.056	127.3
6-1-84	1g + 1kv + Drug	3.886	110.5	.126	146.5	.062	140.9
6-5-84	3g + 1kv + Drug	3.421	97.3	.109	126.7	.045	102.3
6-12-84	3g + 1kv + Drug	3.880	110.3	.102	118.6	.076	172.7
6-15-84	Chamber + Saline	3.572	--	.086	--	.043	--
6-19-84	1g + 1kv + Drug	3.951	112.3	.119	138.4	.048	109.1
6-21-84	.5g + 1kv + Drug	3.492	99.3	.113	131.4	.077	175.0
6-26-84	5g + 1kv + Drug	3.772	107.3	.101	117.4	.047	106.8
6-29-84	5g + 1kv + Drug	3.669	104.3	.114	132.6	.064	145.5
7-10-84	Chamber + Drug	3.982	113.2	.101	117.4	.064	145.5
7-17-84	.5g + Drug	3.165	90.0	.117	136.0	.061	138.6
7-21-84	1g + Drug	3.665	104.2	.129	150.0	.059	134.1
7-24-84	3g + Drug	3.432	97.6	.105	122.1	.049	111.4
7-27-84	5g + Drug	3.915	111.3	.117	136.1	.059	134.1
8-7-84	Baseline + Saline	3.451	--	.089	--	.053	--
8-18-84	Chamber + Saline	3.193	--	.085	--	.043	--

TABLE 22. Response Rates for Rat 10

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-16-84	Baseline	2.441	--	.075	--	.054	--
3-23-84	Baseline	2.495	--	.079	--	.045	--
3-27-84	Baseline	2.150	--	.074	--	.036	--
3-30-84	Chamber	2.095	--	.081	--	.034	--
4-3-84	Chamber	2.247	--	.077	--	.026	--
4-6-84	Chamber + Saline	2.319	--	.081	--	.041	--
4-10-84	Chamber + Saline	2.198	--	.074	--	.051	--
4-17-84	Chamber + Saline	2.672	--	.084	--	.043	--
4-24-84	Chamber + Saline	2.853	--	.079	--	.047	--
4-27-84	Chamber + Drug	2.131	86.4	.124	157.0	.040	95.2
5-1-84	Chamber + Drug	2.131	86.4	.140	177.2	.064	152.4
5-4-84	.5g + Drug	2.410	97.7	.132	167.1	.042	100.0
5-8-84	Chamber + Drug	2.627	106.5	.127	160.8	.043	102.4
5-11-84	1g + Drug	2.493	101.1	.114	144.3	.041	97.6
5-15-84	Chamber + Drug	2.170	88.0	.125	158.2	.043	102.4
5-18-84	3g + Drug	2.112	85.6	.120	151.9	.047	111.9
5-22-84	Chamber + Drug	2.550	103.4	.137	173.4	.042	100.0
5-25-84	5g + Drug	2.542	103.0	.102	129.1	.040	95.2
5-29-84	.5g + 1kv + Drug	2.548	103.3	.115	145.6	.042	100.0
6-1-84	1g + 1kv + Drug	2.504	101.5	.115	145.6	.046	109.5
6-5-84	3g + 1kv + Drug	2.082	84.4	.117	148.1	.037	88.1
6-12-84	3g + 1kv + Drug	2.904	117.7	.104	131.7	.043	102.4
6-15-84	Chamber + Saline	2.863	--	.076	--	.036	--
6-19-84	1g + 1kv + Drug	2.397	97.2	.102	129.1	.048	114.3
6-22-84	.5g + 1kv + Drug	2.482	100.6	.109	138.0	.047	111.9
6-26-84	5g + 1kv + Drug	2.107	85.4	.115	145.6	.045	107.1
6-29-84	5g + 1kv + Drug	2.040	82.7	.117	148.1	.044	104.8
7-10-84	Chamber + Drug	2.910	118.0	.111	140.5	.056	133.3
7-17-84	.5g + Drug	2.313	93.8	.100	126.6	.041	97.6
7-20-84	1g + Drug	2.488	100.9	.125	158.2	.047	111.9
7-24-84	3g + Drug	2.582	104.7	.119	150.6	.048	114.3
7-27-84	5g + Drug	2.304	93.4	.123	155.7	.044	104.8
8-7-84	Baseline + Saline	2.293	--	.080	--	.046	--
8-28-84	Chamber + Saline	2.975	--	.085	--	.040	--

TABLE 23. Average Response Rates for Rat 6

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	3.561/.080	.080/.002	.043/.003
Chamber	3.433/.025	.079/.002	.083/.042
Chamber + Saline	3.379/.262	.082/.003	.044/.003
Chamber + Drug	2.759/.550	.097/.003	.046/.004
.5g + Drug	2.433/.001	.090/.000	.051/.004
1g + Drug	2.697/.168	.098/.006	.046/.006
3g + Drug	2.445/.123	.113/.006	.036/.011
5g + Drug	2.850/.033	.107/.008	.050/.003
.5g + 1kv + Drug	2.587/.051	.105/.004	.042/.006
1g + 1kv + Drug	2.521/.229	.117/.012	.043/.005
3g + 1kv + Drug	2.794/.105	.095/.005	.055/.005
5g + 1kv + Drug	2.705/.110	.093/.003	.045/.004
Controls (all)	3.454/.210	.081/.003	.050/.023

TABLE 24. Average Response Rates for Rat 7

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	3.359/.128	.085/.003	.038/.002
Chamber	3.472/.056	.086/.003	.044/.001
Chamber + Saline	3.538/.072	.081/.005	.041/.004
Chamber + Drug	3.520/.417	.082/.005	.046/.005
.5g + Drug	3.446/.161	.086/.003	.041/.005
1g + Drug	3.718/.233	.094/.001	.048/.007
3g + Drug	3.734/.250	.086/.000	.053/.000
5g + Drug	3.431/.052	.079/.002	.040/.001
.5g + 1kv + Drug	3.536/.103	.087/.002	.039/.003
1g + 1kv + Drug	3.419/.134	.091/.005	.044/.005
3g + 1kv + Drug	3.000/.683	.081/.006	.045/.009
5g + 1kv + Drug	3.731/.252	.085/.002	.045/.001
Controls (all)	3.511/.158	.083/.004	.041/.004



TABLE 25. Average Response Rates for Rat 8

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	3.135/.138	.084/.005	.041/.003
Chamber	3.024/.008	.081/.002	.041/.003
Chamber + Saline	3.340/.235	.081/.004	.045/.013
Chamber + Drug	2.955/.236	.109/.007	.049/.012
.5g + Drug	2.597/.254	.113/.011	.052/.011
1g + Drug	2.870/.133	.111/.011	.050/.001
3g + Drug	2.587/.086	.109/.016	.044/.006
5g + Drug	3.119/.244	.103/.004	.044/.006
.5g + 1kv + Drug	3.140/.039	.113/.007	.051/.015
1g + 1kv + Drug	2.983/.188	.109/.012	.041/.001
3g + 1kv + Drug	3.240/.150	.114/.006	.043/.008
5g + 1kv + Drug	2.408/.104	.105/.011	.044/.000
Controls (all)	3.237/.223	.082/.005	.042/.010

TABLE 26. Average Response Rates for Rat 9

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	3.545/.275	.088/.002	.046/.011
Chamber	3.443/.068	.088/.004	.039/.009
Chamber + Saline	3.539/.173	.085/.002	.043/.004
Chamber + Drug	3.749/.269	.107/.009	.061/.013
.5g + Drug	3.456/.291	.108/.010	.056/.006
1g + Drug	3.714/.049	.111/.018	.064/.005
3g + Drug	3.533/.101	.104/.001	.063/.014
5g + Drug	3.962/.047	.120/.003	.059/.001
.5g + 1kv + Drug	3.427/.065	.113/.001	.056/.009
1g + 1kv + Drug	3.919/.033	.123/.004	.055/.007
3g + 1kv + Drug	3.651/.230	.106/.004	.061/.016
5g + 1kv + Drug	3.721/.052	.108/.007	.056/.009
Controls (all)	3.517/.191	.086/.003	.044/.008

TABLE 27. Average Response Rates for Rat 10

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Baseline	2.362/.152	.076/.002	.045/.007
Chamber	2.171/.760	.079/.002	.030/.004
Chamber + Saline	2.647/.291	.080/.004	.043/.005
Chamber + Drug	2.420/.297	.127/.010	.048/.009
.5g + Drug	2.362/.049	.116/.016	.042/.001
1g + Drug	2.491/.003	.120/.006	.044/.003
3g + Drug	2.347/.235	.120/.001	.045/.004
5g + Drug	2.423/.119	.113/.011	.042/.002
.5g + 1kv + Drug	2.515/.033	.112/.003	.045/.003
1g + 1kv + Drug	2.451/.054	.109/.007	.047/.001
3g + 1kv + Drug	2.493/.411	.111/.007	.040/.003
+ 1kv + Drug	2.074/.034	.116/.001	.045/.001
Controls (all)	2.467/.291	.079/.004	.042/.008

TABLE 28. Summary Response Rates for 6, 7, 8, 9, and 10

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Baseline	3.192/.474	.082/.005	.043/.007
Chamber	3.108/.501	.082/.004	.046/.027
Chamber + Saline	3.289/.398	.082/.004	.043/.007
Baseline + Saline	3.318/.544	.085/.004	.046/.004
Chamber + Drug	3.047/.591	.105/.017	.050/.011
.5g + Drug	2.859/.525	.102/.016	.048/.008
1g + Drug	3.098/.538	.107/.014	.050/.008
3g + Drug	2.929/.609	.108/.015	.049/.012
5g + Drug	3.157/.536	.104/.015	.047/.007
.5g + 1kv + Drug	3.041/.426	.106/.011	.048/.013
1g + 1kv + Drug	3.058/.573	.109/.014	.046/.007
3g + 1kv + Drug	3.035/.547	.101/.013	.048/.012
5g + 1kv + Drug	2.927/.695	.101/.013	.047/.006
Controls (all)	3.257/.455	.082/.004	.044/.013

TABLE 29. Average Percent Control Response Rates for Rat 6

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	95.2/14.6	127.5/22.1	114.1/25.8
.5g + Drug	88.7/12.5	124.6/20.0	109.9/18.9
1g + Drug	95.9/11.6	129.8/17.7	115.3/20.7
3g + Drug	90.5/14.4	131.9/20.4	112.2/30.4
5g + Drug	97.5/10.4	126.7/18.8	106.4/15.1
.5g + 1kv + Drug	94.4/10.1	128.6/13.8	111.1/30.8
1g + 1kv + Drug	94.7/13.3	113.1/16.1	105.1/16.8
3g + 1kv + Drug	94.2/15.2	123.1/17.0	110.3/25.2
5g + 1kv + Drug	89.8/14.2	123.1/16.5	107.3/14.9

TABLE 30. Average Percent Control Response Rates for Rat 7

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	100.2/11.9	99.0/5.8	112.6/12.6
.5g + Drug	98.2/4.6	103.0/3.0	98.8/11.0
1g + Drug	105.9/6.6	112.7/0.6	117.1/17.1
3g + Drug	106.3/7.1	103.6/0.0	129.3/0.0
5g + Drug	97.7/1.5	94.6/1.8	96.4/1.3
.5g + 1kv + Drug	100.8/3.0	104.2/1.8	95.1/7.3
1g + 1kv + Drug	97.4/3.8	109.7/6.1	107.3/12.2
3g + 1kv + Drug	85.4/19.5	97.0/6.6	108.6/20.8
5g + 1kv + Drug	106.3/7.2	101.8/1.8	109.8/2.5

TABLE 31. Average Percent Control Response Rates for Rat 8

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	91.3/7.3	133.3/9.0	115.5/27.6
.5g + Drug	80.7/7.3	137.2/12.8	123.8/26.2
1g + Drug	88.7/4.1	134.8/12.8	119.1/2.4
3g + Drug	80.0/2.7	132.3/18.9	103.6/13.1
5g + Drug	96.4/7.6	125.6/4.9	103.6/13.1
.5g + 1kv + Drug	97.0/1.2	137.2/7.9	120.3/34.6
1g + 1kv + Drug	92.2/5.9	132.3/14.0	96.4/1.2
3g + 1kv + Drug	100.1/4.6	138.4/6.7	101.2/17.9
5g + 1kv + Drug	74.4/3.2	127.4/12.8	104.8/0.0

TABLE 32. Average Percent Control Response Rates for Rat 9

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	106.6/7.7	124.8/10.1	137.9/29.6
.5g + Drug	98.3/8.3	125.0/11.0	126.1/12.5
1g + Drug	105.6/1.4	129.1/21.0	144.4/10.3
3g + Drug	100.5/2.9	121.0/1.2	143.2/31.8
5g + Drug	112.7/1.4	139.0/2.9	133.0/1.2
.5g + 1kv + Drug	97.5/1.9	130.8/0.6	151.2/23.9
1g + 1kv + Drug	111.4/0.9	142.5/4.1	125.0/15.9
3g + 1kv + Drug	103.8/6.5	122.7/4.1	137.5/35.2
5g + 1kv + Drug	105.8/1.5	125.0/7.6	126.2/19.4

TABLE 33. Average Percent Control Response Rates for Rat 10

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	98.1/12.1	161.2/12.0	114.3/21.1
.5g + Drug	95.8/2.0	146.9/20.3	98.8/1.2
1g + Drug	101.0/0.1	151.3/7.0	104.8/7.2
3g + Drug	95.2/9.6	151.3/0.7	113.1/1.2
5g + Drug	98.2/4.8	142.4/13.3	100.0/4.8
.5g + 1kv + Drug	141.8/3.8	141.8/3.8	106.0/6.0
1g + 1kv + Drug	99.4/2.2	137.4/8.3	111.9/2.4
3g + 1kv + Drug	101.1/16.7	139.9/8.2	95.3/7.2
5g + 1kv + Drug	84.1/1.4	146.9/1.3	106.0/1.2

TABLE 34. Summary of Average Percent Control Response Rates for Rat 6, 7, 8, 9, and 10

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	95.2/14.6	127.5/22.1	114.5/25.9
.5g + Drug	88.7/12.5	124.6/20.0	109.9/18.9
1g + Drug	95.9/11.6	129.8/17.7	115.3/20.7
3g + Drug	90.5/14.4	128.0/6.8	115.2/25.1
5g + Drug	96.4/12.4	123.7/18.9	106.4/15.1
.5g + 1kv + Drug	94.4/10.1	128.6/13.8	111.1/30.8
1g + 1kv + Drug	94.7/13.3	133.1/16.1	105.1/16.8
3g + 1kv + Drug	94.2/15.2	123.1/17.0	110.3/25.2
5g + 1kv + Drug	89.7/14.2	123.1/16.5	107.3/14.9

TABLE 35. Response Rates for Rat 11

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-16-84	Baseline	3.555	--	.061	--	.017	--
3-23-84	Baseline	3.327	--	.075	--	.020	--
3-27-84	Chamber	3.357	--	.073	--	.032	--
3-30-84	Chamber	3.345	--	.068	--	.014	--
4-3-84	Baseline	3.454	--	.070	--	.028	--
4-6-84	Chamber + Saline	3.249	--	.065	--	.022	--
4-10-84	Chamber + Saline	3.551	--	.065	--	.026	--
4-17-84	Baseline + Saline	3.383	--	.068	--	.024	--
4-24-84	Chamber + Saline	3.423	--	.061	--	.012	--
4-27-84	Chamber + Drug	2.752	80.2	.161	240.3	.125	568.2
5-1-84	Chamber + Drug	3.419	99.7	.121	180.6	.040	181.8
5-3-84	Chamber	3.343	--	.064	--	.019	--
5-4-84	.5g + Drug	3.050	88.9	.140	209.0	.045	204.6
5-8-84	Chamber + Drug	2.967	86.5	.144	214.9	.018	81.8
5-11-84	1g + Drug	2.113	61.6	.164	24.5	.047	213.6
5-15-84	Chamber + Drug	3.282	95.7	.118	176.1	.027	122.7
5-18-84	3g + Drug	3.563	103.9	.157	234.3	.033	150.0
5-22-84	Chamber + Drug	3.331	97.1	.161	240.3	.039	177.3
5-25-84	5g + Drug	2.150	62.7	.151	225.4	.026	118.2
5-29-84	.5g + 1kv + Drug	3.665	106.9	.148	220.9	.062	281.8
6-1-84	1g + 1kv + Drug	1.725	50.3	.295	440.3	.138	627.3
6-5-84	3g + 1kv + Drug	2.690	78.4	.144	214.9	.086	390.9
6-12-84	3g + 1kv + Drug	2.284	66.6	.124	185.1	.041	186.4
6-15-84	Chamber + Saline	3.361	--	.069	--	.029	--
6-19-84	1g + 1kv + Drug	2.411	70.3	.128	191.0	.038	172.7
6-22-84	.5g + 1kv + Drug	2.210	64.4	.214	319.4	.080	363.6
6-26-84	5g + 1kv + Drug	2.407	70.2	.221	329.9	.036	163.6
6-29-84	5g + 1kv + Drug	2.731	79.6	.119	177.6	.043	195.5
7-10-84	Chamber + Drug	3.492	101.8	.159	237.3	.021	95.5
7-17-84	.5g + Drug	3.585	104.5	.167	249.3	.027	122.7
7-20-84	1g + Drug	2.846	83.0	.146	217.9	.047	213.6
7-24-84	3g + Drug	2.741	79.9	.115	171.6	.028	127.3
7-27-84	5g + Drug	2.292	66.8	.132	197.0	.026	118.2
8-7-84	Baseline + Saline	3.457	--	.067	--	.012	--
8-24-84	Chamber + Saline	3.701	--	.061	--	.022	--

TABLE 36. Response Rates for Rat 12

Date	Condition	FR Resp Rate	FR Rate (% Cont)	DRL Resp Rate	DRL Rate (% Cont)	TO Resp Rate	TO Rate (% Cont)
3-16-84	Baseline	3.713	--	.050	--	.016	--
3-23-84	Baseline	3.827	--	.053	--	.024	--
3-27-84	Chamber	4.108	--	.048	--	.016	--
3-30-84	Chamber	3.793	--	.051	--	.021	--
4-3-84	Baseline	3.225	--	.046	--	.025	--
4-6-84	Chamber + Saline	3.382	--	.053	--	.019	--
4-10-84	Chamber + Saline	3.562	--	.047	--	.010	--
4-17-84	Baseline + Saline	3.523	--	.054	--	.027	--
4-24-84	Chamber + Saline	3.649	--	.051	--	.018	--
4-27-84	Chamber + Drug	2.527	70.6	.150	294.1	.118	655.6
5-1-84	Chamber + Drug	2.583	72.1	.095	186.3	.030	166.7
5-3-84	Chamber	3.541	--	.052	--	.018	--
5-4-84	.5g + Drug	2.958	82.6	.136	266.7	.046	255.6
5-8-84	Chamber + Drug	2.735	76.4	.173	339.2	.094	522.2
5-11-84	1g + Drug	2.372	66.2	.127	249.0	.064	355.6
5-15-84	Chamber + Drug	2.499	69.8	.142	278.4	.065	361.1
5-18-84	3g + Drug	3.269	91.3	.138	270.6	.065	361.1
5-22-84	Chamber + Drug	2.797	78.1	.098	192.2	.086	477.8
5-25-84	5g + Drug	2.956	82.5	.085	166.7	.056	311.1
5-29-84	.5g + 1kv + Drug	3.083	86.1	.184	360.8	.120	666.7
6-1-84	1g + 1kv + Drug	2.687	75.0	.126	247.1	.095	527.8
6-5-84	3g + 1kv + Drug	2.910	81.2	.088	172.6	.035	194.4
6-12-84	3g + 1kv + Drug	2.797	78.1	.094	184.3	.028	155.6
6-15-84	Chamber + Saline	3.283	--	.055	--	.015	--
6-19-84	1g + 1kv + Drug	3.119	87.1	.082	160.8	.043	238.9
6-22-84	.5g + 1kv + Drug	2.450	68.4	.118	231.4	.055	305.6
6-26-84	5g + 1kv + Drug	2.848	79.5	.097	190.2	.017	94.4
6-29-84	5g + 1kv + Drug	3.193	89.1	.106	207.8	.036	200.0
7-10-84	Chamber + Drug	3.362	93.9	.134	262.8	.014	77.8
7-17-84	.5g + Drug	3.499	97.7	.088	172.6	.012	66.7
7-20-84	1g + Drug	3.281	91.6	.122	239.2	.019	105.6
7-24-84	3g + Drug	2.806	78.3	.088	172.6	.034	188.9
7-27-84	5g + Drug	2.958	82.6	.080	156.9	.012	66.7
8-7-84	Baseline + Saline	3.968	--	.056	--	.015	--
8-24-84	Chamber + Saline	2.985	--	.049	--	.007	--

TABLE 37. Response Rates for Rat 13

<u>Date</u>	<u>Condition</u>	<u>FR Resp Rate</u>	<u>FR Rate (% Cont)</u>	<u>DRL Resp Rate</u>	<u>DRL Rate (% Cont)</u>	<u>TO Resp Rate</u>	<u>TO Rate (% Cont)</u>
3-16-84	Baseline	2.799	--	.117	--	.028	--
3-23-84	Baseline	2.659	--	.115	--	.046	--
3-27-84	Chamber	2.646	--	.106	--	.027	--
3-30-84	Chamber	2.749	--	.107	--	.022	--
4-3-84	Baseline	2.800	--	.104	--	.034	--
4-6-84	Chamber + Saline	2.717	--	.109	--	.020	--
4-10-84	Chamber + Saline	2.793	--	.119	--	.034	--
4-17-84	Baseline + Saline	2.701	--	.113	--	.022	--
4-24-84	Chamber + Saline	2.931	--	.112	--	.032	--
4-27-84	Chamber + Drug	2.760	101.1	.194	174.8	.153	566.7
5-1-84	Chamber + Drug	2.351	86.1	.164	147.8	.021	77.8
5-3-84	Chamber	2.542	--	.120	--	.022	--
5-4-84	.5g + Drug	2.291	83.9	.219	197.3	.153	566.7
5-8-84	Chamber + Drug	1.206	44.2	.192	173.0	.154	570.4
5-11-84	1g + Drug	1.268	46.5	.248	223.4	.156	577.8
5-15-84	Chamber + Drug	2.294	84.0	.220	198.2	.238	881.5
5-18-84	3g + Drug	2.583	94.6	.162	146.0	.094	348.2
5-22-84	Chamber + Drug	1.402	51.4	.251	226.1	.212	785.2
5-25-84	5g + Drug	2.541	93.1	.199	179.3	.071	263.0
5-29-84	.5g + 1kv + Drug	1.793	65.7	.229	206.3	.139	514.8
6-1-84	1g + 1kv + Drug	2.156	79.0	.246	221.6	.145	537.0
6-5-84	3g + 1kv + Drug	2.348	86.0	.257	231.5	.046	170.4
6-12-84	3g + 1kv + Drug	2.356	86.3	.204	183.8	.027	100.0
6-15-84	Chamber + Saline	2.533	--	.114	--	.025	--
6-19-84	1g + 1kv + Drug	1.963	71.9	.200	180.2	.032	118.5
6-22-84	.5g + 1kv + Drug	2.170	79.5	.202	182.0	.051	188.9
6-26-84	5g + 1kv + Drug	2.501	91.6	.189	170.3	.021	77.8
6-29-84	5g + 1kv + Drug	2.373	86.9	.226	203.6	.050	185.2
7-10-84	Chamber + Drug	2.392	87.6	.275	247.8	.045	166.7
7-17-84	.5g + Drug	2.149	78.7	.270	243.2	.049	181.5
7-20-84	1g + Drug	2.295	84.1	.218	196.4	.048	177.8
7-24-84	3g + Drug	2.507	91.8	.176	158.6	.047	174.1
7-27-84	5g + Drug	2.207	80.8	.211	190.1	.021	77.8
8-7-84	Baseline + Saline	2.816	--	.096	--	.019	--
8-24-84	Chamber + Saline	2.802	--	.106	--	.014	--

TABLE 38. Response Rates for Rat 15

<u>Date</u>	<u>Condition</u>	<u>FR Resp Rate</u>	<u>FR Rate (% Cont)</u>	<u>DRL Resp Rate</u>	<u>DRL Rate (% Cont)</u>	<u>TO Resp Rate</u>	<u>TO Rate (% Cont)</u>
3-16-84	Baseline	3.000	--	.082	--	.035	--
3-23-84	Baseline	4.603	--	.085	--	.038	--
3-27-84	Chamber	4.614	--	.073	--	.034	--
3-30-84	Chamber	4.374	--	.077	--	.013	--
4-3-84	Baseline	3.974	--	.075	--	.011	--
4-6-84	Chamber + Saline	4.620	--	.086	--	.029	--
4-10-84	Chamber + Saline	4.503	--	.081	--	.013	--
4-17-84	Baseline + Saline	4.438	--	.084	--	.035	--
4-24-84	Chamber + Saline	4.332	--	.088	--	.028	--
4-27-84	Chamber + Drug	1.589	37.9	.133	164.2	.051	196.2
5-1-84	Chamber + Drug	2.050	48.9	.173	213.6	.098	376.9
5-3-84	Chamber	4.630	--	.085	--	.023	--
5-4-84	.5g + Drug	2.712	64.7	.180	222.2	.113	434.6
5-8-84	Chamber + Drug	4.020	95.9	.120	148.1	.032	123.1
5-11-84	1g + Drug	2.852	68.0	.202	249.4	.138	530.8
5-15-84	Chamber + Drug	3.383	80.7	.225	277.8	.171	657.7
5-18-84	3g + Drug	4.357	103.9	.120	148.1	.062	238.5
5-22-84	Chamber + Drug	3.945	94.1	.125	154.3	.042	161.5
5-25-84	5g + Drug	3.476	82.9	.130	160.5	.088	338.5
5-29-84	.5g + 1kv + Drug	3.201	76.4	.128	158.0	.028	107.7
6-1-84	1g + 1kv + Drug	3.543	84.5	.141	174.1	.109	419.2
6-5-84	3g + 1kv + Drug	3.532	84.3	.138	170.4	.034	130.8
6-12-84	3g + 1kv + Drug	3.925	93.6	.187	230.9	.086	330.8
6-15-84	Chamber + Saline	3.679	--	.076	--	.024	--
6-19-84	1g + 1kv + Drug	3.748	89.4	.130	160.5	.042	161.5
6-22-84	.5g + 1kv + Drug	3.267	77.9	.125	154.3	.031	119.2
6-26-84	5g + 1kv + Drug	3.898	93.0	.124	153.1	.027	103.9
6-29-84	5g + 1kv + Drug	3.442	82.1	.133	164.2	.038	146.2
7-10-84	Chamber + Drug	3.915	93.4	.149	184.0	.049	188.5
7-17-84	.5g + Drug	3.577	85.3	.119	146.9	.048	184.6
7-20-84	1g + Drug	3.745	89.3	.130	160.5	.026	100.0
7-24-84	3g + Drug	3.398	81.1	.122	150.6	.046	176.9
7-27-84	5g + Drug	3.884	92.7	.126	155.6	.031	119.2
8-7-84	Baseline + Saline	4.047	--	.079	--	.032	--
8-24-84	Chamber + Saline	3.681	--	.084	--	.024	--



TABLE 39. Average Response Rates for Rat 11

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Baseline	3.445/.093	.069/.006	.022/.005
Chamber	3.348/.006	.068/.004	.022/.008
Chamber + Saline	3.457/.156	.064/.003	.022/.006
Baseline + Saline	3.420/.004	.068/.001	.018/.006
Chamber + Drug	3.207/.262	.144/.018	.045/.004
.5g + Drug	3.318/.268	.154/.014	.036/.009
1g + Drug	2.480/.367	.155/.009	.047/.000
3g + Drug	3.152/.411	.136/.021	.031/.003
5g + Drug	2.221/.071	.142/.010	.026/.000
.5g + 1kv + Drug	2.938/.728	.181/.033	.071/.009
1g + 1kv + Drug	2.068/.343	.212/.084	.088/.050
3g + 1kv + Drug	2.487/.203	.134/.010	.064/.023
5g + 1kv + Drug	2.569/.162	.170/.051	.040/.004
Controls (all)	3.430/.118	.067/.004	.022/.006

TABLE 40. Average Response Rates for Rat 12

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Baseline	3.588/.261	.050/.003	.022/.004
Chamber	3.814/.232	.050/.002	.018/.002
Chamber + Saline	3.372/.233	.051/.003	.014/.005
Baseline + Saline	3.746/.223	.055/.001	.021/.006
Chamber + Drug	2.751/.294	.132/.028	.068/.036
.5g + Drug	3.229/.271	.112/.024	.029/.017
1g + Drug	2.827/.455	.125/.003	.042/.023
3g + Drug	3.038/.232	.113/.025	.050/.016
5g + Drug	2.957/.001	.083/.003	.034/.022
.5g + 1kv + Drug	2.767/.317	.151/.033	.088/.033
1g + 1kv + Drug	2.903/.216	.104/.022	.069/.026
3g + 1kv + Drug	2.854/.057	.091/.003	.032/.004
5g + 1kv + Drug	3.021/.173	.102/.005	.027/.010
Controls (all)	3.582/.300	.051/.003	.018/.006

TABLE 41. Average Response Rates for Rat 13

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	2.753/.066	.112/.006	.036/.008
Chamber	2.646/.085	.111/.006	.024/.002
Chamber + Saline	2.755/.131	.112/.004	.025/.007
Baseline + Saline	2.759/.058	.105/.009	.021/.002
Chamber + Drug	2.068/.563	.216/.038	.137/.080
.5g + Drug	2.220/.071	.245/.026	.101/.052
1g + Drug	1.782/.514	.233/.015	.102/.054
3g + Drug	2.545/.038	.169/.007	.071/.024
5g + Drug	2.374/.167	.205/.006	.046/.025
.5g + 1kv + Drug	1.982/.189	.216/.014	.095/.044
1g + 1kv + Drug	2.060/.097	.223/.023	.089/.057
3g + 1kv + Drug	2.352/.004	.231/.027	.037/.010
5g + 1kv + Drug	2.437/.064	.208/.019	.036/.015
Controls (all)	2.730/.109	.111/.007	.027/.008

TABLE 42. Average Response Rates for Rat 15

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Baseline	3.859/.660	.081/.004	.028/.012
Chamber	4.539/.014	.078/.005	.023/.009
Chamber + Saline	4.163/.405	.083/.004	.024/.006
Baseline + Saline	4.243/.196	.082/.003	.034/.002
Chamber + Drug	3.150/.973	.154/.036	.074/.048
.5g + Drug	3.145/.433	.150/.031	.081/.033
1g + Drug	3.299/.447	.155/.025	.082/.056
3g + Drug	3.878/.480	.121/.001	.054/.008
5g + Drug	3.680/.204	.128/.002	.068/.020
.5g + 1kv + Drug	3.234/.033	.127/.002	.030/.002
1g + 1kv + Drug	3.646/.103	.136/.006	.076/.034
3g + 1kv + Drug	3.729/.197	.163/.025	.060/.026
5g + 1kv + Drug	3.670/.228	.129/.005	.033/.006
Controls (all)	4.192/.476	.081/.005	.026/.009

TABLE 43. Summary Response Rates for 11, 12, 13, and 15

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Baseline	3.411/.544	.078/.023	.027/.010
Chamber	3.587/.703	.077/.023	.022/.006
Chamber + Saline	3.437/.560	.078/.023	.021/.007
Baseline + Saline	3.542/.560	.077/.019	.034/.002
Chamber + Drug	2.794/.749	.162/.045	.074/.048
.5g + Drug	2.978/.529	.165/.054	.062/.044
1g + Drug	2.597/.712	.170/.044	.068/.048
3g + Drug	3.153/.584	.135/.027	.051/.021
5g + Drug	2.808/.590	.139/.044	.041/.025
.5g + 1kv + Drug	2.730/.617	.169/.041	.071/.038
1g + 1kv + Drug	2.669/.594	.169/.067	.080/.044
3g + 1kv + Drug	2.855/.556	.155/.054	.048/.023
5g + 1kv + Drug	2.924/.510	.152/.049	.034/.010
Controls (all)	3.482/.597	.077/.022	.023/.008

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TABLE 44. Average Percent Control Response Rates for Rat 11

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Chamber + Drug	93.5/7.7	214.9/27.3	204.6/166.9
.5g + Drug	96.7/7.8	229.2/20.2	163.7/41.0
1g + Drug	72.3/10.7	121.2/96.7	213.6/0.0
3g + Drug	91.9/12.0	203.0/31.4	138.7/11.4
5g + Drug	64.8/2.1	211.2/14.2	118.2/0.0
.5g + 1kv + Drug	86.7/21.3	270.2/49.3	322.7/40.9
1g + 1kv + Drug	60.3/10.0	315.7/124.7	400.0/227.3
3g + 1kv + Drug	72.5/5.9	200.0/14.9	288.7/102.3
5g + 1kv + Drug	74.9/4.7	253.8/76.2	179.6/16.0

TABLE 45. Average Percent Control Response Rates for Rat 12

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Chamber + Drug	76.8/8.2	258.8/54.5	376.9/201.2
.5g + Drug	90.2/7.6	219.7/47.1	161.2/94.5
1g + Drug	78.9/12.7	244.1/4.9	230.6/105.0
3g + Drug	84.8/6.5	221.6/49.0	275.0/86.1
5g + Drug	82.6/0.3	161.8/4.9	188.9/122.2
.5g + 1kv + Drug	77.3/8.9	296.1/64.7	486.2/180.6
1g + 1kv + Drug	81.1/6.1	260.8/100.0	383.4/144.5
3g + 1kv + Drug	79.7/1.6	178.5/5.9	175.0/19.4
5g + 1kv + Drug	84.3/4.8	199.0/8.8	147.2/52.8

TABLE 46. Average Percent Control Response Rates for Rat 13

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>T0 Resp Rate</u>
Chamber + Drug	75.7/20.6	194.6/33.9	508.1/295.9
.5g + Drug	81.3/2.6	220.3/23.0	374.1/192.6
1g + Drug	65.3/18.8	209.9/13.5	377.8/200.0
3g + Drug	93.2/1.4	152.3/6.3	261.2/87.1
5g + Drug	87.0/6.1	184.7/5.4	170.4/92.6
.5g + 1kv + Drug	72.6/6.9	194.2/12.2	351.9/163.0
1g + 1kv + Drug	75.5/3.6	200.9/20.7	327.8/209.3
3g + 1kv + Drug	86.2/3.7	207.7/23.9	135.2/35.2
5g + 1kv + Drug	89.3/2.4	187.0/16.7	131.5/53.7

TABLE 47. Average Percent Control Response Rates for Rat 15

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	75.2/23.2	190.3/44.7	284.0/533.3
.5g + Drug	75.0/10.3	184.6/37.7	309.6/125.0
1g + Drug	78.7/10.7	205.0/44.5	315.4/215.4
3g + Drug	92.5/11.4	149.4/1.3	207.7/30.8
5g + Drug	87.8/4.9	158.1/2.5	228.9/109.7
.5g + 1kv + Drug	77.2/6.9	156.2/1.9	113.5/5.8
1g + 1kv + Drug	87.0/2.5	167.3/6.8	290.4/128.9
3g + 1kv + Drug	89.0/4.7	200.7/30.3	230.8/100.0
5g + 1kv + Drug	87.6/5.5	158.7/5.6	125.1/21.2

TABLE 48. Summary of Average Percent Control Rates for 11, 12, 13, and 15

Mean/S. D. of:

<u>Condition</u>	<u>FR Resp Rate</u>	<u>DRL Resp Rate</u>	<u>TO Resp Rate</u>
Chamber + Drug	80.3/18.2	214.7/49.5	343.4/245.6
.5g + Drug	85.8/11.2	213.4/37.9	252.1/156.2
1g + Drug	73.8/14.7	195.0/70.2	284.4/172.9
3g + Drug	90.6/9.5	181.6/43.0	220.6/83.0
5g + Drug	80.5/10.2	178.9/22.7	176.6/102.3
.5g + 1kv + Drug	78.2/12.9	229.1/69.8	318.5/181.8
1g + 1kv + Drug	75.9/11.7	222.0/87.2	350.4/187.5
3g + 1kv + Drug	81.8/7.4	196.7/23.6	207.4/94.2
5g + 1kv + Drug	84.0/7.1	199.6/52.3	145.8/45.1

TABLE 49. Response Rates for all Exposure Conditions for Rat 1

<u>SHAM</u>				<u>COMBINED FIELDS</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
8-15-84	4.724	.062	.037	9-6-84	4.970	.066	.023
8-16-84	4.909	.063	.022	9-7-84	4.631	.086	.015
4-26-84	4.653	.075	.032	9-13-84	4.836	.064	.028
4-27-84	4.880	.073	.018	9-14-84	4.707	.078	.024
4-23-84	4.737	.064	.021	9-17-84	4.638	.067	.023
4-24-84	4.435	.068	.024	9-18-84	4.653	.089	.015
9-27-84	4.991	.073	.013	9-24-84	4.467	.071	.031
9-28-84	4.885	.068	.014	9-25-84	4.848	.084	.015
10-18-84	4.601	.066	.007	10-11-84	4.661	.071	.018
10-19-84	4.863	.063	.019	10-12-84	4.780	.094	.029

<u>OSCILLATING</u>				<u>STATIC</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
4-30-84	4.653	.075	.032	10-22-84	4.601	.066	.007
5-1-84	4.639	.073	.022	10-23-84	4.725	.064	.019
5-21-84	5.054	.073	.009	10-25-84	4.391	.072	.024
5-22-84	4.614	.070	.011	10-26-74	4.637	.072	.015
8-20-84	5.113	.071	.035	11-1-84	4.440	.063	.011
8-21-84	5.027	.068	.024	11-2-84	3.750	.072	.024
8-23-84	4.619	.065	.017	11-8-84	4.619	.068	.017
8-24-84	4.979	.066	.045	11-9-84	4.759	.061	.023
8-27-84	4.829	.069	.017	11-19-84	4.467	.066	.024
8-28-84	4.970	.077	.015	11-20-84	4.887	.076	.018

CONTROL (Mean/SD)

<u>FR</u>	<u>DRL</u>	<u>TO</u>
4.703/.201	.063/.004	.022/.009

TABLE 50. Response Rates for all Exposure Conditions for Rat 2

<u>SHAM</u>				<u>COMBINED FIELDS</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
8-15-84	2.593	.056	.021	9-6-84	3.040	.058	.012
8-16-84	2.933	.055	.033	9-7-84	2.941	.073	.018
4-26-84	2.887	.050	.021	9-13-84	3.234	.050	.040
4-27-84	3.052	.046	.007	9-14-84	2.959	.082	.029
4-23-84	2.918	.056	.013	9-17-84	3.086	.058	.018
4-24-84	2.729	.059	.012	9-18-84	2.850	.067	.027
9-27-84	3.139	.054	.037	9-24-84	3.120	.051	.025
9-28-84	3.087	.050	.011	9-25-84	3.097	.067	.011
10-18-84	3.014	.053	.009	10-11-84	3.102	.053	.014
10-19-84	3.118	.056	.011	10-12-84	2.652	.069	.014

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<u>OSCILLATING</u>				<u>STATIC</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
4-30-84	2.993	.056	.020	10-22-84	3.318	.054	.011
5-1-84	3.055	.056	.011	10-23-84	3.116	.052	.013
5-21-84	2.648	.053	.012	10-25-84	3.047	.056	.013
5-22-84	2.548	.058	.014	10-26-84	3.235	.059	.025
8-20-84	3.033	.054	.025	11-1-84	3.071	.057	.027
8-21-84	3.049	.053	.028	11-2-84	3.329	.058	.014
8-23-84	2.977	.048	.009	11-8-84	2.914	.054	.029
8-24-84	3.020	.056	.023	11-9-84	3.102	.053	.014
8-27-84	2.840	.053	.032	11-19-84	2.607	.057	.014
8-28-84	3.006	.058	.012	11-20-84	2.646	.050	.028

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<u>CONTROL (Mean/SD)</u>		
<u>FR</u>	<u>DRL</u>	<u>TO</u>
2.979/.188	.054/.003	.020/.009

TABLE 51. Response Rates for all Exposure Conditions for Rat 3

<u>SHAM</u>				<u>COMBINED FIELDS</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
8-15-84	2.670	.071	.016	9-6-84	2.897	.074	.022
8-16-84	2.752	.073	.028	9-7-84	2.877	.092	.013
4-26-84	3.004	.068	.025	9-13-84	2.909	.072	.010
4-27-84	3.020	.069	.027	9-14-84	2.851	.087	.018
4-23-84	2.878	.075	.021	9-17-84	2.709	.070	.019
4-24-84	2.913	.079	.007	9-18-84	2.619	.083	.037
9-27-84	2.691	.073	.033	9-24-84	2.740	.075	.011
9-28-84	2.869	.077	.018	9-25-84	2.876	.096	.037
10-18-84	2.710	.074	.023	10-11-84	2.835	.075	.005
10-19-84	2.812	.071	.013	10-12-84	2.581	.089	.015

<u>OSCILLATING</u>				<u>STATIC</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
4-30-84	2.858	.076	.028	10-22-84	2.581	.070	.025
5-1-84	3.019	.072	.017	10-23-84	3.039	.073	.009
5-21-84	2.936	.062	.019	10-25-84	2.917	.071	.010
5-22-84	2.571	.070	.007	10-26-84	2.847	.075	.007
8-20-84	2.540	.068	.077	11-1-84	2.679	.072	.018
8-21-84	2.707	.073	.028	11-2-84	2.758	.075	.025
8-23-84	2.851	.077	.016	11-8-84	2.827	.073	.011
8-24-84	2.870	.069	.031	11-9-84	2.654	.074	.013
8-27-84	2.837	.076	.016	11-19-84	2.403	.078	.011
8-28-84	2.897	.074	.022	11-20-84	2.460	.068	.029

CONTROL (Mean/SD)

<u>FR</u>	<u>DRL</u>	<u>TO</u>
2.774/.147	.073/.004	.021/.016



TABLE 52. Response Rates for all Exposure Conditions for Rat 4

<u>SHAM</u>				<u>COMBINED FIELDS</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
8-15-84	3.810	.063	.014	9-6-84	3.678	.063	.016
8-16-84	3.740	.067	.031	9-7-84	3.478	.070	.027
4-26-84	3.775	.063	.016	9-13-84	3.459	.064	.020
4-27-84	3.568	.066	.029	9-14-84	3.607	.058	.019
4-23-84	3.698	.073	.025	9-17-84	3.821	.059	.014
4-24-84	3.591	.061	.019	9-18-84	3.553	.074	.015
9-27-84	3.323	.068	.011	9-24-84	3.641	.064	.016
9-28-84	3.179	.069	.014	9-25-84	3.523	.082	.011
10-18-84	3.620	.064	.019	10-11-84	3.645	.063	.017
10-19-84	3.751	.072	.012	10-12-84	3.582	.071	.017

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<u>OSCILLATING</u>				<u>STATIC</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
4-30-84	3.642	.064	.010	10-22-84	3.745	.062	.016
5-1-84	3.676	.063	.026	10-23-84	3.531	.065	.022
5-21-84	3.844	.062	.019	10-25-84	3.290	.076	.027
5-22-84	3.463	.067	.005	10-26-74	3.309	.060	.007
8-20-84	3.609	.063	.020	11-1-84	3.206	.061	.034
8-21-84	3.474	.059	.017	11-2-84	3.187	.064	.013
8-23-84	3.304	.065	.011	11-8-84	3.153	.059	.020
8-24-84	3.393	.076	.017	11-9-84	3.312	.061	.009
8-27-84	3.646	.069	.012	11-19-84	2.629	.070	.007
8-28-84	3.446	.060	.037	11-20-84	2.687	.066	.015

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<u>CONTROL (Mean/SD)</u>		
<u>FR</u>	<u>DRL</u>	<u>TO</u>
3.527/.291	.065/.004	.017/.006

TABLE 53. Response Rates for all Exposure Conditions for Rat 5

<u>SHAM</u>				<u>COMBINED FIELDS</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
8-15-84	3.486	.055	.026	9-6-84	3.529	.057	.007
8-16-84	3.739	.059	.018	9-7-84	3.565	.087	.016
4-26-84	3.318	.062	.026	9-13-84	3.614	.058	.020
4-27-84	3.702	.060	.015	9-14-84	3.675	.094	.016
4-23-84	3.902	.065	.019	9-17-84	3.624	.065	.020
4-24-84	3.554	.054	.015	9-18-84	3.538	.089	.017
9-27-84	3.805	.066	.012	9-24-84	3.618	.054	.018
9-28-84	3.495	.056	.027	9-25-84	3.805	.084	.026
10-18-84	3.557	.061	.015	10-11-84	3.363	.066	.023
10-19-84	3.537	.060	.021	10-12-84	3.491	.079	.016

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<u>OSCILLATING</u>				<u>STATIC</u>			
<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>	<u>Date</u>	<u>FR</u>	<u>DRL</u>	<u>TO</u>
4-30-84	3.995	.057	.027	10-22-84	3.557	.061	.015
5-1-84	3.543	.053	.012	10-23-84	3.588	.059	.031
5-21-84	3.837	.063	.022	10-25-84	3.636	.063	.009
5-22-84	3.782	.061	.024	10-26-84	3.677	.066	.018
8-20-84	3.667	.056	.026	11-1-84	3.544	.056	.021
8-21-84	3.625	.052	.022	11-2-84	3.574	.063	.022
8-23-84	3.514	.054	.021	11-8-84	3.321	.065	.012
8-24-84	3.525	.061	.033	11-9-84	3.287	.051	.013
8-27-84	3.644	.056	.023	11-19-84	3.579	.057	.010
8-28-84	3.502	.053	.026	11-20-84	3.531	.062	.008

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<u>CONTROL (Mean/SD)</u>		
<u>FR</u>	<u>DRL</u>	<u>TO</u>
3.606/.173	.060/.004	.019/.006

TABLE 54. Percent Control Response Rates for All Exposures For Rat 1

<u>SHAM</u>			
Date	FR	DRL	TO
8-16-84	104.3	100.0	100.0
4-24-84	103.7	115.9	145.4
4-27-84	94.3	107.9	109.1
9-28-84	103.9	107.9	63.6
10-19-84	103.4	100.0	86.4
	$\bar{X} = 101.9/3.8$	$\bar{X} = 106.3/5.9$	$\bar{X} = 100.9/27.0$

<u>OSCILLATING</u>			
Date	FR	DRL	TO
5-1-84	98.6	115.9	100.0
5-22-84	98.1	111.1	50.0
8-21-84	106.9	107.9	109.1
8-24-84	105.9	104.8	204.5
8-28-84	105.7	122.2	68.2
	$\bar{X} = 103.0/3.9$	$\bar{X} = 112.4/6.1$	$\bar{X} = 106.4/55.5$

<u>STATIC</u>			
Date	FR	DRL	TO
10-23-84	100.5	101.6	86.4
10-26-84	98.6	114.3	68.2
11-2-84	79.7	114.3	109.1
11-9-84	101.2	96.8	104.5
11-20-84	103.9	120.6	81.8
	$\bar{X} = 96.8/8.7$	$\bar{X} = 109.5/8.9$	$\bar{X} = 90.0/15.0$

<u>COMBINED FIELDS</u>			
Date	FR	DRL	TO
9-7-84	98.5	136.5	68.2
9-14-84	100.1	123.8	109.1
9-18-84	98.9	141.3	68.2
9-25-84	103.1	133.3	68.2
10-12-84	101.6	149.2	131.8
	$\bar{X} = 100.4/1.7$	$\bar{X} = 136.8/8.4$	$\bar{X} = 89.1/26.6$

TABLE 55. Percent Control Response Rates for All Exposures For Rat 2

<u>SHAM</u>			
Date	FR	DRL	TO
8-16-84	98.5	101.9	165.0
4-24-84	91.6	109.3	60.0
4-27-84	102.5	85.2	35.0
9-28-84	103.6	92.6	55.0
10-19-84	104.7	103.7	55.0
	$\bar{X} = 100.2/4.8$	$\bar{X} = 98.5/8.6$	$\bar{X} = 74.0/46.3$

<u>OSCILLATING</u>			
Date	FR	DRL	TO
5-1-84	102.6	103.7	55.0
5-22-84	85.5	107.4	70.0
8-21-84	102.3	98.1	85.0
8-24-84	101.4	103.7	115.0
8-28-84	100.9	107.4	54.5
	$\bar{X} = 98.5/6.5$	$\bar{X} = 104.1/3.4$	$\bar{X} = 75.9/22.5$

<u>STATIC</u>			
Date	FR	DRL	TO
10-23-84	104.6	96.3	65.0
10-26-84	108.6	109.3	125.0
11-2-84	111.7	107.4	70.0
11-9-84	104.1	98.1	70.0
11-20-84	88.8	92.6	140.0
	$\bar{X} = 103.6/7.9$	$\bar{X} = 100.7/6.5$	$\bar{X} = 94.0/31.8$

<u>COMBINED FIELDS</u>			
Date	FR	DRL	TO
9-7-84	98.7	135.2	90.0
9-14-84	99.3	151.9	145.0
9-18-84	95.7	124.1	135.0
9-25-84	104.0	124.1	55.0
10-12-84	89.0	127.8	70.0
	$\bar{X} = 97.3/4.9$	$\bar{X} = 132.6/10.5$	$\bar{X} = 99.0/35.4$

TABLE 56. Percent Control Response Rates for All Exposures For Rat 3

<u>SHAM</u>			
Date	FR	DRL	TO
8-16-84	99.2	100.0	133.3
4-24-84	105.0	108.2	33.3
4-27-84	108.9	94.5	128.6
9-28-84	103.4	105.5	85.7
10-19-84	101.4	104.2	61.9
	$\bar{X} = 103.6/3.3$	$\bar{X} = 102.5/4.8$	$\bar{X} = 88.6/38.4$

<u>OSCILLATING</u>			
Date	FR	DRL	TO
5-1-84	108.8	98.6	81.0
5-22-84	92.7	95.9	33.3
8-21-84	97.6	100.0	133.3
8-24-84	103.5	94.5	147.6
8-28-84	104.4	101.4	104.8
	$\bar{X} = 101.4/5.6$	$\bar{X} = 98.1/2.6$	$\bar{X} = 100.0/40.5$

<u>STATIC</u>			
Date	FR	DRL	TO
10-23-84	109.6	100.0	42.9
10-26-84	102.6	102.7	33.3
11-2-84	99.4	102.7	119.4
11-9-84	95.7	101.4	61.9
11-20-84	88.7	93.2	138.1
	$\bar{X} = 99.2/7.0$	$\bar{X} = 100.0/3.5$	$\bar{X} = 79.1/42.0$

<u>COMBINED FIELDS</u>			
Date	FR	DRL	TO
9-7-84	103.7	126.0	61.9
9-14-84	102.8	119.2	85.7
9-18-84	94.4	113.7	176.2
9-25-84	103.7	131.5	176.2
10-12-84	93.0	121.9	71.4
	$\bar{X} = 99.5/4.8$	$\bar{X} = 122.5/6.0$	$\bar{X} = 114.3/51.1$

TABLE 57. Percent Control Response Rates for All Exposures For Rat 4

<u>SHAM</u>			
Date	FR	DRL	TO
8-16-84	106.0	103.1	182.4
4-24-84	101.8	93.8	111.8
4-27-84	101.2	101.5	170.6
9-28-84	90.1	106.2	82.4
10-19-84	106.4	110.8	70.6
	$\bar{X} = 101.1/5.9$	$\bar{X} = 103.1/5.6$	$\bar{X} = 123.6/45.4$

<u>OSCILLATING</u>			
Date	FR	DRL	TO
5-1-84	104.2	96.9	152.9
5-22-84	98.2	103.1	29.4
8-21-84	98.5	90.8	164.7
8-24-84	96.2	116.9	100.0
8-28-84	97.7	92.3	217.6
	$\bar{X} = 99.0/2.7$	$\bar{X} = 100.0/9.5$	$\bar{X} = 132.9/63.8$

<u>STATIC</u>			
Date	FR	DRL	TO
10-23-84	100.1	100.0	129.4
10-26-84	93.8	92.3	41.2
11-2-84	90.4	98.5	76.5
11-9-84	93.9	93.8	52.9
11-20-84	76.2	101.5	88.2
	$\bar{X} = 90.9/8.0$	$\bar{X} = 97.2/3.6$	$\bar{X} = 77.6/30.8$

<u>COMBINED FIELDS</u>			
Date	FR	DRL	TO
9-7-84	98.6	107.7	158.8
9-14-84	102.3	89.2	111.8
9-18-84	100.7	113.8	88.2
9-25-84	99.9	126.2	64.7
10-12-84	101.6	109.2	100.0
	$\bar{X} = 100.6/1.7$	$\bar{X} = 109.2/11.9$	$\bar{X} = 104.7/31.2$

TABLE 58. Percent Control Response Rates for All Exposures For Rat 5

<u>SHAM</u>			
Date	FR	DRL	TO
8-16-84	103.7	98.3	94.7
4-24-84	98.6	90.0	78.9
4-27-84	102.7	100.0	78.9
9-28-84	96.9	93.0	142.1
10-19-84	98.1	100.0	110.5
	$\bar{X} = 100.0/2.7$	$\bar{X} = 96.3/4.0$	$\bar{X} = 101.0/23.6$

<u>OSCILLATING</u>			
Date	FR	DRL	TO
5-1-84	98.3	88.3	63.2
5-22-84	104.9	101.7	126.3
8-21-84	100.5	86.7	115.8
8-24-84	97.8	101.7	173.7
8-28-84	97.1	88.3	136.8
	$\bar{X} = 99.7/2.8$	$\bar{X} = 93.3/6.9$	$\bar{X} = 123.2/36.8$

<u>STATIC</u>			
Date	FR	DRL	TO
10-23-84	99.5	98.3	163.2
10-26-84	102.0	110.0	94.7
11-2-84	99.1	105.0	115.8
11-9-84	91.2	85.0	68.4
11-20-84	97.9	103.3	42.1
	$\bar{X} = 97.6/3.6$	$\bar{X} = 100.3/8.5$	$\bar{X} = 96.8/41.4$

<u>COMBINED FIELDS</u>			
Date	FR	DRL	TO
9-7-84	98.9	145.0	84.2
9-14-84	101.9	156.7	84.2
9-18-84	98.1	148.3	89.5
9-25-84	105.5	140.0	136.8
10-12-84	96.8	131.7	84.2
	$\bar{X} = 100.2/3.1$	$\bar{X} = 144.3/8.3$	$\bar{X} = 95.8/20.6$

END

DT/C

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