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BEHAVIORAL STUDIES FOLLOWING IONIZING RADIATION EXPOSURES: A DA--ETC(U)  
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## TECHNICAL REPORT

### Behavioral studies following ionizing radiation exposures: A data base

C. G. Franz  
R. W. Young  
W. E. Mitchell

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Research was conducted according to the principles enunciated in the "Guide for the Care and Use of Laboratory Animals," prepared by the Institute of Laboratory Animal Resources, National Research Council.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <b>For over a decade, the Behavioral Sciences Department (BHS) of the Armed Forces Radiobiology Research Institute (AFRRI) has collected data concerning the effects of ionizing radiation on primate performance. These data are the basis for the current radiation combat casualty criteria used by the armed forces of this country and NATO. In order to ensure the continued accessibility of these data and to increase their usefulness in retrospective studies, the data have been consolidated into a computerized</b>		

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20. ABSTRACT (continued)

data base. This report provides potential users with the background and details necessary to access the data base and to retrieve information from it. The report defines the search parameters for the data base, and discusses the sources, extent, and reliability of data contained in the data set.

The document is organized into seven chapters and four appendices. In the first chapter, a brief history surveys the data collection methods used in acquiring the data. Chapter 2 covers the structure and general contents of the data base. Chapters 3 and 4 detail the contents of the data base. Chapters 5 and 6 describe the software used to build, maintain, safeguard, and retrieve the data. Chapter 7 describes the analysis routines. Appendix A contains complete instructions for operating the search, retrieval, and analysis software. Appendix B describes the data file format for the use of programmers. Appendix C contains the reference tables used to set up a search. Appendix D describes in detail the behavioral tasks used in the research from which this data set was derived.

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# Acknowledgments

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Without the dedication of Albert B. Butler and John R. Harrison, this project would not have been completed. Mr. Butler not only maintained the data tapes but also kept copies of all the programs, made and saved detailed notes on their functions, and remembered details of each of the many changes in hardware and software made during his tenure in the AFRRI Central Computer Facility. Had he not worked with exceptional dedication and meticulous attention to detail throughout the years, we could not have located, identified, and salvaged the older data tapes. In addition, Mr. Butler maintained a file of information about hardware and software, to which we referred repeatedly when gathering and converting data originally recorded on older devices or operating systems. Last, but not least, Mr. Butler was always willing to teach those of us who knew nothing about computers how to work with them.

Mr. Harrison patiently excavated most of the identifying data, which required much detective work in locating summary sheets, laboratory notebooks, dosimetry records, and individual subject files. This job also required meticulous attention to detail in verifying subject numbers, data files, studies, and investigators. In addition, Mr. Harrison keypunched most of the identifying data and much of the old performance data, proofread the results, and made necessary corrections.

We also express our gratitude to the entire staff of the Central Computer Facility for their assistance in developing programs and sorting and manipulating the 130 digital tapes of data.

We express our appreciation to all Behavioral Sciences Department technicians for meticulous record keeping over the years, which made possible the collection of data. In addition to the data, they also kept notes of procedures and problems that proved invaluable.

We acknowledge the outstanding assistance of the AFRRI library staff in locating all of the laboratory notebooks issued to investigators and technicians over the years. We also note their patience with our explorations through the notebooks and publications, causing considerable disarray in the back file room.

The dosimetry staff was extremely helpful in determining doses, reference points, and TAR's, and in deciphering and replicating historical dosimetry runs to confirm the results.

Victor A. Kieffer assisted in locating information for studies in which he had participated.

Dr. Alexandra Bakarich assisted in preparing this document, and tested the usefulness of the programs to persons unfamiliar with the original research.

# Introduction

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The Behavioral Sciences Department (BHS) of the Armed Forces Radiobiology Research Institute (AFRRI) has been collecting data concerning the effects of ionizing radiation on the primate performance of learned tasks for over 11 years. In any such ongoing research effort, management of the accumulated data becomes a problem. This is especially true when data collection methods change and when it is desirable to compare new data to older data. The BHS performance data are a unique resource for military planners. These data are the research basis for the current radiation combat casualty criteria used by NATO and by the U.S. military services. Therefore, continued accessibility is particularly important.

Computer technology has been used to ensure the continuing accessibility of these data and to increase their usefulness. The first step was to develop computer programs to enter, search, retrieve, and analyze the data. The second step was to locate, verify, and enter the data onto a data base. The final step was to prepare a software manual to document the programs and a report to describe the data base (the present report). The purpose of this report is to provide potential users with the background and the details necessary to access the data and to use the retrieved information in a valid manner. Appendix A is a user's manual for search and retrieval software of the data base.

# Chapter 1.

## Historical Perspective

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The Behavioral Sciences Department of AFRRI has been conducting an intensive research program to develop a model of performance of learned tasks postirradiation. A number of investigators have participated in this effort over the last 11 years. Several unique studies were completed in the early years. They involved dose-response curves, relative field effects, split doses, and partial body shielding. The task used in the early work, a two-choice visual discrimination task, was held constant while other parameters were varied. Later a physical activity task was added to test the effects of radiation on physical performance. These studies provided basic information that is still useful for comparison.

The elements of this research program could not remain static over the years. Techniques for data analysis were developed and refined after the earlier data had been analyzed. The empirical definition of one of the radiation effects, early transient incapacitation (ETI), evolved and was refined. (See section on Response Parameters on page 17.) The method used to collect data has evolved from manual recording on checklists to computer collection on magnetic disks, as the state of the art changed.

### DATA COLLECTION

#### 1968-1971

Originally the experimental apparatus was controlled by relay racks, and the data were collected by checking a form for each response and recording the cumulative latency for each ten trials. This system provided an accurate record of responses, but latency calculations always had to be based on the average latency for ten trials.

#### 1971-1974

The next stage retained the relay racks to control the task, but an encoder was developed to record each individual response and latency on analog magnetic tapes. These tapes were then played through a decoder to the AFRRI data-acquisition system, to be stored on digital computer tapes and analyzed by an SDS-920 computer.<sup>1</sup> This system provided individual latencies for analysis, but it was complex (difficult to set up and difficult to maintain) and expensive in man-hours and computer-hours when transferring data. In addition, precision of control for the behavioral task was still a function of precision of the relay rack timing devices. The remnants of this system are being used as an interim data-collecting device for the physical activity task.

### 1974 to Present (1980)

Task control and data collection were transferred to a computerized behavioral control system (SCAT) developed by the Grason-Stadler Company (now manufactured by BKP Scientific, P.O. 34, Berlin, Massachusetts 01503). A SCAT can be programmed to operate experimental apparatus, collect and store responses and latencies on disk or magnetic tape, and provide a running printout of the data. This system is precise to thousandths of a second. It is possible to use the SCAT computer, a PDP-8A, to analyze data. We still transfer our data to the AFRRI Central Computer Facility for storage and analysis because of the large amount we have accumulated and because our SCAT's are used full-time for experimental control.

In summary, these stages of development involved (1) increase in the detail and the accuracy with which data were recorded and (2) increase in the precision of behavioral control. Because of these refinements, the precision and accuracy of collected data improved with each stage of development.

## UPDATING

### 1973

In 1973 we published a summary covering much of the data collected up to that time.<sup>2</sup> In order to produce that paper, we keypunched the data that had been recorded by hand and stored them on magnetic tapes in the same format as the data that had been sent through the decoder. This made the data more accessible and permitted analysis by newer techniques. But the number of magnetic tapes needed to store the data became cumbersome, and the difficulty of retrieving data for a specific set of subjects increased. If too many subjects were stored on a single tape, the search and retrieval time was prohibitive, since magnetic tape is a serial access device. On the other hand, if small groups or sets were stored on separate tapes, then regrouping the subjects involved handling a large number of tapes.

A second problem arose with the use of magnetic tape as the storage device. Each time we updated the system software, we lost access to the older tapes. With the last update, we lost all access to all tapes for the third time in 8 years. Regaining tape access after each system change caused an increase in software development overhead. Each conversion also required a greater number of man-hours and computer-hours because of the steadily increasing number of tapes.

### 1978--1980

The original reports for many of the early studies did not extract all available information. This was due either to the perceived needs of the study or to the unavailability of analysis and data retrieval techniques. But recent advances in analysis techniques permitted comprehensive looks at cross sections of the data from several studies, and questions arose that made it desirable to take those looks. When we attempted to do so with the data accumulated over 10 years, it became obvious that the existing system of data management was not adequate.

The magnitude of the problem became apparent when we found that we had accumulated 1300-1400 files of pre- and postirradiation data on 130 magnetic tapes. These were the performance data for about 600 subjects from 18 studies. The overall difficulty of data retrieval was compounded by the fact that there were up to 37 other relevant bits of information for each subject. This information identified each subject, described the study, and defined the radiation exposure. Most investigators had published or prepared summaries of only those factors relevant to a particular study. This meant that for a study involving 50 subjects, only 9 or 10 of the 37 bits of information could be retrieved from the summary of the study. The rest had to be collected and correlated for each subject individually, from sources such as laboratory notebooks, file folders, dosimetry reports, publications, drafts, computer printouts, and computerized data files. We had to retrieve this information and match it to the appropriate performance data in order to select subjects for our comprehensive analysis. Even locating the identifying information required familiarity with the overall program and each of the studies. Linking the two types of data required extensive knowledge of the overall research program, the investigators for each study, and the record-keeping and data-management systems of each. The tenure of only two BHS investigators still at AFRRI covers most of the period under consideration. One or the other of these investigators has worked on the studies and is familiar with the data. If either were to leave AFRRI before effective organization of the data, the result would be loss of access to a significant portion of the information about primate performance postirradiation.

Recent advances in software capability and computer hardware at AFRRI have provided solutions to the problems of data management, mass storage, and rapid access, in the form of searchable data bases on random-access disks. Simply transferring all performance data from tapes to a single random-access mass-storage device would have eliminated some of the problems with tape storage and access mentioned above. This could be done because all performance data files had the same name and internal format as well as a consistent, unduplicated, assigned code for response identification, keyed to analysis routines by task codes (see Appendix B). Still, the large number of files would be a problem if we wanted to retrieve data for a specific subject. We avoided this problem by entering the data into a searchable data base so that the computer finds and retrieves the data files for us. In addition, the same data base can store identifying information for each subject. This means that we have to collect, sort, and verify the information only once.

# Chapter 2.

## Data Base Structure

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### CONTENTS AND ORIENTATION

Once the need for a data base had been established, it was necessary to decide what would be included, how it would be entered, and how one would search for and retrieve the data.

A two-part data base appeared to be the most practical and least cumbersome answer, with performance data files as one part and remaining information as the other part. The two sections of the data base would be interrelated in that the subject-identifying information would include the performance data file numbers for each subject. The search and retrieval program would then have access to all the information in this section and could also retrieve the performance data for any subject.

The 37 items of information identified as relevant are used as specifiable search parameters. Nonnumeric items are entered in coded form. For each item, more space is allowed in the structure of the data base than is needed for the largest current value of that item (i.e., no code is larger than two digits, but there is space for three digits). There is also space in the structure for additional items. The user is permitted to specify a value or range of values for any or all of the 37 items during a search. Each item may be specified only once. The relationship between the item and the value specified for it is expressed in terms of a logical operator (see Glossary). The logical operators are

- Equal
- Not equal
- Inside the range
- Outside the range
- Greater than
- Less than

Some standard analysis routines are built into the search and retrieval program. Simple statistics are run automatically; more complex routines are run on request. An output file is provided to be used as an interface with external statistical routines. It would be possible to build additional analysis capabilities into the program, but this would needlessly increase the time required to complete a search. Insofar as possible, the only other limitations permitted were those inherent in the hardware. This extensive flexibility was dictated by our past experience with data-management solutions that did not allow increasing sophistication in data collection and analysis.

All the programs relating to the data or data base had to be designed for relatively naïve computer users who have little or no interest in becoming sophisticated computer users. The data base was intended to be used by persons with backgrounds and interests in the fields of radiobiology or behavioral sciences rather than computer sciences or computer operation. We felt that requiring extensive knowledge of the operating system and system utility routines would needlessly restrict the usefulness of the data base. In any case, in a multi-user environment, the operations that do require knowledge of the system must be accomplished by a computer operator with a privileged account number, because those operations can adversely affect other users. In a single-user environment, one person can do everything required if he/she can set up the system. Otherwise, the assistance of a computer operator is needed.

## DOCUMENTATION

One of the reasons for establishing a data base was to ensure the data against loss. We intended to make the data available for analysis by users not involved in the original research-effort. Because the programs are simple to operate and are very interactive, there is no necessity for the user to have extensive training with the software in order to search and to analyze the data retrieved. However, a user who wishes to exercise the data base effectively and obtain valid results from it does need to be familiar with the contents of the data base, the search parameters, and the meaning of each. In addition, one needs to know the source, extent, and reliability of the information in the data base. Some of the required information about the data is available in AFRRRI scientific reports and in open-literature publications documenting the studies from which the data were drawn.<sup>2-28</sup> The present document provides the rest of the necessary information. It is the only source that defines the search parameters or discusses the source, extent, and reliability of the data that have been incorporated into the data base.

Descriptions of all the software needed to build and maintain the data base are found in Chapters 5 and 6. Detailed operating instructions will be presented in a separate software manual for those persons who will be editing, updating, or otherwise manipulating the basic components of the data base. Instructions for operating the search, retrieval, and analysis software are attached to the present report as Appendix A. Some additional information about the software is available in the form of computer program documentation. In the case of older programs, internal documentation is either nonexistent or inadequate.

NOTE:

The data base is a dynamic system, intended to grow as additional data are acquired. The programs to be used with it are also designed to grow and develop, as new demands are placed on them. No document produced at one time can completely describe such a system. The present document describes the basic data base and related programs. Additions and extensions will be covered in later documents.

## Chapter 3.

# Parameters

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To clarify and simplify the parameters used for a search, the identifying information will be treated as subsets: subject, task, radiation, and study. No such distinction exists on the data base. Search parameters may be specified in any sequence. For a complete listing of the parameters and their meaning, see Appendix C.

### SUBJECT PARAMETERS

Several subject-related variables can be specified on a search; these are age, weight, height, girth, sex, and species of the animal. Within the area of subject identification, there are two dichotomies that have been subcoded for other variables. There is not yet enough information about these variables to determine whether they affect response to radiation. Therefore, although a user would expect to find only two codes for species when rhesus monkeys (Macaca mulatta) and cynomolgus monkeys (Macaca fascicularis) had been used, there are four codes. Each species is subcoded to indicate wild or domestic origin. Similarly, six codes for sex are included to permit identification of the maturity of the animals, if known.

Clinical records of the subjects were used as the source of most subject-related variables. If a subject had been kept in-house for an extended period before irradiation, we recomputed its age to reflect age at time of irradiation. Subjects used for the physical activity program normally gained a substantial amount of weight while being physically conditioned. These subjects were weighed the morning before irradiation, and this weight was entered into the data base. The weights of the other subjects were taken from the clinical records.

Each subject received by AFRRRI was assigned an identification number, which was used to identify the performance data, radiation dose, etc. The problem of duplication of numbers did not arise with single studies. However, there were duplications through the years due to changes in suppliers or changes in the AFRRRI numbering system. For the data base it was necessary to ensure that each subject's number was a unique animal ID. In the case of single subjects having duplicate numbers, we added a letter after the number to create a unique ID. In some cases almost all of the subject numbers in a study were duplicated elsewhere. For those we added a meaningful group code (such as "HG" for high gamma) before or after the original animal number. The added letters should be ignored when associating subjects with previous publications. To ensure retrieval of listings and graphs for a specific subject from a specific publication, the user should search for that group and use the animal ID found, rather than the published number.

If the AFRRRI and open-literature reports are read independently, it may appear that a great many more subjects were irradiated than is true. Frequently the same group of subjects served as controls for more than one experiment. That will happen even more often with the existing data base, because we can pull out groups that closely match the experimental group on several parameters.

## TASK PARAMETERS

Task is one of the coded parameters. Eleven tasks are described in Appendix D. We used a visual discrimination task in the majority of early studies on the data base and changed other variables.<sup>3-15</sup> This task was used to establish a dose-response curve for the normal TRIGA field.<sup>14</sup> This serves as a reference curve against which the effect of manipulating other variables can be measured. One of the variables manipulated is task. A physical activity task was developed to determine the effect of radiation on physical performance.<sup>16-18</sup> A simple cued avoidance task, which paired a lever pull with a light, was used to test some radioprotective agents.<sup>19-22</sup> Variations and combinations of these tasks produced the rest of the tasks used.

It is important to realize that the performance data represent the performance of a subject on a specific task. It is obvious that all variables relating to performance are task-related. But task may also affect non-performance-related variables. For instance, task appears to affect survival time. Unless it can be clearly established that the task variable did not affect other variables examined, the tasks should not be mixed.

## RADIATION PARAMETERS

The radiation exposure for each subject is defined on the data base by several parameters. Two of the parameters are interrelated and cannot be dealt with separately. These are the reference point and the tissue-to-air ratio (TAR). Each exposure was measured free in air and converted to the absorbed dose at a specific point (such as midhead or midline tissue) by using an experimentally determined TAR. It is possible to use the TAR to convert the dose back to free in air, but it is not possible to use the TAR from one exposure configuration to alter the reference point for subjects from a different study.<sup>21,22</sup> The dosimetry measurements were done for each study with the apparatus in place except for the subject. The TAR's for each study were developed for a specific configuration of subject, apparatus, and shielding (if used). All doses for whole-body exposures were converted to midline tissue thorax, using conversion factors determined with extensive phantom dosimetry. Head-only exposures are still reported as midline head doses. The reference points in the data base are the reference points of the requested doses. To ensure comparability of studies, the dosimetry for all studies was reviewed. Results of that review confirm the comparability of reported doses (to be published elsewhere). As search parameters, the reference point was coded and the TAR was multiplied by 100 to convert it to an integer number.

Other parameters that define the radiation exposure are exposure date; dose reported; neutron-to-gamma ratio (times 100); proposed dose; time of day; Julian date of exposure; and coded values for part of body exposed, radiation source, exposure mode, and dose rate.

The parameters calendar date, Julian date, and time of day permit the material to be cross-referenced against the specific exposures and dosimetry runs in laboratory notebooks maintained by AFRRI's Dosimetry Support Division. These laboratory notebooks are the original source for information on radiation, reference point, TAR, and reported dose. It may be observed that the doses used in the data base are accurate to the decimal point whereas those used in publications are usually rounded off to the nearest hundred. The dose reported may not in fact be accurate to the last place, but the opinion of the authors is that rounding off should be left to the discretion of the investigator or author, because then he/she will know if a bias has been introduced in the rounding off process.

The reported dose, radiation source, exposure mode, dose rate, and neutron-gamma ratio define the radiation involved. All these factors are known to affect postirradiation response, and so does the part of body exposed. Several partial-body studies are represented in the data base. In the studies with shielding, a significant fraction of the dose (as much as 8%) from the AFRRI reactor was delivered to the shielded part of the body.<sup>3,6,7</sup> This was not the case when the AFRRI LINAC or the Naval Research Laboratory cyclotron was the source.<sup>15</sup>

The requested dose or programmed dose has no effect on postirradiation performance. This parameter was included in the data base primarily as a quick way to set up and review groups. These doses were not altered to reflect midline tissue thorax doses, because that would have defeated the purpose of their inclusion. Most of the large differences between requested dose and reported dose are due to the fact that the reference point for the requested dose was midhead rather than midline tissue. However, in some cases, a great deal of variability existed in the dose received by a group of subjects, even though the requested dose and reference point were the same.

## RESPONSE PARAMETERS

Certain possible responses to radiation were considered to constitute parameters. These were time of onset of permanent, complete incapacitation; postirradiation frequency and time of emesis; survival time; and the occurrence, frequency, and time of onset and recovery from early transient incapacitation (ETI). ETI is an empirically defined postirradiation behavioral response. "Early" is defined as within the first 2 hours postirradiation. "Incapacitation" is defined as complete cessation of response on the task for a period of at least 1 minute. Time of onset is the beginning of that minute. Recovery from incapacitation is determined by the resumption of correct responding for at least 1 minute. Time of recovery is the beginning of that minute. At no time should the term incapacitation, used in this way, be equated with physical incapacitation. A behaviorally incapacitated subject is not necessarily also physically incapacitated. In a few of the early studies, different definitions of "early," "onset," and "recovery" were used. The data from these studies were recomputed for the data base, using the current criteria to ensure uniformity for purposes of comparison. This led to disparity between some of the published results and the data base.

The times for incapacitation and recovery were generally taken from group summary sheets prepared while the study was in progress. The exceptions to this were those studies in which a different criterion for ETI was used and a few cases in which there appeared to be a discrepancy between the summary sheet and the published results. In

these cases, ETI onset and recovery were computed from the subject's performance data file. The times drawn from the summary sheets were spot-tested for accuracy by recomputing the values for a few subjects from each group.

If the subject received two or more doses of radiation, the number of ETI's can be specified as a search parameter as the total number or the number for a specific dose. The time of onset is always measured from the dose before the ETI. If onset occurred before the second dose and recovery after, then the time of onset after the second dose is 0.

An incapacitation from which there is no recovery before death is permanent, complete incapacitation (PCI). In some cases it was necessary to determine if a recovery had occurred before death, by referring to the laboratory notebook for that subject. Only the performance data for the first 24 hours were recorded in such a way that they could be entered even if the subject had been tested over a longer period of time. Note that time to PCI is measured in hours and minutes. If only minutes were specified as a search parameter, all subjects meeting the criterion would be retrieved, regardless of the number of hours. For subjects with multiple doses, the time of onset was measured from the first dose.

The number of episodes of postirradiation emesis and the time after exposure at which the episode occurred are search parameters. For subjects with more than one dose, it is possible to search for the total number of episodes or for the dose. However, the time of occurrence is always the time from the dose that was followed by the episode.

Survival time as a search parameter is given in days, hours, and minutes. It is possible to specify a value for any or all of those units. Note that if only hours are specified in a search, all subjects meeting the criterion for hours will be included, regardless of how many days or minutes the subject survived. The same is true if only minutes or days are used as search parameters. For subjects receiving more than one dose, the time is measured from the first dose. If the subject was sacrificed, then no survival time is given.

## STUDY PARAMETERS

The final three search parameters are preirradiation treatments, number of doses, and time (days and/or minutes) between the doses. Some of the studies involved surgical implants and/or administration of potentially radioprotective agents.<sup>9-11,19-22</sup> The number of treatments and the type of treatment (coded) are searchable parameters.

An extensive study was undertaken to determine the effect of fractioning the dose.<sup>4,8,13</sup> The number of doses and the number of days or minutes between doses are searchable parameters. The time between doses is computed when the subject is entered, using the Julian date and the time of irradiation.

# Chapter 4.

## Data

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### IDENTIFYING DATA

The data base was designed to contain all the relevant identifying information available for any subject rather than only that information that is complete for all subjects. More information is recorded about the subjects today than in the past. Thus, when a full listing of the data base is obtained, it appears that many data are missing for some subjects. Even for information normally available for all subjects, we could not always obtain every item of information about each subject. For example, the age of most subjects had been determined by a dental formula. But this had not been done in a few cases because of a problem with the teeth or because no staff member had been available to check. No entry was made if there was any doubt about the validity of either the subject identification or the information.

Certain individual items of information were left out for other reasons, such as survival times for subjects that were sacrificed or PCI onset times when testing was terminated before PCI occurred. Since these gaps were expected, they present no problems for the existing data base programs. In writing additional statistical routines for working with these data, it is important to handle zero values in such a way that they do not bias the results or cause software failures.

### PERFORMANCE DATA

There were two major considerations in dealing with the performance data. The first was the accuracy of the data, and the second was the accuracy of the connection of the data and the subject. Much effort and time were spent to ensure this accuracy.

In its earliest form, the visual discrimination task was presented to the subject in blocks of 100 trials with a long-time-out of approximately 3 minutes between sessions (see Appendix D). This long-time-out was for the convenience of the person manually recording the subject responses. When the data were recorded on magnetic tape, the long-time-out was eliminated and the subject presented with a single 2-hour block of trials. Tests had shown that this change did not affect the subject's performance; however, in the studies in progress at this time, the 100-trial-block procedure was retained.

The program used to enter manually collected data from cards also automatically inserted sufficient time-out trials into the long-time-outs to provide compatibility

with the intermittent data recorded on magnetic tape. Therefore, the total number of trials does not agree with previous publications, but the numbers of corrects, incorrects, and omissions remain unchanged. (No time-outs were added to the end of the pretest because that would have distorted the time postirradiation.) Any future analysis routines must be made to deal with these time-out trials as trials of the regular length. Such programs must take into account the gaps in testing when averaging, etc., in cases where subjects that were tested continuously are combined with or compared to subjects that were tested with time-out periods. Except in the case of split-dose subjects, no time-outs were added to files for the rest periods after the first 2 hours, since this testing occurred at regular intervals for all the subjects tested. A second program was made to insert time-out trials into the intermittent data recorded on magnetic tape. Therefore, the total number of trials does not agree with previous publications, but again the numbers of corrects, incorrects, and omissions remain unchanged. (No time-outs were added to the end of the pretest because that would have distorted the time postirradiation.) Any future analysis routines must be made to deal with these time-out trials as trials of the regular length. Such programs must take into account the gaps in testing when averaging, etc., in cases where subjects that were tested continuously are combined with or compared to subjects that were tested with time-out periods. Except in the case of split-dose subjects, no time-outs were added to files for the rest periods after the first 2 hours. Since this testing occurred at regular intervals for all the subjects tested for more than 2 hours, analysis software can be made to handle these data without further modification of the data files. Time-outs were inserted between doses for the split-dose subjects.

#### Manually Collected Data

Performance data that had been collected with check sheets and later punched on cards were listed out and proofread on a trial-by-trial basis to ensure against keypunch errors. The program that reads the cards and builds the data files catches latency errors outside very narrow limits. The exact limits, how the data were entered, and how the latencies were determined are covered thoroughly in the text on the program CARDIN (Chapter 5).

#### Encoder Decoder Data

When data were transferred to the computer, a certain amount of line noise was inevitable. The program MASTER (see Chapter 5), which transfers the data from the collection tape to a master tape, was provided with an optional software filter for cued data. This permitted the deletion of trials having excessively short or long latencies. The deleted trials were printed out in the process so that it was possible to determine that they were in fact noise and not the result of subject variability. Listings were checked against the manual record of the subject's performance.

Line noise in the data-acquisition system, when transferring uncued data, caused erroneous session identifiers. The program FLIP (see Chapter 5) was written to correct this problem. The data were printed and the session changes located. The number of revolutions per session was then compared to the manually recorded number of revolutions, and the required corrections were made.

In a majority of cases, the question of correlating data files to subjects does not arise. The first record of each file contains the subject identification (Appendix B). This

method of identifying files was adopted when file identification problems arose in the first few months of computerized data storage. The program that reads and enters the cards for key-punched data provides the same type of first record.

The only files that presented a problem were the first files stored on computer tapes in 1971. These files did not have internal subject identification. The data had been used in studies and left in storage in a different format. There were five possible points of identification for these data files, as follows:

1. Label on the tape, which should have identified the files in the order in which they were recorded
2. Total number of corrects, incorrects, and omissions in the pretest and in the block of 600 trials
3. Occurrence or nonoccurrence of ETI, as determined by definitions used in the study
4. Group of subjects around this file (radiations were done by group, and data were transferred by group from tapes on which more than one subject were recorded)
5. Original listing of data from files

If the original listing of data existed, then trial-by-trial identity was considered adequate identification. If no list existed, then a file had to match other records on points 2 and 3 and on either 1 or 4, in order to be considered identified. Fortunately, there were no postexposure duplications on 2 and 3. The only questionable baseline files were identical in every respect except latency, which differed by an amount that could be reduced to hundredths of a second per trial. These two files were arbitrarily assigned to the two subjects.

#### SCAT Data

Data collected on and transferred with the SCAT were checked against the trial-by-trial printout generated by the SCAT.

NOTE:

It is possible to have a high degree of confidence in the accuracy of performance data on the data base. In every manipulation of a performance data file, human judgment was used to check and override machine inflexibility. Software traps were set to catch human and machine errors in entering data. Where possible, programs were developed to facilitate proofreading and checking data. When this was not possible, the necessary time was spent to ensure accuracy of the final results.

## Chapter 5.

# Performance Data Programs

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NOTE:

Software development and modification occupied one programmer for a full year, with assistance from other members of the AFRI programming staff. Like the data base itself, it was a two-part effort. The result of this effort was a family of programs designed to store, manipulate, and analyze the data. These programs can be operated by anyone who can log into the computer. In order to provide this simplicity of operation, the complexity of the programs was necessarily increased. This slowed the execution of the programs and resulted in a tedious amount of interaction for trained computer operators. But the advantage is that the data are manipulated by persons who are familiar with them.

Programs developed over the years to manipulate the performance data join with those programs written to meet specific needs during construction of the data base, to form a family of auxiliary programs. These programs are used primarily by the person who builds, edits, maintains, and updates the data base. These programs do affect the performance data and can be used to modify it. The searcher needs an understanding of how these programs can interact with the data and how the programs were used, in order to determine the validity of the data retrieved.

The principle that guided the modification and development of the data base software was that every program should be user-oriented and terminal-interactive. Every old program for manipulating or analyzing performance data had to be modified. It was not necessary to change the functions of the original programs, although some functions were added to older programs. Safeguards were built into some programs to protect against human error. This made it possible for data to be entered, edited, and manipulated by persons more knowledgeable about the research and the data than about computers.

The performance data programs fall into three categories:

1. Programs used to enter performance data.
2. Programs used to edit and manipulate performance data. These programs are a unique resource in that they were specifically designed as tools to work with the DATA.TMP file format (see Appendix B). The programs ensure that the data remain in the format needed for the

analysis routines under all operating systems. This is not always the case when performance data files are manipulated with system utilities.

3. Programs used to obtain ETI and PCI information.

## PROGRAMS TO ENTER PERFORMANCE DATA

### BICOLS/COLECTS--DECODER

The original program used to decode analog coded data was BICOLS/COLECTS. There are occasional references to this program in publications and data records. The program had been modified repeatedly to reflect changes in hardware, software, and experiments. When it became necessary to construct an entirely new hardware device for decoding the data, a new program was written to receive the decoded data. This program is DECODER.

BICOLS/COLECTS and DECODER do much the same thing. Differences in the programs reflect differences in the hardware. Data that are recorded on analog tape in encoded form are transmitted to the computer through a decoder and an interface. The software puts the data into temporary storage in raw form until it receives an end-of-transmission signal. It then translates the data into response identifier and latency (clock ticks/second), adds the subject-identifying information, and outputs a DATA.TMP file. For precise description of a DATA.TMP file, see Appendix B. There is some hardware filtering of the transmitted data to reduce noise and some software filtering after the data are received. AFRRI Technical Note 73-6 describes the encoder and the decoder that functioned with BICOLS/COLECTS.<sup>1</sup> The same encoder is used with a more modern decoder for DECODER. Each file of data was listed and checked before transfer to a master tape for storage.

### NEWSPP/SCATR

Because the PDP-8 is a 12-bit machine and the PDP-11's are 16-bit machines, direct transmission of data collected by the SCAT to the AFRRI Central Computer Facility is not possible without software intervention. At the PDP-8 end of the transmission, a program called TDUMP or TABLDOS translates the data and sends them to the Central Computer Facility.

Either PIPE/SCATR or NEWSPP/SCATR receives the data at the PDP-11 end of the transmission. These programs function in the same way as BICOLS/COLECTS, wherein the data are received and stored until an end-of-transmission signal is received; then the subject-identifying information is added and a DATA.TMP file created. The NEWSPP version takes the header information from a terminal; the PIPE version reads a punched card. This represents a procedural difference in dumping data. Either one person works with two computers from two terminals or two persons work the two machines from different locations. In either case, the data are checked against the SCAT printouts before being transferred to a master tape.

## CARDIN

CARDIN was developed to permit data that had been collected manually to be entered into the data base. As the first step, the data were keypunched onto cards. CARDIN read from the first card in a deck the subject-identifying information for a DATA.TMP file. It then read from each additional card in the deck an index number, ten response identifiers, and the cumulative latency of those ten trials. The index number represented the real time postirradiation at the end of the first of the ten trials. CARDIN processed the data on each card by

1. Subtracting the value of the previous cumulative latency (initially 0) from the current cumulative latency
2. Deducting from the remainder the value (number of omits times MAXLAT) (see Glossary)
3. Dividing the result by the number of non-omit responses
4. Assigning to each of the non-omits the resulting average latency and to each of the omits a latency value equal to MAXLAT

When ten cards (100 trials) had been read, CARDIN did the following:

1. Stored the index number on the last card
2. Reset the cumulative latency value to 0
3. Read the index number on the next card
4. Inserted a number of time-out trials with latencies of MAXLAT, which accounted for the difference in time between the first and second index numbers

It then read the next card and repeated the process until an end-of-file card was reached.

This program is an excellent example of the type of software traps that were used to catch human errors. The program checked for typographical errors, problems in handling the card decks, and minor differences in the control clock settings that would affect the latency values. The program would stop, delete the partial file, and wait for corrections to be made if any of the following occurred:

1. MAXLAT was reached on a non-omit response.
2. MAXLAT was exceeded by more than 0.1 seconds.
3. MAXLAT fell short by more than 0.1 seconds.
4. A card was missing from a set of ten (or was out of order).
5. A previously unspecified number of time-outs had to be inserted (the specified numbers were built in to check the split-dose data between doses).

6. A response was identified as anything other than a correct, incorrect, escape, or omission.

**NOTE:**

Caution should be used for latency analysis on data entered from cards. Latencies for individual trials are average latencies for ten trials.

**APAIN**

APAIN was developed to permit the entry of visual discrimination data from subjects for which there were computer printouts but no useable DATA.TMP file. The data were entered from a VT-55 terminal and checked trial by trial against a SCAT print-out or original listing. In this case, the individual trial latencies are in fact the real latencies for the responses, not averages.

**PAW**

PAW was developed to permit the entry of manually collected data from the physical activity task. These data were in the form of a minute-by-minute breakdown of revolutions. The data were entered from a terminal. The program assigned an average interresponse time to the number of revolutions occurring in a given minute. In the case of minutes during which there were no revolutions, the time was added to the last revolution in the preceding minute. This provided accurate input for analytical routines that compute time postirradiation by cumulating interresponse times. It did not provide data suitable for extensive analysis of interresponse times. The data were checked by generating a minute-by-minute analysis and comparing it to the original input.

**PROGRAMS FOR MANIPULATING OR EDITING PERFORMANCE DATA**

**MASTER**

MASTER was originally developed to permit the transfer of data from the mixed-study collection tapes to single-study master tapes for analysis. In the process, MASTER was used to delete the spurious trials that had been introduced by noise in the data-acquisition system. As new hardware was acquired, MASTER was modified for use with other mass storage devices. Under the current operating system (RSX11M+), MASTER cannot be used to transfer data to or from a tape because the DATA.TMP files are not in ANSI format. Only ANSI-formatted tapes are supported by the operating system.

We used MASTER to move files, renumber them, and on request delete spurious responses while building the data base. One notable advantage in using MASTER to manipulate DATA.TMP files is that it will not accept any file that has been corrupted in such a way that the analysis programs cannot read it. In the process of moving files, this program opened the files, changed the internal file number, and arrayed the data so that the trials could be renumbered correctly for the output file. As problems arose that required this type of file access, they were solved by adding options to MASTER. Specific safeguards used with each option will be explained later in this publication, as each option is described. In general, when the editing and/or file-modifying options were used, two persons checked each of the affected files to ensure that erroneous data had been corrected or removed, rather than added.

### Master Options

1. The first option permits corrections to be made to the title block of the file. The format of the title block had been changed over the years. It had been expanded to include several useful items of information in addition to the subject number. This title block is never seen by a data base user, but it is critical for the operation of retrieval programs. The old format title blocks were changed to conform to the new format. Typographical errors that had been made in entering title blocks were also corrected. To ensure that the identification is entered into the correct file, MASTER displays the original identification.
2. The second option deletes spurious responses (too long or too short) from data dumped through the decoder. Unfortunately it also deletes perfectly legitimate responses on either speed stress or uncued data, or from very fast or erratic subjects. This option was part of the inflexible, old program. The criterion by which it determined that a trial was spurious could not be changed. The program prints a list of the deleted trials as the deletions occur. These lists were always checked to ensure that no good trials had been deleted. Genuinely spurious trials were easy to identify since (a) the number of deleted trials equalled the difference between the record of the total number of trials worked and the number of responses in the data file, and (b) the latencies were impossibly long or very short. This option was used only in the few instances in which a master tape file had been lost or corrupted and had to be retrieved from a collection tape. The data were printed and compared trial by trial with the printout on file of the original corrected data.
3. The third option permits changing the variable "clock speed" in the header record. Latencies are not recorded in seconds but in "clock ticks." The analysis programs use clock speed to recover seconds. A few early data files had a clock speed of 10.0, which was not acceptable to any of the analysis routines. Rather than modify all the analysis routines, this option was used to modify the clock speed and, correspondingly, the number of "clock ticks." As a safety feature, this option does not change the data when the new clock speed is identical to the old. Printouts of the changed data were compared to the original listings for correspondence of latencies.
4. The fourth option of the program permits us to change the variable "number of trials in the pretest" in the header record. This number is used by the analysis routines to distinguish between preexposure and postexposure performances. The program that built the DATA.TMP file assumed a pretest of 100 trials. However, in some cases, subjects were given two pretests or pretests of odd lengths, and the number of responses on the pretest were subject-generated in uncued tasks. This option was used to correct the error if the laboratory notebooks, or other records of the subject's performance, or the protocol of the study indicated that the pretest had not been 100 trials. The header records were printed out, and the number of trials in the pretest were compared with the original records.

5. The fifth option permits changing the maximum latency (MAXLAT) variable in the header record of the data file. MAXLAT represents the time permitted for completion of each trial. It is used by several of the analysis programs and by plotting routines to set up plot parameters. The value of this variable was generated by the routine that built the DATA.TMP files for the unstressed visual discrimination task. In the case of speed-stressed subjects, MAXLAT was subject-determined. The real MAXLAT value for each subject was obtained by checking the values in the laboratory notebooks and cross-checking against the SCAT printout. The header records were printed out and checked against the other records.
6. The sixth option of MASTER permitted data from tapes created under old operating systems to be recovered until the latest change in operating system. MASTER no longer accesses tapes. The system library program NANSI was developed to transfer all non-ANSI-format magnetic tapes on to other mass storage devices.
7. The seventh option of MASTER permits changing the trial identifier and latency of one or more trials. This option was added to permit correction of files recorded under a faulty SCAT operating system, which had been transmitted to the computer with 0's scattered through them. The correct identifiers and latencies were obtained from the SCAT listings, and printouts of the changed data were compared to the SCAT printouts.
8. The final option permits adding trials coded as time-outs to data transmitted as if it had been continuous although the subject had had time-outs. These trials were added to ensure accuracy in analysis routines that compute time postirradiation by counting trials and assuming 10 seconds per trial. Twenty filler trials were added after each 100 trials except the pretest. The data were analyzed to determine that the proper number of trials had been added and that the analysis routines would function correctly.

## MERGER

Sometimes data were dumped through the decoder to the SDS-920 from more than one tape. Noise caused by tape recorder starts and stops was reduced by closing the data file as each tape was completed. This resulted in multiple files for a single subject. For the same reason, if more than one subject had been recorded on a single track of a single tape (sequential runs), then all the data were dumped into a single file. MERGER was developed to merge and split DATA.TMP files. MERGER was used primarily with the early taped data, but there were three cases in which it was necessary to use it on data collected on the SCAT, because separate tapes had been used to record the 2-hour continuous run and the overnight run. MERGER is the only program in the library that permits modification of the "task code" variable in the header record of the performance data file. Since this value is critical to the proper functioning of the analysis routines, it was checked before and after the merging of files. The files that had been combined or split with MERGER were checked against the original data.

## FLIP

The encoder/decoder system had to be modified to record and transmit uncued data generated by the physical activity task. It was necessary to reduce the filtering in order to handle the session-change signal, which could be very short if the session change coincided with a revolution. The software and hardware filters were "tuned" to catch the majority of these signals and reject the majority of noise signals. FLIP was developed to correct the remaining false response identifiers. In some cases it was necessary to reverse as many as 5000 responses. The data were made to agree with the manual record of revolutions per session and the time of session change.

## LATLIS

LATLIS was developed to print out the entire first record of the DATA.TMP files so that every variable in the record could be checked. LATLIS was also used to ensure the correctness of the data base file numbers for each subject. This program does not in any way modify the files.

## OMCOR

In early work at AFRRI, several different criteria for early transient incapacitation were used by different investigators. It was necessary to compute ETI's for these data using the current criterion in order to have consistency within the data base. OMCOR was written to facilitate this task. Accuracy of the onset and recovery times computed by OMCOR was tested by manually computing times and comparing the results. This program can be used only with cued tasks having trial lengths of 10 seconds. If, for any reason, it is desirable to use a different ETI criterion, one should refer to the Hazards section of the OMCOR chapter of the software manual (in preparation) before using this program. OMCOR is a useful analytical tool for cued data, but it is designed to do a specific job in relation to a specific set of data.

## CALLAT

CALLAT was developed to facilitate identification of times of ETI onset and recovery for uncued data. Time between the exposure and any given trial number in uncued data was computed by cumulating the interresponse times, including rest periods. An interresponse time equal to or greater than 1 minute represents the start of an incapacitation. The criterion for recovery is 1 minute of continuous performance; shorter periods of activity between long interresponse times are not recoveries. In doubtful cases, the interresponse times of the trials between stops were cumulated, using CALLAT to determine if a recovery had occurred. The same precautions recommended for use with OMCOR apply to CALLAT. Specifically, CALLAT cannot be used to compute time postirradiation for cued data because it makes no allowance for time between trial starts.

# Chapter 6.

## Searchable Data Base Programs

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NOTE:

To safeguard the integrity of the data base and ensure against mis-use, only the data base manager and the data base programmer are permitted to use any of the programs that will modify the contents of the data base. Other users may obtain the password to the account from a staff member of the AFRRI Central Computer Facility or from the data base manager, and then they may use only YDBLS.

### PROGRAMS FOR CREATING DATA BASE

#### DBSU

DBSU was used only to establish the three linking files that constitute the searchable data base. DBSU is not needed to add subjects once the files have been opened. To prevent partial duplications of this file set, DBSU destroys the existing data base before creating the three new files. This function was removed from the data base program as a safeguard against accidental destruction of the data base.

#### DBLIST

DBLIST was used to list the entire contents of the searchable data base for proofreading. It was originally an option of the search and retrieve program. It was made a separate routine when the data base grew to such a size that an accidental specification of the option locked up the program operation for a prohibitive length of time. The program is primarily of interest to the person maintaining the data base, since the information is printed out in the order in which it was entered, rather than in meaningful groups. DBLIST provides a list of the performance data file numbers for each subject.

### PROGRAMS FOR USING DATA BASE

#### YDBE/LS

The program YDBE was developed to build, edit, and search the section of the data base containing the identifying information and also to retrieve the desired data. At

the same time, the subprogram YDBLS was developed without the building and editing options for the use of persons who want to exercise the search, retrieval, and analysis options of YDBE. YDBLS cannot in any way affect the contents of the data base.

The novice user should refer to Appendix A in order to understand the interactive questions and to know the appropriate responses. In most cases, an incorrect response will simply cause the prompt to be repeated; only a correct response to the prompt will permit the program to continue. When errors are made in running, it becomes obvious that YDBE/LS is a very complex program. Even an experienced data base user will have difficulty restarting the program if it exits with a system error. (System error exits were allowed to happen only if forcing the program to continue in spite of a system error caused an endless loop.) The results should be dealt with by a computer operator who has access to the software manual. A system crash during a run also requires intervention by a computer operator.

YDBE/LS performs inclusive searches. Any subjects that are not specifically excluded by the search selection parameters will be included in the final group. For instance, sex should be specified unless a mixture of male and female subjects is acceptable. It is important to remember that the information on the data base was drawn from a number of studies. Great care should be exercised in using the data to ensure that the "found subjects" are compatible. This does not mean that the subjects can be used only in the original groupings but rather that those selection parameters should be specified that are known to be related to response to radiation. If the original groups are to be retrieved, tables in the software manual will assist in setting up the search parameters.

The program YDBE is used to perform the following operations:

- ADEN - To add an entry from cards
- EDIT - To correct an existing entry or part of an entry
- LITI - To list an entry to the terminal
- LILP - To list an entry to the line printer
- SRCH - To search the data base
- LATS - To run LAT for a single animal
- EXIT - To exit the program

YDBLS shares the last five functions with YDBE. Only those two functions that are not shared and that were used to build the data base will be covered here. The remaining functions are described in Appendix A, which duplicates the software manual instructions for using YDBLS.

#### **ADEN**

ADEN is the option used to build the data base and update it as necessary. It checks before entering each subject in order to prevent accidental duplication of animal numbers. If any other error occurs, ADEN clears the information for the subject from the

buffers before reading the corrected cards. This ensures that the information for one subject is not mixed with the information for a second subject. ADEN also checks the Julian date against the calendar date to ensure accurate computation of the time between doses for subjects with more than one dose.

#### EDIT

EDIT permits the correction of identifying data that have been entered incorrectly through ADEN. The notable exception is performance file numbers, which cannot be edited. The data base must be rebuilt in order to change the file numbers. The performance file number is the only link between a subject and its performance data.

NOTE:

It would be impossible for a user to notice an incorrect file number because the performance file access is transparent to the user. The files cannot be seen during analysis. We found that this safeguard was the only way to protect against accidental change of the file number.

## Chapter 7.

# Installed Auxiliary Programs

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Four auxiliary programs must be installed in order for the search option of the data base to run properly. These programs are REF, AVLAT, LAT, and PLTLAT. REF is a program that displays the cross-reference tables to the user terminal during a search or edit. AVLAT, LAT, and PLTLAT are old routines for standard analysis of performance data, which are called and run by YDBE/LS. All four are documented here and in the software manual as if they are separate programs. A fifth program, SIDLAT, is discussed, which will be added to the data base as soon as possible.

### REF

A search is accomplished by entering a selected parameter, the desired logical operator, and the desired value of the parameter. Each of the parameters has an item reference number, which is used to enter it. If the search is to be set up in advance, the item (parameter) reference numbers are obtained from Appendix C. However, sometimes the found group includes unwanted subjects. These can be eliminated by specifying additional selection parameters. There are a large number of selection parameters for search and multiple values for coded parameters. REF will display the search parameters and their item reference numbers, and decode the codes while the user is engaged in a search, without affecting selection parameters already entered.

### AVLAT

AVLAT calls and runs LAT to build arrays of responses and latencies by trial sets for individual subjects, computes group averages, and then calls PLTLAT to build plot files. The resultant files are spooled to the system plot routine. These programs deal with only cued data, and read the task code incorporated into the data file to determine if there are time-outs in any of the data that require adjustment.

### LAT

The YDBE/YDBLS version, LATS, can be called to analyze performance data for a single subject specified by animal ID. The program asks if the user wishes to analyze the base (preirradiation) data file or the perf (postirradiation) data file.

LAT has three functions:

1. To list the data for each trial, with latencies
2. To compute percent correct and average latency by trial sets and send them to PLTLAT to be plotted
3. To build a file of the computations for input into AVLAT or other analysis routines

The data in the output file, DATA.STA, are averaged by trial sets. (In cued data, each trial equals a known time, so  $x$  trials =  $y$  time.) Latency is converted to a normalized value for each subject and inverted for plotting purposes by subtracting each latency ( $lat$ ) from MAXLAT and dividing it by the mean pretest latency ( $\bar{x} lat$ ) subtracted from MAXLAT. The resulting value is multiplied by 100 for plotting purposes. The formula is

$$\text{latency ratio} = \frac{\text{MAXLAT} - \text{lat}}{\text{MAXLAT} - \bar{x} \text{ lat}} \cdot 100$$

In plotting mixed data, uncued data will cause a line break. Time-out trials also cause a line break and space the line over by trial sets. The file for input into AVLAT is averaged by trial sets.

NOTE: TLAT is an independent version of LAT used to list data for proof-reading. LATE is incorporated into the data base.

## PLTLAT

PLTLAT has the sole function of building the plot and parameter files. These files are used by the system's plotting program to plot the output of TLAT, LAT, and AVLAT. PLTLAT is transparent to the user, and is never called from a terminal.

## SIDLAT

This two-part program was developed to analyze data obtained from the free operant avoidance (running) section of the physical activity wheel task (see Appendix D). In its current form, this function exemplifies the worst of the old programs: it is inflexible, cumbersome, complex, and poorly documented. After the task has been completely rewritten, it will be added to the data base program. Only the four functions marked with ¶ in the following text will be retained. The other functions are covered because they cannot be deleted from the program as it stands.

### Part 1. IRT Distribution Histogram

¶ This part of the program provides one set of histograms and tables per session. It can be suppressed if the output is not needed. The data are binned in 120 equal bins plus 1 overflow bin. Any interresponse time longer than 120 times the bin size is put into an

overflow bin, labeled "incapacitation," and plotted at the far right. The output is a set of histograms of the percent of total responses in that session. The percents are also presented in tabular form in conjunction with the plots.

#### Part 2. Session Data, Percent of Baseline, and Incapacitations

This part of the program provides a six-part printout and two plots. It is not possible to suppress any part of the output.

##### Output

The six-part printout and two plots are the following:

1. List of first trials for each baseline session and postirradiation session.
- ¶ 2. Table showing the number of revolutions and percent of baseline, in a minute-by-minute profile (limit 12 minutes). The computation is truncated to the shorter session (baseline or postirradiation). If the last minute is partial, computation is based on rate of performance for that minute (which may lead to excess revolutions being reported in this section only).
3. Line plot of the minute-by-minute data.
- ¶ 4. Table showing session-by-session breakdown in terms of revolutions on the baseline; session time in seconds; revolutions per minute; revolutions postirradiation less those during an incapacitation; time less incapacitation; rate when not incapacitated; and percent of baseline when not incapacitated. If an overall computation of the session including incapacitation is desired, the user should not input any incapacitation starts and stops.
- ¶ 5. Plot of the session-by-session data.
6. Table showing total time incapacitated per session, based on incapacitation start and end trial numbers as input (for postirradiation data only).
7. List of trial number, session, and duration for all trials in an activity session that exceed 60 seconds, which are flagged if they are not the first trial in a session.
8. List of incapacitations, duration of each, and session number in which each occurred (for postirradiation data only). For the program to provide this list, the start and end trial of each incapacitation must be entered.

# Appendix A.

## Young Data Base List and Search Manual

---

**NOTE:**

Due to special display operations, this program should be run from a VT55 or a VT100. If hard copy is desired, a DECwriter III may be used, but excessive copy will be generated.

### ACCESSING THE DATA BASE

The data base is currently located in a virtual disk file. A virtual disk is an imaginary device that is treated by the computer as a real device. The size of this device is flexible, which solved the problem of the data base being too large or too small for any of the available hardware devices. A certain procedure must be followed carefully in order to access the virtual disk. This procedure has been simplified and automated as much as possible. The operators in the AFRRI Central Computer Facility are familiar with the process and will provide the user with any assistance necessary.

The Central Computer Facility must be notified in advance that the data base will be used. The operator can then install and mount the RP06 disk containing the virtual disk file. This must be done before the user logs on, or the automatic access will fail. A user must log on under User Identification Code (UIC) [300,300] in order to work with the data base. The operator will know the current password for that account and the number of a free virtual disk. This will be needed to run the command file. The LOGIN command file for UIC[300,300] will assign the virtual disk, mount it, and assign it as the system device. It does not allocate the virtual disk to the user terminal because operator assistance from another terminal is required to install the auxiliary programs. The command file will run automatically at login, or it can be run by the command @SY:[300,300]LOGIN.CMD. The program exit command calls and runs the LOGOFF command file, which performs the operations necessary to detach the virtual disk. If this is not done, the next attempt to access the virtual disk file will fail. If either command file fails to run, report the error messages to the computer operator. Do not exit until printouts and plot routines have been completed.

The LOGIN command file will present any Central Computer Facility messages and then ask questions, as follows:

PRECEDING PAGE BLANK-NOT FILMED

PLEASE NOTE  
;  
;  
;IN ORDER TO GET YOUR SYSTEM UP AND RUNNING THE FOLLOWING QUESTIONS  
;NEED TO BE ANSWERED. THE SYSTEM WILL TELL YOU WHAT HAS BEEN DONE...  
\*ANY QUESTIONS??[Y/N]

A Y (yes) response to this question notifies the operator at the console terminal that someone in need of assistance wants to use the data base. It then runs the LOGOFF command file. An N (no) response continues the command file sequence:

\*please enter your name:

If the name entered is the last name of an authorized user, the file continues.

\*enter virtual disk : [S]:

The correct response is the number (0-7) of a free virtual disk.

;THE FOLLOWING FUNCTIONS HAVE BEEN PERFORMED  
;           1. THE VIRTUAL DISK HAS BEEN ASSIGNED  
;           2. THE VIRTUAL DISK HAS BEEN MOUNTED  
\*DO YOU WANT TO WORK ON THE VD? Y/N.

An N response to the question runs the LOGOFF command file. A Y response to the question will send a message to the operator, requesting that the auxiliary programs be installed.

```
PLEASE WAIT FOR CONFIRMATION THAT YOUR TASKS HAVE BEEN INSTALLED
( THE WAIT IS OPTIONAL; HOWEVER, THE DATA-BASE WILL NOT RUN
CORRECTLY WITHOUT THIS ACTION FROM THE COMPUTER CENTER)
```

```
AT. -- PAUSING. TO CONTINUE TYPE 'UNS AT.T13'
UNS AT.T13
```

```
AT. -- CONTINUING
```

```
>
>#
>#
># 3. THE VD: HAS BEEN ASSIGNED AS THE SY:
># DON'T USE 'BYE' TO SIGN OFF, USE 'QBYE'
># CALL THE COMPUTER CENTER IF YOU HAVE ANY QUESTIONS
># <EOF>
```

The operator will broadcast a message when the programs have been installed. To complete the command file, replace n with the number of the terminal that will appear as part of the message from the operator.

```
UNS AT.Tn
; 3.THE VD: HAS BEEN ASSIGNED AS THE SY:
@<EOF>
```

The login command file has performed all these steps for you:

1. AVD VDn:=DBm:[ 300,300 ]YDBE.DSK

It has assigned or attached the virtual disk number specified to the data base disk file.

2. MOU VDn:YDBE

It has mounted the virtual disk from the user terminal. In the multi-user system, a terminal can access only those devices that are mounted from it or mounted for public access.

3. ASN VDn:=SY:

It has assigned the virtual disk as the system device. All the data base programs require that the virtual disk be the system device.

4. BRO TTO: PLEASE RUN: @[7,1]YDBEON FOR DATA BASE SET-UP

It has broadcast a message to the operator's terminal requesting him to run the auxiliary program installation command file. These programs must be installed for the data base to run properly and cannot be installed until after the previous steps have been completed.

5. RUN YDBLS

It has started the data base list and search program.

The command file notifies the user of any operation that fails and of the associated error message. The computer operator can correct the problem that caused the failure and complete the sequence.

### YDBLS (VERSION 22 JAN 81)

NOTE:

YDBLS was designed to grow and develop as new demands are placed on it. Please note the version date of the program you are using and refer to updates of this document to ensure that you have the appropriate documentation for the version you are using.

Two assumptions are made about the person who is using this document. The first is that such a person wishes to search the data base. The second is that the person either has access to the limited distribution software manual or is being assisted by someone who has such access.

### Introduction

The program YDBE was developed to build, maintain, edit, and test the AFRRRI-BHS Behavioral Data Base. That program is intended for use by persons responsible for keeping the data base intact and up-to-date and also programmers who add and test additional functions. A separate program, YDBLS, a subset of YDBE, was developed to search the data base for the purpose of retrieving and analyzing data. Both programs are identical in the functions they share, since they use the same subroutines and access the same files. The difference is twofold. First, YDBE alone has the building and editing options. Second, YDBE is used to test and debug software modules and therefore may contain options that are not yet functioning correctly.

Neither program can be used successfully without care and attention to detail. The shared software modules may cause some confusion. For example, "ENTER -1 TO RETURN TO YDBE" will return the user to YDBLS if that is the program being run.

## Function

The program YDBLS has the following main functions:

1. LITI - To list an entry to the terminal you are working from. Displays only searchable items for the single subject whose data base animal ID (see Chapter 3) is entered.
2. LILP - To list an entry to the line printer. Lists only searchable items for the single subject whose data base animal ID is entered.
3. SRCH - To search for, retrieve, and analyze data for selected subjects.
4. LATS - To perform LAT analysis for the subject whose animal ID is entered (see Chapter 7 for details on LAT).
5. EXIT - To exit the program, to send print files to the print spooler, to clean up the UIC, and to run the logout command file. **Do not exit with a control Z** (see below).

YDBLS consists of multiple linked programs. These may share software modules and subroutines, but they were developed and debugged independently. Once you have entered one of these programs, you can return to the main program only by using the exit provided. The exits will stop the subprogram and call the main program. If you exit the subprogram with a **control Z**, you will not be able to return to the main program. If this should happen, an operator with a software manual should be able to straighten out the data base and recover some of the printouts and plots that would be lost.

When you enter the program, the date of the last changes made in the program and the last changes made in the contents of the data base are displayed. The available functions are also displayed.

```

LAST VERSION WAS: 22, JAN, 1981*
BOB YOUNG DATA BASE EDITOR
LAST DATE ANIMAL FILE UPDATED: 10/9/80
LAST DATE DOSE FILE UPDATED: 10/9/80
LAST DATE PERF FILE UPDATED: 10/9/80
  
```

THE FOLLOWING FUNCTIONS ARE AVAILABLE

```

LITI - LIST AN ENTRY TO THE TERMINAL
LILP - LIST AN ENTRY TO THE LINE PRINTER
SRCH - SEARCH DATA BASE BY PARAMETERS
AND PERFORM DATA ANALYSIS
LATS - RUN LAT FOR A SINGLE ANIMAL
EXIT - EXIT THE PROGRAM
  
```

ENTER DESIRED FUNCTION -

\*This is the version documented.

This is the initial stop in the program. The list of available functions is referred to as the "first menu." It also serves as the "home base" display to which you return when you exit one of the functions. There is a second menu in SRCH. In each menu the description of the available options is as clear as space will allow. Because of the complexity of YDBLS, each separate function is documented as if it were an independent program.

## LITI

### Introduction

Sometimes it is desirable to see all the information for a single subject or for a few subjects. This is the case, for instance, if the user wishes to determine parameter values for a subject whose animal ID is known. No hard copy is necessary when you wish to look at subjects individually. This can be accomplished by displaying the information for that subject on the screen with LITI.

### Function

LITI lists all of the accessible information for a single subject to the terminal you are working from.

### Program Specifications

Input: Terminal; animal ID; retrieves information from YOUNG.DAT, DOSE.DAT

Output: Terminal; subject data

Auxiliary Routines: For hard copy, run LILP.

Rule to Use: Use LITI when you want to see the information for a single subject but do not need hard copy.

Limitations: Works with a single subject at a time. You must know the subject's data base animal ID, which may or may not be the number reported in a study or used in the performance data file (see Chapter 3).

Hazards: Will continue to request animal ID in a loop until given a subject that is on the data base. Do not use **control Z** to exit. To exit the routine, use animal ID 143 or the animal ID of any subject you are sure is there.

### Annotated Operating Instructions

In YDBLS, LITI appears on the first menu and can be called from only that menu.

```

THE FOLLOWING FUNCTIONS ARE AVAILABLE
LITI - LIST AN ENTRY TO THE TERMINAL
LILP - LIST AN ENTRY TO THE LINE PRINTER
SRCH - SEARCH DATA BASE BY PARAMETERS
      AND ANALYZE THE DATA
LATS - RUN LAT FOR A SINGLE ANIMAL
EXIT - EXIT THE PROGRAM

```

```

ENTER DESIRED FUNCTION - LITI

```

Enter the subject's data base animal ID.

```

ANIMAL ID: G4-08

```

You must know the subject's data base animal ID, which may or may not be the number reported in a study or used in the performance data file. Any spaces in the animal ID must be entered as spaces and any 0's as 0's.

Initially, all basic information is output. The optional output of dose, ETI, emesis, and treatment information may be requested by typing Y (yes) when prompted. (The default response is yes.) The following is an example of basic information only.

```

ANIMAL ID: G4-08
AGE      : 37
WEIGHT   : 27
HEIGHT   : 0
GIRTH    : 0
SEX      : 5
TASK     : 1
SPECIES  : 0
NUMBER OF DOSES : 1
REFERENCE POINT : 1
NUMBER OF EMESIS: 2
PCI      : 0 HOURS 0 MINUTES
SURVIVAL : 0 DAYS 8 HOURS 0 MINUTES
NUMBER OF EIs : 4
NUMBER OF SURGERIES : 3

LIST DOSE - Y OR N : N
-----
LIST EIs - Y OR N : N
-----
LIST SURGERIES - Y OR N : N
-----
LIST EMESIS - Y OR N : N

```

The following is an example of all information.

```

ENTER DESIRED FUNCTION - LITI

ANIMAL ID : 803
AGE       : 42
WEIGHT    : 44
HEIGHT    : 0
GIRTH     : 0
SEX       : 5
TASK      : 1
SPECIES   : 0
NUMBER OF DOSES : 2
REFERENCE POINT : 0
NUMBER OF EMESIS : 1
PCI       : 0 HOURS 0 MINUTES
SURVIVAL  : 3 DAYS 20 HOURS 0 MINUTES
NUMBER OF EIS : 1
NUMBER OF SURGERIES : 0

LIST DOSE - Y OR N : Y
-----
DATE  DOSE  N/G  TAR  P  DOSE  TIME  W/P  SRC  MODE  RATE  J  DATE
21169 2500  40   82   2500  1600   0   0   0   0   0   42
21169 2500  40   82   2500  2200   0   0   0   0   0   42

LIST EIS - Y OR N : Y
-----

ONSET RECOV  DNSET RECOV  ONSET RECOV  ONSET RECOV
130    720

LIST EMESIS - Y OR N : Y
-----

EMESIS (MINUTES)
54
    
```

## LILP

### Introduction

Sometimes it is desirable to see all the information for a single subject or for a few subjects. This is the case, for instance, if you wish to find a parameter value that would exclude a group of subjects from a search and you have obtained the animal ID of one or more members of the group. If hard copy is desired, this can be obtained by printing the data for that subject with LILP.

### Function

LILP lists all the accessible information for a single subject to the line printer.

### Program Specifications

Input: Terminal; animal ID; retrieves information from YOUNG.DAT,DOSE.DAT

Output: Line printer; subject data

Auxiliary Routines: For terminal display, run LITI.

Rule to Use: Use LILP when you want to see the information for a single subject and need hard copy.

Limitations: Works with a single subject at a time. You must know the subject's data base animal ID, which may or may not be the number reported in a study or used in the performance data file.

Hazards: Will continue to request animal ID in a loop until given a subject that is on the data base. Do not use **control Z** to exit. To exit the routine, use animal ID 143 or the animal ID for any subject you are sure is there.

### Annotated Operating Instructions

LILP appears on the first menu and can be used from only that menu. You must know the subject's data base animal ID, which may or may not be the number reported in a study or used in the performance data file. The first menu will be presented on the screen.

```
THE FOLLOWING FUNCTIONS ARE AVAILABLE
LITI - LIST AN ENTRY TO THE TERMINAL
LILP - LIST AN ENTRY TO THE LINE PRINTER
SRCH - SEARCH DATA BASE BY PARAMETERS
LATS - RUN LAT FOR A SINGLE ANIMAL
EXIT - EXIT THE PROGRAM
```

```
ENTER DESIRED FUNCTION - LILP
```

```
-----
ANIMAL ID: G4-08
```

The output will go to the line printer.

## SRCH

NOTE:

The installed auxiliary programs REF, LAT, AVLAT, and PLTLAT must be installed before running this subroutine.

### Introduction

The object of building the data base was to be able to access and analyze the data. The SRCH subroutine is, in fact, the means by which the data base is accessed and analyzed. This is a large and complex subroutine, which also calls and runs the four installed auxiliary programs.

### Function

SRCH will do the following:

1. Search the data base for parameters matching the selected search parameters.
2. Retrieve all subjects not excluded by the search parameters.
3. Provide a file and print out a bitmap of ETI's, PCI's, or both by minutes. If this option is selected, you also have the option of sorting the subjects by dose and selecting the second-dose data for display.
4. Display and print on request the basic information for the subjects found, in the order found.
5. Retrieve, display, and/or print emesis and early incapacitation information for the subjects found.
6. Retrieve all or selected segments of the baseline (base) or postirradiation (perf) performance data for the subjects.
7. Perform routine statistical analysis of the retrieved data.
8. Display and/or print the search parameters used to locate the group.
9. Perform AVLAT (Chapter 8) analysis of the performance data.
10. Produce an output file containing the record numbers of the group, to be used as input for external statistical analysis routines.

A search is accomplished by matching selected parameter values against parameter values for the subjects in the data base in terms of six logical operators. The supported logical operators are:

1. EQ - equal to
2. NE - not equal to
3. GT - greater than
4. LT - less than
5. BT - between limits
6. OS - outside limits

#### Program Specifications

**Input:** Terminal; accesses and retrieves data from VDn:[300,300] YOUNG.DAT, DOSE.DAT, PERF.DAT, and VDn:[300,13] DATA.TMP files.

This subroutine allows the user to search the data base for animals having values of a selected parameter that are equal to specific values or within certain limits. There are 37 items that can be used as search parameters. Each search parameter has been assigned an item reference number from 1 to 37. The item reference number is obtained from the cross-reference tables in Appendix C. Or the cross-reference tables may be called and displayed during a search. A search parameter, the value(s) specified for that parameter, and the logical operator used to define the relationship between the two constitute a selection parameter. The user may specify as many selection parameters as needed to define the subjects to be retrieved. However, only one selection parameter may be specified for each search parameter. (For example, the user cannot retrieve a subject whose dose was between 500 and 5000 but outside 2500 to 2600 in a single search.) Each selection parameter is in the form: item reference number, logical operator, value.

#### NOTE:

It is very important to put the commas in the command. If they are left out, the command will be ignored. Spaces in the command will be interpreted as zeros. The format for using each logical operator appears on the screen when you enter SRCH.

OPERATOR	INPUT COMMAND
Equal	(EQ) NN,EQ,IIIIII,[JJJJJJ],[KKKKKK],[LLLLLL]
Not Equal	(NE) NN,NE,IIIIII
Greater Than	(GT) NN,GT,IIIIII
Less Than	(LT) NN,LT,IIIIII
In Range	(BT) NN,BT,IIIIII,JJJJJJ
Out of Range	(OS) NN,OS,IIIIII,JJJJJJ

Where NN - item reference number [ ] - optional values

The user should be aware of the following points:

1. For EQ the user may enter up to four values, and the referenced item will be tested for equality with any of the values.
2. For NE, LT, and GT, only a single value is interpreted for evaluation.
3. For BT and OS, one pair of values are interpreted for the limits. A selection parameter entered as "NN,BT,first value,second value" is interpreted by the program to mean that the user wishes to locate values of NN so that  $\text{first value} \leq \text{NN} \leq \text{second value}$ . A selection parameter entered as "NN,OS,first value,second value" is interpreted by the program to mean that the user wants to locate values of NN so that  $\text{first value} \geq \text{NN} \geq \text{second value}$ .
4. The values for numeric search parameters (i.e., dose) are integers up to six digits.
5. Values for nonnumeric search parameters (i.e., task) are coded as integers up to three digits.
6. Any number of items can be searched for during any search.
7. If it is necessary to change a parameter, reenter it. Only the last selection parameter entered for a given item reference number is used in a search. If a selection parameter is accidentally entered for an item the user did not intend to specify, replace that parameter with NN,NE,999999. This should include all possible values.

At the bottom of the screen are displayed four alternatives:

```
ENTER '-1' TO START SEARCH
ENTER '-2' TO SEE THE CROSS REFERENCE TABLE
ENTER '-3' TO GO TO THE BEGINNING OF 'YDBE'
ENTER '-4' TO DISPLAY THE SEARCH PARAMETERS ENTERED
```

1. -1 will terminate selection parameter input and initiate the search.
2. -2 will display the cross-reference tables. The cross-reference tables are displayed by the program REF (see Chapter 7). The -1 used to exit that program and return to YDBE/LS will not initiate the search. Within REF the user can request details on as many items as needed before returning to YDBE/LS. This does not in any way affect search parameters that were entered before asking for the cross-reference tables.
3. -3 will return the user to the first menu and erase any parameters already entered.
4. -4 will display the selection parameters the user has entered.

Value has two possible meanings. For numerical items, it is the desired integer value from 0 to 999999 inclusive. If the value was a decimal number, it was raised to the power that would make it an integer (see Appendix C). For items that are not intrinsically numerical, a code number from 0 to 999 was assigned. The code numbers can be obtained by asking REF for details on the item at run time or by referring to Appendix C.

Output: Terminal; line printer; Versatec plotter. Plot files, temporary data files, line printer files, and output files are written to VDn:[300,300]; BITMAP.EI files are written to DBO:[300,300].

Auxiliary Routines: LAT, PLTLAT, REF, and AVLAT must be installed before a search is started. The system plot routine must be available if plots are requested.

Rule to Use: Use to search the data base, retrieve data, analyze the data, and output files for input into other analysis routines.

Limitations: Additional modules are being developed, but at this time the program will analyze only cued data.

Hazards: If LAT or AVLAT are called and have not been installed, there will be no output and no error message. If REF is called and is not installed, there is no way to reenter the main program. The computer operator can help to straighten out the results, but it is necessary to abort the task. Aborting the task will run the logout command file. YOUNG.DAT, PERF.DAT, and DOSE.DAT will be locked. LAT, AVLAT, PLTLAT, and the system plot routine will abort with "FILE NOT FOUND" error messages, unless the operator mounts the virtual disk to another terminal before aborting the task. Partially completed temporary files, plot files, etc., will have to be cleaned out of UIC[300,300]. Before restarting, the user will need to determine how much of what was requested has already been processed. In general, every return to the home base (first menu) completes every process except plots. However, if a large group is being processed, this may not be true.

Any exit, intentional or accidental, will run the logout command file and deassign the virtual disk. Output will be halted, since all temporary output files are on the virtual disk. LATS, AVLAT, PLTLAT, and the system plot routine will abort (see above). System crashes cause the same problems with respect to locked files and lost output, but the disk file will also be locked.

#### **Annotated Operating Instructions**

Since this program is very complicated, an annotated sample search is substituted for instructions. This example demonstrates how to

1. Access the data base
2. Install the auxiliary programs
3. Start YDBLS
4. Enter the search subroutine

5. Determine item reference numbers from REF
6. Obtain code values from REF
7. Enter selection parameters
8. Review selection parameters
9. Initiate the search
10. Obtain a bitmap
11. Sort by dose
12. Select dose
13. Delete an unwanted subject from the group
14. Review the performance data
15. Review EI and emesis data
16. Obtain hard copies of the data
17. Run AVLAT
18. Exit YDBLS

**Example of Entire SRCH Program**

I wish to select a group of subjects whose ages are greater than 2 years, and whose weights are between 3.2 and 3.8 kilos. I want only subjects who were performing the visual discrimination task from studies conducted before 1969.

This becomes a matrix:

age greater than 24  
weight between 32 and 38  
task equal to visual discrimination  
dose year less than 69

My first step is to access the data base virtual disk.

```

HEL YDBE
PASSWORD:

                                PLEASE NOTE
;
;
;IN ORDER TO GET YOUR SYSTEM UP AND RUNNING THE FOLLOWING QUESTIONS
;NEED TO BE ANSWERED.  THE SYSTEM WILL TELL YOU WHAT HAS BEEN DONE...
;*ANY QUESTIONS??[Y/N] N
-----

;*Please enter your name: SMITH
;*enter virtual disk : [S]: 0

;THE FOLLOWING FUNCTIONS HAVE BEEN PERFORMED
;      1. THE VIRTUAL DISK HAS BEEN ASSIGNED
;      2. THE VIRTUAL DISK HAS BEEN MOUNTED
;*DO YOU WANT TO WORK ON THE VD? Y/N. Y

;PLEASE WAIT FOR CONFIRMATION THAT YOUR TASKS HAVE BEEN INSTALLED
;(THE WAIT IS OPTIONAL; HOWEVER, THE DATA-BASE WILL NOT RUN
;CORRECTLY WITHOUT THIS ACTION FROM THE COMPUTER CENTER)

;TO CONTINUE TYPE 'UNS AT.Tn'

```

A message will be broadcast to me when the programs have been installed. I must restart the command file by typing:

```

UNS AT.Tn
;      3.THE VD: HAS BEEN ASSIGNED AS THE SY:
;DON'T USE 'BYE' TO SIGN OFF USE '@BYE'
; CALL THE COMPUTER CENTER IF YOU HAVE ANY QUESTIONS.
@<EDF>

```

When I receive a message that the auxiliary programs are installed, I am ready to start.

LAST VERSION WAS: JULY 3,1980  
 BOB YOUNG DATA BASE EDITOR  
 LAST DATE ANIMAL FILE UPDATED: 10/9/80  
 LAST DATE DOSE FILE UPDATED: 10/9/80  
 LAST DATE PERF FILE UPDATED: 10/9/80

THE FOLLOWING FUNCTIONS ARE AVAILABLE

LITI - LIST AN ENTRY TO THE TERMINAL  
 LILP - LIST AN ENTRY TO THE LINE PRINTER  
 SRCH - SEARCH DATA BASE BY PARAMETERS  
 AND PERFORM DATA ANALYSIS  
 LATS - RUN LAT FOR A SINGLE ANIMAL  
 EXIT - EXIT THE PROGRAM

ENTER DESIRED FUNCTION - SRCH

-----  
 DATA BASE SEARCH

OPERATOR		INPUT COMMAND
EQUAL	(EQ)	NN,EQ,IIIIII,[JJJJJJ],[KKKKKK],[LLLLLL]
NOT EQUAL	(NE)	NN,NE,IIIIII
GREATER THAN	(GT)	NN,GT,IIIIII
LESS THAN	(LT)	NN,LT,IIIIII
IN RANGE	(BT)	NN,BT,IIIIII,JJJJJJ
OUT OF RANGE	(OS)	NN,OS,IIIIII,JJJJJJ

WHERE NN - ITEM REFERENCE NUMBERS  
 [ ] - INDICATES OPTIONAL VALUES

ENTER AS MANY SELECTION PARAMETERS AS DESIRED  
 ENTER '-1' TO START SEARCH  
 ENTER '-2' TO SEE THE CROSS REFERENCE TABLE  
 ENTER '-3' TO GO TO THE BEGINNING OF 'YDBE'  
 ENTER '-4' TO DISPLAY THE SEARCH PARAMETERS ENTERED

ENTER SELECTION PARAMETERS : -2

I wish to see the cross-reference tables to determine the item reference numbers of my chosen search parameters (age, weight, task, and dose year).

EDIT AND SEARCH CROSS REFERENCE TABLES

E	S	ITEM	E	S	ITEM
0	-	ANIMAL ID	11	11	PCI HOURS
1	1	AGE	12	12	PCI MINUTES
2	2	WEIGHT	13	13	SURVIVAL DAYS
3	3	HEIGHT	14	14	SURVIVAL HOURS
4	4	GIRTH	15	15	SURVIVAL MINUTES
5	5	SEX	16	16	#EI'S
6	6	TASK	17	17	# TREATMENTS
7	7	SPECIES	26	18	TREATMENT ENTRIES
8	8	DOSE E-ITS S#	36	19	EMESIS
9	9	REFERENCE POINT	111	20	EI
10	10	#EMESIS	-	21-37	DOSE SEARCH ITEMS

ENTER ITEM NUMBER FOR DETAILS (-1 FOR RETURN TO YDBE) :22

One of my search parameters, dose year, is a dose search item, so I enter a number from 21 to 37 in order to see the dose item table (the dose item table would not fit with the rest on the screen).

```

21  MONTH
22  DAY
23  YEAR
24  DOSE
25  N/G RATIO
26  TAR
27  P DOSE
28  TIME
29  W/P BODY
30  SOURCE
31  MODE
32  DOSE RATE
33  JULIAN DATE
34  * EMESIS
35  * EI'S
36  SPLIT DAYS
37  SPLIT MIN.
ENTER ITEM #: 1 FOR MASTER TABLE, 2 FOR RETURN TO 'YDBE' : 1

```

I do not need any details for dose year; therefore, I do not enter the item number 23. I do need additional information about task, so I enter 1 to return to the main table.

## EDIT AND SEARCH CROSS REFERENCE TABLES

E	S	ITEM	E	S	ITEM
0	-	ANIMAL ID	11	11	PCI HOURS
1	1	AGE	12	12	PCI MINUTES
2	2	WEIGHT	13	13	SURVIVAL DAYS
3	3	HEIGHT	14	14	SURVIVAL HOURS
4	4	GIRTH	15	15	SURVIVAL MINUTES
5	5	SEX	16	16	*EI'S
6	6	TASK	17	17	* TREATMENTS
7	7	SPECIES	26	18	TREATMENT ENTRIES
8	8	DOSE E-ITS S#	36	19	EMESIS
9	9	REFERENCE POINT	111	20	EI
10	10	EMESIS	-	21-37	DOSE SEARCH ITEMS

ENTER ITEM NUMBER FOR DETAILS (-1 FOR RETURN TO YDBE) : 6

I need the code number for task since it is a nonnumerical variable. I can obtain this by entering its item number.

```
TASK CODES
1      Visual Discrimination
2      Physical Activity Unstressed
3      Unexercised Visual Disc-wheel
4      Exercised Visual Disc-chair
5      Exercised Visual Disc-wheel
6      PA-VD Wheel
7      VD-PA Wheel
8      Visual discrimination, Speed Stressed
9      Match to sample
10     Physical activity 15 min. delay
11     Cued escape-avoidance, no incorrect

ENTER : 1 FOR MASTER TABLE, 2 TO RETURN TO 'YDBE' :
```

If I had entered an item number for which there were no details, the following message would appear:

```
ENTER ITEM NUMBER FOR DETAILS : 8
No details for this item available

ENTER : 1 FOR MASTER TABLE, 2 FOR RETURN TO 'YDBE' :
```

I am now ready to enter my selection parameters.

```
DATA BASE SEARCH

OPERATOR          INPUT COMMAND

EQUAL             (EQ)   NN,EQ,IIIIII,[JJJJJJ],[KKKKKK],[LLLLLL]
NOT EQUAL         (NE)   NN,NE,IIIIII
GREATER THAN     (GT)   NN,GT,IIIIII
LESS THAN        (LT)   NN,LT,IIIIII
IN RANGE         (BT)   NN,BT,IIIIII,JJJJJJ
OUT OF RANGE     (OS)   NN,OS,IIIIII,JJJJJJ

WHERE             NN - ITEM REFERENCE NUMBERS
[] - INDICATES OPTIONAL VALUES

ENTER AS MANY SELECTION PARAMETERS AS DESIRED
ENTER '-1' TO START SEARCH
ENTER '-2' TO SEE THE CROSS REFERENCE TABLE
ENTER '-3' TO GO TO THE BEGINNING OF 'YDBE'
ENTER '-4' TO DISPLAY THE SEARCH PARAMETERS ENTERED

ENTER SELECTION PARAMETERS : 1,GT,24
ENTER SELECTION PARAMETERS : 2,BT,32,38
ENTER SELECTION PARAMETERS : 23,LT,69
ENTER SELECTION PARAMETERS : 6,EQ,1
ENTER SELECTION PARAMETERS : -4
```

Before I start the search, I wish to make sure I have entered the selection parameters correctly.

ITEM	FUNCTION			
AGE	GREATER THAN	24		
WEIGHT	BETWEEN	32	AND	38
TASK	EQUAL TO	1		
D YEAR	LESS THAN	69		

HIT CARRIAGE RETURN TO RETURN TO SEARCH AREA :

These are the correct values, so I am ready to start the search.

```

DATA BASE SEARCH

OPERATOR          INPUT COMMAND

EQUAL             (EQ)   NN,EQ,IIIIII,[JJJJJJ],CKKKKKK],[LLLLLL]
NOT EQUAL        (NE)   NN,NE,IIIIII
GREATER THAN     (GT)   NN,GT,IIIIII
LESS THAN        (LT)   NN,LT,IIIIII
IN RANGE         (RT)   NN,RT,IIIIII,JJJJJJ
OUT OF RANGE     (OS)   NN,OS,IIIIII,JJJJJJ

WHERE             NN - ITEM REFERENCE NUMBERS
[] - INDICATES OPTIONAL VALUES

ENTER AS MANY SELECTION PARAMETERS AS DESIRED
ENTER '-1' TO START SEARCH
ENTER '-2' TO SEE THE CROSS REFERENCE TABLE
ENTER '-3' TO GO TO THE BEGINNING OF 'YDBE'
ENTER '-4' TO DISPLAY THE SEARCH PARAMETERS ENTERED

ENTER SELECTION PARAMETERS : -1
-----
Do you want an EI/PCI/BOTH/NO lp bitmap output? BOTH
-----
ANIMAL #768 HAS A SECOND DOSE ASSOCIATED WITH IT
Do you want 1st dose (1) or 2nd dose (2) information? 1
Do you want to sort by dose <Y/N> : Y
-----
SEARCH COMPLETE WITH 5 ANIMALS FOUND

ANIMAL ID  DOSE  AGE  WEIGHT  HEIGHT  GIRTH  PCI  SURV
781        4816  36   36     0       0    28H 17M 3D  7H  0M
768        4816  30   34     0       0    14H 17M 0D 20H 48M
785        4816  30   32     0       0    24H 17M 1D  3H  0M
780        5030  36   38     0       0    127H 0M 6D  7H  0M
778        5138  30   35     0       0     0H 42M 0D  1H  6M

AVERAGES   4923  32   35     0       0    39H 0M 2D  7H 46M

HIT <CR> TO SEE OPTIONS AVAILABLE AT THIS TIME :

```

```
OPTIONS:
DE - to delete an animal
BA - to go back to base information output
RB - to output base file statistics
RP - to output Perf file statistics
EI - to output EI statistics
EM - to output emesis statistics
LP - to list search parameters
ST - to output a found file
EX - to return to the main program (YDRE)

ENTER DESIRED OPTION : DE
```

I have decided that I do not wish to have three subjects with identical doses in my group, so I delete (DE) 781.

```
ENTER ANIMAL ID : 781
```

The DE command deletes an animal from the group but not from the data base.

```
OPTIONS:
DE - to delete an animal
BA - to go back to base information output
RB - to output base file statistics
RP - to output Perf file statistics
EI - to output EI statistics
EM - to output emesis statistics
LP - to list search parameters
ST - to output a found file
EX - to return to the main program (YDRE)

ENTER DESIRED OPTION : RB

-----
DO YOU WANT LINEPRINTER OUTPUT <Y OR N>? N
-----
ENTER START/STOP TRIAL /SESSION <NNNNN,NNNNN> : 1,100
-----
```

ANIMAL	DOSE	CORR	PCORR	INCO	OMIT	SID	T. O.	AV LAT	TRL
768	4816	84	84.00	11	5	0	0	1.680	100
785	4816	92	92.00	8	0	0	0	1.320	100
780	5030	91	91.00	9	1	0	0	1.720	100
778	5138	80	80.00	20	0	0	0	1.150	100
AVERAGE	4950	86	86.75	12	1	0	0	1.494	100

```
HIT <CR> TO SEE OPTIONS AVAILABLE AT THIS TIME :
```

The RB and RP commands open the appropriate DATA.TMP file for every subject in the group. The simple performance statistics for a selected range of trials or sessions are computed and displayed as shown above for each subject. If I specify line printer output, it will be printed in the same format. Cued data are requested by trial number. Uncued data are requested by session. The data file contains a task code that allows the program to determine which type of data the file contains. If the requested range exceeds the data available for any subject, then all available data are displayed.

```
DE - to delete an animal
BA - to go back to base information output
RB - to output base file statistics
RP - to output perf file statistics
EI - to output EI statistics
EM - to output emesis statistics
LF - to list search parameters
ST - to output a found file
EX - to return to the main program (YDBE)
```

ENTER DESIRED OPTION : EI

DO YOU WANT LINEPRINTER OUTPUT ? N

```
*****EI STATISTICS*****
ANIMAL- DOSE ONSET DUR RECDV DNSET BUR RECDV
768 2 4816 4M 40S 35M 29S 40M 9S 54M 20S 6M 10S 60M 30S
785 1 4816 3M 29S 4M 31S 8M 0S
780 1 5030 11M 40S 4M 20S 120M 0S
778 1 5138 4M 50S 5M 0S 9M 50S
AVERAGES 1 4950 32M 9S 12M 20S 44M 29S 54M 20S 6M 10S 60M 30S
HIT <CR> TO SEE OPTIONS AVAILABLE AT THIS TIME :
```

The EI option displays the total number of EI's for each subject and the full information for the first two occurrences. The average times are computed, using the number of subjects having an EI as the divisor.

```
OPTIONS :

DE - to delete an animal
BA - to go back to base information output
RB - to output base file statistics
RP - to output perf file statistics
EI - to output EI statistics
EM - to output emesis statistics
LP - to list search parameters
ST - to output a found file
EX - to return to the main program (YDBE)

ENTER DESIRED OPTION : EM
-----
DO YOU WANT LINEPRINTER OUTPUT ? N
-----
***** EMESIS STATISTICS *****
ANIMAL DOSE - EM'S 1 2 3 4 5
768 4816 3 40 42 56
785 4816 1 52
780 5030 1 23
778 5138 0

AVERAGES 4950 1 38 42 56 0 0

HIT <CR> TO SEE OPTIONS AVAILABLE AT THIS TIME :
```

The EM option displays the total number of episodes of emesis for each subject and the full information for the first five occurrences. The average times are computed, using the number of subjects having an EM as the divisor.

```
DE - to delete an animal
BA - to go back to base information output
RB - to output base file statistics
RP - to output perf file statistics
EI - to output EI statistics
EM - to output emesis statistics
LP - to list search parameters
ST - to output a found file
EX - to return to the main program (YDBE)

ENTER DESIRED OPTION : BA
```

The BA command will display the basic information again, but first asks if I want to send it to the line printer.

The LP option will display the selection parameters, but first asks if I want to send it to the line printer. If I want hard copy, I simply select the options in order and respond "yes" to the line printer query. This causes a temporary file LP.LST to be built in UIC [300,300]. It is not sent to the line printer until I exit the main program.

## OPTIONS :

DE - to delete an animal  
 BA - to go back to base information output  
 RB - to output base file statistics  
 RP - to output perf file statistics  
 EI - to output EI statistics  
 EM - to output emesis statistics  
 LP - to list search parameters  
 ST - to output a found file  
 EX - to return to the main program (YDBE)

ENTER DESIRED OPTION :EX

Exiting this subroutine does not send the information I requested to the line printer. Selecting the exit option blanks the screen to the questions:

DO YOU WANT TO RUN AVLAT ON THIS GROUP <Y OR N> ? Y

AVLAT is offered only for cued data. AVLAT will analyze either the baseline performance data or the postirradiation performance data. Since the cued data have standard, fixed trial lengths, then n number of trials equals x length of time. The visual discrimination task used a 10-second trial; therefore, I can obtain a minute-by-minute analysis by specifying six trials per set.

DO YOU WANT BASE OR POST IRRADIATION FILE(S)<B OR P> :  
 ENTER # TRIALS PER SET : 6  
 LAT WILL DO 4 ANIMAL(S)

OPTIONS ARE AVLAT

HIT CARRIAGE RETURN TO RUN LAT /AVLAT OR -1 TO BYPASS :

The data base calls LAT, which tells me what it will do. If I have not already done so, I should now check with the operator to be sure that the Versatec is on-line and ready to go, and that the system plot routine is installed. If anything is wrong, I can still bypass the option. The Versatec must be on-line since there are plots from AVLAT. If I elect to continue, the version date is flashed on the screen. This lets me know that the proper version of AVLAT has been installed.

THE LATEST VERSION WAS JULY 2, 1980

The program returns to home. LAT, AVLAT, and PLTLAT are now running independently of the main program. PLTLAT will send its version data to the screen at the first opening. If I wish to exit YDBLS before my plots are completed, I must notify the operator not to run YDBEOFF.COMD when the logout command file requests it, and have him mount the virtual disk to another terminal to block the DVD command. Otherwise the plots will be aborted.

LITI - LIST AN ENTRY TO THE TERMINAL  
LILP - LIST AN ENTRY TO THE LINE PRINTER  
SRCH - SEARCH DATA BASE BY PARAMETERS  
AND PERFORM DATA ANALYSIS  
LATS - RUN LAT FOR A SINGLE ANIMAL  
EXIT - EXIT THE PROGRAM  
ENTER DESIRED FUNCTION - EXIT

The EXIT subroutine exits the program, sends temporary files to the line printer, and runs the LOGOFF command file.

## Appendix B.

# Performance Data File Format

---

**NOTE:**

This section was prepared by the AFRR Computer Division when the transfer from the SDS-920 to the PDP-11 was accomplished. It is the only existing description of the format of the performance data files. These files are not standard format for any of the machines used. The task descriptions in this section are intended to only clarify the data types. For detailed descriptions of the tasks, see Appendix D.

### TASKS

The data were generated by one of three types of task: cued, uncued, or mixed.

#### Cued

This form of data consists of a trial response latency and an associated trial response type. An animal is presented with a cue and has to respond. It can respond correctly, incorrectly, or not at all in the time allowed. This type of data is collected from the SCAT using programs PIPE and SCATTR or from analog tape using programs BICOLS and COLECT.

#### Uncued

This form of data consists of an interresponse time and an associated response type. The interresponse time has no fixed length. Most of this form of data has been collected from a monkey placed in an exercise wheel. A cue informs the monkey that a session has started, the brake is backed off, and the monkey is supposed to start walking. Each revolution of the wheel is a single response. After a specified period of time, the animal enters a time-out period, in which it may or may not walk, as it desires. (In the standard task, the brake is brought on.) The time between responses and the response type (SID for a response during a work session and TIME for a response during a time-out period) are recorded. For any given session, the time from the start of a session to the first response is recorded as the interresponse time of the first response. The time from the last response to the end of the session is recorded as the interresponse time of the last response. This type of data is collected from analog tape using programs BICOLS and COLECT.

**Mixed**

This is a form of data in which the two types of task are performed alternately.

**DATA FILE FORMAT**

All data base performance data are stored on the virtual disk in UIC [300,13] in the format described in this Appendix. Each file in the data base is named DATA.TMP;N, where N is some octal version number. In the discussion that follows, latency denotes either latency or interresponse time. Each file is written as an unformatted sequential file, which can be described as follows:

Note that every record in the file is 124 bytes long.

**Record 1 Variables**

Variable 1: Integer 1

Variable 2: Integer file version number of file when created. This number may not correspond to the DATA.TMP version number because the DATA.TMP version number can be changed by PIP.

Variable 3: A byte array dimensioned 24 giving ID and date information about the animal run.

Elements 1-8: Animal ID

Elements 9-20: Calendar date of experiment (MMMM,DD,YYYY)

Element 21: :

Elements 22-24: Julian date. The data are stored in this array in 24A1 format.

Variable 4: An integer number of real trials in this file.

Variable 5: A real number for the number of clock ticks per second. When data are acquired from analog tape, this variable is given a value of 40.0 because a 40-cycle clock keeps time. When a latency is stored in the data base, it is stored as an integer number of clock ticks. To retrieve the latency in seconds for a given response, the stored latency must be divided by Variable 5. When data are taken from the SCAT, latencies are transmitted in seconds and fractions thereof, and must be converted to integers before being placed in the data base. Variable 5 is assigned a value of 1000.0 in this case, and the latencies are multiplied by it, converted to integers, and stored in the data base.

Variable 6: A real variable representing the maximum allowable latency (MAXLAT) in seconds and hundredths of seconds. For uncued data this value is equal to the session length.

Variable 7: An integer variable representing a code for the type of data in this file. A value of 1 means strictly cued without time-outs, a value of 2 means strictly uncued, a value of 3 means mixed cued and uncued, and a value of 4 means cued data with time-outs. (See Appendix D for details.)

Variable 8: An integer variable representing the number of trials to be considered as the pretest. The pretest is assumed to start with trial 1.

The eight variables are followed by 82 blank characters to fill out this record to be 124 bytes long.

#### Record 2 Through Record N Variables

There can be 40 trials in each of these records. If the number of trials is not divisible by 40, record N is the last record completely filled with real data. If the number of trials is divisible by 40, record N is the second to last record filled with real data. Each record has the following format:

Variable 1: Integer 2

Variable 2: Integer file version number of file when created. This number may not correspond to the DATA.TMP version number because the DATA.TMP version number can be changed by PIP.

Variable 3: Response code stored as a byte variable. For cued data, the response code is 1 for a correct response, 2 for incorrect, and 3 for omit. For uncued data, the code is 4 for a response during a work session and 5 for a response during a rest session. For cued data with time-outs between work sessions, filler trials are inserted with response codes of 5.

Variable 4: Response latency multiplied by clock ticks (variable 5 of record 1) and stored as an integer. Filler trials in cued data are assigned latencies equal to the value of MAXLAT (Variable 6 in Record 1). In order to recover the response latency in seconds, this variable must be divided by Variable 5 of Record 1.

Variables 3 and 4 are repeated until there are 40 trials in a record as follows: 3, 4, 3, 4, etc.

#### Record N + 1

Record N is defined above. Record N + 1 is the last record in the file that contains any real data. The four records following this record contain dummy data.

Variable 1: Integer 3

Variable 2: Integer file version number of file when created. This number may not correspond to the DATA.TMP version number because the DATA.TMP version number can be changed by PIP.

*BHS Data Base*

Variable 3: Same as for Records 2 through N except that if real data run out before this record is full (it contains 40 trials), dummy response codes are inserted with values of 6.

Variable 4: Same as for Records 2 through N except that if real data run out before this record is full, dummy latencies are inserted with values of 0.

Variables 3 and 4 are repeated until there are 40 trials in this record.

**Last Four Records**

These are dummy records. These records were originally used to allow magnetic tape access to function properly. They cannot be eliminated now, because all the programs for working with DATA.TMP files use them. Each record has the following format:

Variable 1: Integer 4

Variable 2: Integer file version number of file when created. This number may not correspond to the DATA.TMP version number because the DATA.TMP version number can be changed by PIP.

Variable 3: Same as above except that all response codes in these records are 6.

Variable 4: Same as above except that all latencies in these records are 0.

Variables 3 and 4 are repeated until there are 40 trials in each record.

## Appendix C. Cross-Reference Tables

---

The cross-reference tables are displayed when REF is called during an EDIT or SRCH. The master table appears on the screen in the form shown below.

EDIT AND SEARCH CROSS REFERENCE TABLES					
E	S	ITEM	E	S	ITEM
0	-	ANIMAL ID	11	11	PCI HOURS
1	1	AGE	12	12	PCI MINUTES
2	2	WEIGHT	13	13	SURVIVAL DAYS
3	3	HEIGHT	14	14	SURVIVAL HOURS
4	4	GIRTH	15	15	SURVIVAL MINUTES
5	5	SEX	16	16	# EI'S
6	6	TASK	17	17	# TREATMENTS
7	7	SPECIES	26	18	TREATMENT ENTRIES
8	8	DOSE E-ITS S-#	36	19	EMESIS
9	9	REFERENCE PNT	111	20	EI
10	10	#EMESIS	-	21 - 37	DOSE ITEMS

The "-1" exit will return the user to YDBLS if that is the task being run.

There was not room on the screen to display all the dose-related search items. Entering any number from 21 to 37 will display the remaining items, as follows:

21	-	MONTH
22	-	DAY
23	-	YEAR
24	-	DOSE
25	-	N/G RATIO
26	-	TAR
27	-	PROGRAMMED DOSE
28	-	TIME
29	-	W/P BODY
30	-	SOURCE
31	-	MODE
32	-	DOSE RATE
33	-	JULIAN DATE
34	-	#EMESIS
35	-	#EIS
36	-	SPLIT DAYS
37	-	SPLIT MINUTES

Details are available for all coded variables. All variables that were not intrinsically numerical were given code numbers, to represent each value of the variable. When details are requested for a coded variable, the appropriate decoding table is shown. In some cases, additional information is provided for uncoded variables.

## SUBJECT SEARCH ITEMS

0. **ANIMAL ID:** Cannot be searched for; may not match the animal number in publications. Data base animal ID is displayed when the subject is found on a search.
1. **AGE:** In months. Enter the integer number of months.
2. **WEIGHT:** In kilos times 10. Weight was measured in kilograms to the nearest tenth. This value was multiplied by 10 to make it an integer value.
3. **HEIGHT:** In inches from base of tail to top of head. This variable was assigned a value of 1 for those split-dose subjects that were used as part of the n/g 0.4 dose-response curve.
4. **GIRTH:** In inches around chest at nipples
5. **SEX:** Coded and subcoded to reflect maturity, if known

### SEX CODES

0	UNKNOWN
1	Juvenile Male
2	Juvenile Female
3	Mature Male
4	Mature Female
5	Male of unknown maturity
6	Female of unknown maturity

6. **TASK:** Coded. Task codes used here are not the same as task codes internal to the DATA.TMP files. Those codes relate to the type of data generated rather than the specific task. See Appendix D for complete descriptions of the tasks.

### TASK CODES

1	Visual Discrimination
2	Physical Activity Unstressed
3	Unexercised Visual Disc-wheel
4	Exercised Visual Disc-chair
5	Exercised Visual Disc-wheel
6	PA-VD Wheel
7	VD-PA Wheel
8	Visual discrimination, Speed Stressed
9	Match to sample
10	Physical activity 15 min. delay
11	Cued escape-avoidance, no incorrect

ENTER : 1 FOR MASTER TABLE, 2 TO RETURN TO 'YDBE' :

## 7. SPECIES: Coded and subcoded to reflect source, wild or domestic

## SPECIES CODES

0	Rhesus - Wild
1	Rhesus - Domestic
2	Cynomolous, wild
3	Cynomolous, domestic

## 8. DOSE: Items in editing; number of doses in searching

## 9. REFERENCE POINT: Coded; the point at which the dose requested was measured

## REFERENCE POINT CODES

0	Midline Tissue
1	Mid Head
2	Mid Thorax
3	Kerma Free in Air
4	Mid brain

## 10. NUMBER OF EMESES: Number of observed episodes of vomiting

## 11. PCI HOURS: Number of hours postirradiation at which permanent, complete incapacitation occurred

## 12. PCI MINUTES: Number of minutes postirradiation at which permanent, complete incapacitation occurred

## 13. SURVIVAL DAYS: Number of days postirradiation at which death occurred

## 14. SURVIVAL HOURS: Number of hours postirradiation at which death occurred

## 15. SURVIVAL MINUTES: Number of minutes postirradiation at which death occurred

## 16. NUMBER OF EI'S: Number of EI's within the first 2 hours from which there was recovery

## 17. NUMBER OF TREATMENTS: Number of surgical or drug treatments

18. TREATMENT ENTRIES: Types of surgical or drug treatments

TREATMENT INFORMATION CODES	
1	WR 1607
2	WR 2721
3	Blood Pressure (catheter)
4	Blood Flow (catheter)
5	EEG
6	Norepinephrine (drug)
7	Chlortrimeton (drug)
8	H1 H2 Blocker
9	Vitamin C & E

19. EMESIS ENTRIES: Times of episodes of vomiting

20. EI ENTRIES: Times of onsets and recoveries from EI's

DOSE SEARCH ITEMS

21. MONTH: Numbers 1-12

22. DAY: Numbers 1-31

23. YEAR: Last two digits

24. DOSE: Midline tissue in rads (midline body part in partial-body exposures)

25. N/G RATIO: Free-in-air n/g ratio times 1000

26. TAR: Midline tissue-to-air ratio times 100

27. P DOSE: Proposed dose; requested dose at reference point

28. TIME: Military time in hours and minutes

29. W/P BODY: Coded to reflect whole body or part of body exposed

WHOLE OR PARTIAL BODY CODES	
0	Whole body
1	Head only
2	Trunk only
3	Neck only

30. SOURCE: Coded radiation source

SOURCE CODES	
0	AFRRI TRIGA
1	AFRRI Cobalt
2	AFRRI LINAC
3	NRL Cyclotron

\* NRL - Naval Research Laboratory

31. MODE: Coded exposure mode

MODE CODES	
0	Pulse
1	Steady State
2	Multiple pulses LINIAC

32. DOSE RATE: Coded rate of exposure

DOSE RATE CODES	
0	TRIGA 50 millisecond
1	2000 Rads/Min.
2	7.5 PPS
3	60 PPS
4	120 PPS

33. JULIAN DATE: Three-digit type

34. # EMESIS: Number of episodes of vomiting for this dose

35. # EI'S: Number of episodes of EI for this dose

36. SPLIT DAYS: Days between doses

37. SPLIT MIN.: Minutes between doses

## Appendix D.

### Tasks

---

There are three primary tasks on the data base. The rest of the task codes refer to variations or combinations of the primary tasks. In all tasks, each subject was given a baseline test to establish a normal level of performance. The baseline performance had to meet a predetermined criterion; however, the length of the baseline test and the criterion for stability varied between studies. In every study the subject was also required to meet a pretest criterion at 3 to 30 minutes before irradiation. The interval between pretest and irradiation depended on other factors related to each study. In cases in which there was an unexpectedly long delay, the subject was given a second pretest.

#### VISUAL DISCRIMINATION TASKS

##### Visual Discrimination Chair

The first of the three primary tasks is a negative-reinforcement, two-choice visual discrimination task, performed by monkeys in restraint chairs.<sup>3-15</sup> Each subject was trained to push one of two keys illuminated at the same time. One key was illuminated with a square and the other with a circle. The square was always the correct choice. The square alternated between the two keys in such a way that it appeared on each key for 50 percent of the trials but never on the same key for more than three consecutive trials. With these two restrictions, the square presentation was randomly generated to prevent the subject from learning a pattern of presentation rather than the discrimination. Each trial lasted for 10 seconds, with a 5-second choice period and a 5-second time-out.

There were two versions of the primary visual discrimination task. In the earlier version, the subject worked 100 trial blocks with short rest periods for the first 2 hours of testing. In the second version, the rest periods were eliminated so that the subject worked continuously for 2 hours (see Table 1). Task code 1 was used for both of these versions because these differences did not significantly affect the subject's performance. However, there was a difference in the performance data from the two versions. In order to permit the analysis and plotting routines to assume that  $x$  trials =  $y$  time for all the visual discrimination tasks, 20 time-out trials were inserted in each of the between-sessions rest periods in the version-1 data. After the first 2 hours of testing, the subjects were tested hourly for 6 hours and then once every 2 hours for 16 hours (Table 1). No time-out trials were inserted into the long rest periods. The version-1 data were entered from punched cards using CARDIN (Chapter 5). The response codes used for collecting and storing visual discrimination data are listed in Table 2.

TABLE 1. VARIATIONS OF VISUAL DISCRIMINATION TASK

	Part of Test	Work	Rest	Trial	Maximum Latency
TASK CODE 1 Chair Version 1	Pretest	100 trials 16.67 min	Indeterminate until pulse	10 sec	5 sec
	2 Hours	100 trials 16.67 min Repeat 6 times	20 time-outs* 3.33 min	10 sec	5 sec
	Break of 60 min; transfer to training room				
	Overnight	100 trials 16.67 min	None 43.33 min for 6 hr 103.33 min for 16 hr	10 sec	5 sec
TASK CODE 1 Chair Version 2	Pretest	100 trials 16.67 min	Indeterminate until pulse	10 sec	5 sec
	2 Hours	720 trials 120 min	None	10 sec	5 sec
	Break of 60 min; transfer to training room				
	Overnight	100 trials 16.67 min	None 43.33 min for 6 hr 103.33 min for 16 hr	10 sec	5 sec
TASK CODE 8 Speed-Stressed	Pretest	100 trials 16.67 min	Indeterminate until pulse	10 sec	1 sec*
	2 Hours	720 trials 120 min	None	10 sec	1 sec*
	Break of 60 min; transfer to training room				
	Overnight	100 trials 16.67 min	None 43.33 min for 6 hr 103.33 min for 16 hr	10 sec	1 sec*
TASK CODES 4,5,6,7 Wheel Version	Pretest	100 trials 10 min	Indeterminate until pulse	6 sec	5 sec
	2 Hours	100 trials	5 min	6 sec	5 sec
	Break of 8-25 min; transfer to training room				
	6 Hours	100 trials	5 min	6 sec	5 sec

\* Time-out trials inserted by CARDIN

∇ No time-out trials inserted

\* Reaction time for individual subject

**ATTENTION,  
Programmers:**

All future analysis routines must recognize the time-out trials as having the same overall trial length as other trials for both visual discrimination data and cued avoidance data. They must also ignore these trials when computing percent correct, etc. In physical activity data, the interresponse time associated with the time-outs is the total real time.

TABLE 2. RESPONSE CODES FOR VISUAL DISCRIMINATION TASKS

Response	Cards	DATA.TMP	Tape	SCAT
Correct	C	1	1 0	2
Incorrect	I	2	0 1	1
Omission	O	3	0 0	0
Time-Outs		5		
Start			1 1	

#### Exercised Visual Disc-Chair

Although this condition used a different task code, 4, the second version of the visual discrimination was used. The different task code indicates that the subject was physically conditioned. Each subject was first trained to the visual discrimination task. Then it was removed from the chair and exercised in the physical activity wheel to a predetermined criterion (see below under Physical Activity Task). The subject was then replaced in the chair to be baselined and irradiated within 48 hours.

#### Visual Discrimination Speed Stress

Task code 8 is a modification of visual discrimination version 2. The overall trial length was kept at 10 seconds, but the length of the choice period was reduced to a reaction time set for each subject. In all cases this was less than 1 second, with a range of 0.43 to 0.76 seconds. All other conditions were the same.

#### Unexercised Visual Disc-Wheel and Exercised Visual Disc-Wheel

With task codes 3 and 5, a modified version of the visual discrimination task was used. The overall trial length was changed to 6 seconds with a 5-second choice period and a 1-second time-out. The subject worked blocks of 100 trials with 5-minute rest periods between blocks for a total of 6 hours (see Wheel Version, Table 1). The subject was unrestrained in the physical activity wheel rather than in a restraint chair. The brake was fully on throughout baseline and irradiation. Task code-3 subjects had never been exercised. Task code-5 subjects had been exercised to the physical activity criterion (see below under Physical Activity Task) before exposure.

## PHYSICAL ACTIVITY TASK

### Physical Activity Unstressed

Task code 2 was the second primary task, a free operant avoidance task with exteroceptive cues.<sup>16-18</sup> The subject was required to turn a nonmotorized physical activity wheel at a speed greater than 1 mph to avoid a shock. If the subject exceeded 5 mph, the brake exerted enough pressure to slow the wheel. Ten-minute work periods alternated with 5-minute rest periods. During the work periods, tone and light cues were used to indicate underspeed, sure safe speed, and overspeed. The rest period included the 1 to 3 minutes required for the brake to move on and off, since no shock could occur unless the brake was fully off. The brake was fully on for the balance of the rest period. The **baseline criterion** for this task required the subject to perform for 6 hours with no more than a 20% loss in performance between the first and last work sessions. The baseline was a mock exposure in the wheels used for postexposure testing so that baseline and postexposure data could be compared. There were inherent differences between the wheels, which led to differences in performance. The physical activity task parameters are summarized in Table 3.

TABLE 3. PHYSICAL ACTIVITY UNSTRESSED

Part of Test	Activity	Rest	Trial	Maximum Latency
Pretest	10 min $\pm$ 3	Indeterminate until pulse	Variable subject determined	800 sec
2 Hours	10 min $\pm$ 3	5 min $\pm$ 3	Variable	800 sec
Break of 8-25 min; transfer to training room				
4 Hours	10 min $\pm$ 3	5 min $\pm$ 3	Variable	800 sec
After 16 sessions, break for 18 hr				
Additional Testing Until Death or PCI	10 min $\pm$ 3	5 min $\pm$ 3	Variable	800 sec
Eight sessions; break for 22 hr				

The interresponse times (IRT's) collected on this task serve two purposes. First, they are cumulated to establish time after exposure. Second, they are used to establish stability of performance. In order to make the data fit the data base format and serve both purposes, two response codes were used for revolutions: SID and TIME (see Table 4). Revolutions that occur during brake travel time, between work and rest periods, are identified as time-out revolutions. The balance of the rest period is also identified as a time-out revolution, so that time after irradiation could be determined by cumulating IRT's. When analyzing IRT's, the analysis routine ignores these time-outs to prevent the longer IRT's from contaminating the work period IRT's (see Chapter 7).

TABLE 4. RESPONSE CODES FOR PHYSICAL ACTIVITY TASKS

Response	Label	DATA.TMP	Tape
Start			1 1
Activity Period	SID	4	0 0
Brake Travel Period	TIME	5	0 0
Balance of Rest Period	TIME	5	0 0
Session Change to Rest	TIME	5	0 1
Session Change to Activity	SID	4	0 1

#### Physical Activity 15-Min Delay

Task code 10 was used to identify two subjects that did not begin working the physical activity task immediately after irradiation, due to an equipment failure. In both cases the subject remained confined in the squeeze box throughout the delay period.

### MIXED TASKS

#### PA-VD Wheel and VD-PA Wheel

The physical activity task was alternated with the wheel version of the visual discrimination task. For task code 6, PA-VD, the 10-minute activity task was presented first. For task code 7, VD-PA, the 5-minute visual discrimination task was presented first. The subject was given 1 minute between tasks to allow adequate time for the brake. There was no other rest period. (See Tables 1 and 3 for descriptions of the wheel version visual discrimination task and the physical activity task, respectively.)

### REMAINING TASKS

#### Cued Escape Avoidance No Incorrect

The third primary task on the data base<sup>19-22</sup> is a simple cued avoidance task with escape permitted and with no penalty for random responses or for holding the manipulanda. Two levers were used. Each lever was under a large, red light. When the light was illuminated, the subject had 5 seconds in which to pull the lever below it. If this response did not occur, a 0.5-second shock was delivered. A correct response during the shock period terminated the shock presentation. The cued avoidance task is summarized in Table 5. The response codes for this task are given in Table 6. There is no code given for random responses. They were rare and tended to be idiosyncratic; therefore, they were not entered as data.

TABLE 5. CUED AVOIDANCE TASK NO INCORRECT

Part	Work	Rest	Trial	Maximum Latency
Pretest	100 trials 16.67 min	Indeterminate until pulse	10 sec	5.5 sec
2 Hours	100 trials 16.67 min	20 time-outs* 3.33 min	10 sec	5.5 sec
Break of 60 min; transfer to training room				
Overnight	100 trials 16.67 min	None 43.33 min/6 hr 103.33 min/16 hr	10 sec	5.5 sec

\*These trials are inserted by the CARDIN program.

TABLE 6. RESPONSE CODES FOR CUED AVOIDANCE

Response	Cards	DATA.TMP
Correct	C	1
Escape	E	7
Omission	O	3
Time-Outs*		5

\*These trials are inserted by the CARDIN program.

# Glossary

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Following is a list of computer and behavioral terms that have specific meaning for users of this data base.

**animal ID** Identification number of subject on data base, plus any letters added to ensure a unique animal ID

**ANSI** American National Standards Institute

**ANSI format** Format of file structured tapes as defined by ANSI. Because most of our taped data were obtained before this format was established, the DATA.TMP format files will not fit the ANSI format.

**ASSIGN** The ASSIGN command is used in two ways. First, it is used to connect the virtual disk on the main computer in place of the CONNECT ONLINE command, which must never be used with the virtual disk. Second, it is used to set up special conditions for the data base user. The virtual disk becomes the system device through an ASSIGN command. All temporary files are therefore written on the virtual device, which has a sufficient number of free blocks to prevent a space problem.

**AVLAT** A data analysis program that is run as a subprogram under the search option of YDBE/LS. See Chapter 7 of this document.

**base file** DATA.TMP file(s) containing a subject's baseline performance data

**base information** Animal ID, dose, age, weight, height, girth, PCI onset, and survival time. The information automatically displayed on the terminal when a group of subjects is retrieved.

**bitmap** A minute-by-minute "map" of the first 2 hours of data in which a "1" indicates incapacitation during that minute

**BITMAP.EI** The only file created on the main system device. It contains the bitmap.

**code** Integer number used to represent a nonnumerical value, i.e., task

**coded variables** Variables used as search parameters for which integer (I3) numbers are used to represent nonnumerical values

**command file** Fixed sequence of commands built into a file. By calling and running this file, the commands are executed in the proper order without the user's having to remember the sequence.

**console terminal** Terminal (TTO:) from which the entire computer system is being controlled. The terminal through which the operator can usually be reached.

**cross-reference table** Tables showing the 37 search parameters and their item reference numbers and code information

**DATA.TMP** Refers to both the name of the files containing the performance data and the format of these files. Details on precise format are in Appendix B.

**default** That assumed by computer when nothing is specified by user. In most software, the default answer is consistently "yes" or "no" throughout. In some of the data base software, the default answer is simply the most common answer. In some cases, no default is accepted, and the user must select one of the alternatives.

**EI or ETI** Early transient incapacitation. An empirically defined postirradiation behavioral response. "Early" is defined as within the first 2 hours postirradiation. Onset of ETI is defined as complete cessation of response on the task for at least 1 minute. Recovery is determined by the resumption of correct responding for at least 1 minute. At no time should the term incapacitation, used in this way, be equated with physical incapacitation. A behaviorally incapacitated subject is not necessarily also physically incapacitated.

**emesis** Vomiting

**EXIT** The exit functions in YDBLS serve a dual purpose: (1) to exit a subprogram or subroutine, and (2) to complete and close the temporary files. In the first function, it either calls the next subroutine or returns to the main program. When the user exits the main program, the logoff command file is run.

**found group** Group of subjects retrieved by the program as matching the selection parameters chosen

**found record numbers** The YOUNG.DAT record numbers for the subjects in the found group

**function** The data base program has been broken into subprograms, which perform logically related operations. Each of these subprograms is referred to as a function.

**input command** Specific format for input required

**interresponse time** Time between responses in an uncued or continuous avoidance task. Indirectly, the rate of response. In some cases, programs that had been designed to run with cued avoidance data were modified to work with the continuous avoidance task. In these cases, the interresponse times are referred to as latencies in the program and on output.

**IRT** See interresponse time.

**item reference number** Each search parameter was assigned a number from 1 to 37 to be used in setting up selection parameters. To find the numbers, call REF while running, or see Appendix C of this document.

**latency** Correctly, time between occurrence of stimulus and subject's response in a cued avoidance task. Also used in some programs for data base as a label for interresponse times for uncued task.

**LAT** Cued data analysis routine. See Chapter 7 of this document.

**LATS** A data base function that runs the program LAT

**LILP** List information to the line printer

**LITI** List information to TI: . TI: refers to the terminal at which the user is working. No hard copy is generated by LITI unless TI: is a hard-copy terminal.

**logical operator** In a search, the two-letter abbreviation that specifies the desired relationship between a search parameter and the chosen values of the parameter.

**LOGIN** Initiates a connection between the user terminal and the computer. In the multiuser system, it is necessary for each user to sign on or log into the operating system. This is required even if a single-user computer is being run under a multiuser operating system.

**LOGOFF or LOGOUT** Terminates the connection between user terminal and computer

**main program** In the data base, a central program permits the user to select from a group of subprograms. Normally this is referred to as the main program. Occasionally, within one of the subprograms, an auxiliary program is called and run. Exit from these programs will return the user to the part of the subprogram from which he/she entered the auxiliary. If given the option of returning to the main program (or to YDBE), a return to the main program is a means of aborting the subprogram.

**MAXLAT** Maximum latency. Amount of time the subject is allowed for responding before the aversive stimulus.

**menu** List of functions or options displayed on the terminal for the user to choose from

**mount** Initiates a connection between a device and a user terminal

**operator** Staff member of the AFRRRI Central Computer Facility authorized and trained to operate the computer system

**password** Six-letter word used to limit the users of an account to authorized persons

**PCI** See permanent complete incapacitation

**perf file** The DATA.TMP file(s) containing a subject's postirradiation performance data

**permanent complete incapacitation** An incapacitation from which there is no recovery before death. Criterion for onset is same as for early transient incapacitation.

**record number** Each subject's basic information is contained in a record in the YOUNG.DAT file. Included in that file are the related record numbers in DOSE.DAT and PERF.DAT. Since each record has the same byte format, it follows that the YOUNG.DAT record number for a subject or group of subjects provides rapid access to all the available information for that subject. For instance, a user wishing to work with age could develop a program to read word 7 of the records in the found record number output file.

**REF** Installed auxiliary program that displays cross-reference tables for quick reference during a search. Appendix C is used to set up a search in advance.

**SCAT** State Change Analog Translator. A PDP-8A based behavioral control system developed by Grason-Stadler.

**search area** Part of the SRCH function at which selection parameters are entered See Appendix C of this document.

**search parameter** Any one of 37 items of information about the subjects, which can be used to select a group with the desired characteristics

**selection parameter** Search parameter item reference number, logical operator, and value desired. Selection criterion for the parameter. See Appendix A of this document.

**SIDLAT** Analysis routine for uncued data

**SRCH** Subroutine of YDBE/LS, which is used to search, retrieve, and analyze data

**survival time** Time between radiation exposure and death. For multiple exposures, time is computed from first exposure.

**system device** Device on which all of a user's programs are located and where all output files will be written unless another device is specified. When using the data base, the virtual disk must be assigned to be the system device. A few of the data input programs specify other devices for data output, but all the programs, subprograms, and subroutines for the data base proper are located on the virtual disk, as are all the files for input. All output files, except BITMAP.EI, are sent to the assigned system device, whether they are permanent or temporary files. BITMAP.EI is sent to the main system device.

**task** See Appendix D of this document.

**TI** Short form for TTnn: , the user terminal

**user identification code** Two numbers identifying group and individual for the multiuser system. An unprivileged user, such as the data base, can read from most UIC's, but may write to only members of the same group. The data base is group 300 and individual 300, and the program may be run under only this UIC. (For accounting purposes, the data base is considered to be a user.)

**YDBE** YOUNG DATA BASE EDITOR. Program or group of programs to build, edit, and search the data base. (New options are added to this program for testing. Not available to users other than BHS staff members authorized to build and edit.)

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