Table of Contents

An important objective of science courses is to give students experience in reporting the results of research. After research has been conducted, data analyzed, and results interpreted, investigators must inform the scientific community of the work. Science is a social enterprise, and the results of research are of little scientific worth if they are not made public. Although results may be reported to others orally (e.g., at talks given at scientific meetings), the most significant form of scientific communication is through articles published in journals. Such articles provide objective and easily disseminated accounts of scientific work.

Effective scientific communication requires considerable experience and practice. One way you can acquire these skills is to examine critically articles published in psychology journals. Although these articles, like the research they report, are never perfect, they illustrate the style of writing to be followed. They also provide information about conventions followed in organization of tables and figures, use of abbreviations, ways in which statistical tests are referred to, and so forth. Among journals you might consult are:

Animal Learning and Behavior
Behavioral Neuroscience
Developmental Psychology
Journal of Abnormal Psychology
Journal of Applied Psychology
Journal of Experimental Psychology: General
Journal of Experimental Psychology: Human Perception and Performance
Journal of Experimental Psychology: Animal Learning and Behavior
Journal of Personality and Social Psychology
Journal of the Experimental Analysis of Behavior
Memory and Cognition
Perception and Psychophysics

Although the author of a research report has considerable freedom in the style of writing and organization, we have several conventions concerning report writing. These conventions, which are explained below in an abbreviated fashion, are described in the Publication Manual of the American Psychological Association (APA). They are followed in all journals sponsored by APA, as well as most (but not all) other psychology journals. Collectively, these conventions are called "APA style." This Guide is designed to introduce you to APA style (although in a few cases the Guide will deviate slightly from APA's requirements).

During the semester, you will be required to submit several reports based upon data collected during laboratory sessions. These reports are to be prepared in line with the requirements of the Guide. Some requirements may seem arbitrary or even "silly." As you gain experience however, you may recognize the need to follow such conventions in scientific communication. Within the limits of these conventions, however, authors still have considerable room for creative expression.

Please note that the requirements, particularly those concerning organization and style, are not always the only acceptable procedure. You will encounter published papers which take different approaches and you should try to relate these other approaches to the ones presented here. However, at the outset, you are advised to adhere closely to the "rules" given below and to depart from them only when you have mastered the fundamental skills of writing reports.

==========

PART I:

SECTIONS OF THE REPORT

==========

A research report consists of the following (presented in order of appearance in the manuscript):

1. title, which is accompanied by the author's name and institutional affiliation;

2. abstract or summary which gives the reader a preview of what is to follow;

3. introduction to the research problem, including a review of relevant research on the same or similar problems;

4. detailed description of the study's method, with subsections devoted to the subjects, apparatus, and procedures;

5. results, presented in both verbal (qualitative) and numerical (quantitative) terms, and in some cases backed by statistical analysis;

6. discussion of the findings, including comparison with other results published in the literature and consideration of the emperical, theoretical, or practical implications;

7. list of references, providing bibliographic information about the book, chapters, and articles cited in the report;

8. NOTE: In a manuscript submitted for journal publication, tables, figure captions, and figures or graphs and footnotes are placed at the end of the manuscript in the order indicated above. However, in theses and laboratory reports or term papers, the APA manual states that such material may be incorporated at the appropriate point in the text as a convenience to the reader. Each table or figure is placed on a separate page immediately following the page on which the table or figure is first mentioned. No "insert Figure X here" statement is needed if this strategy is followed, as such statements are merely instructions for the journal typesetter. Figure captions are then typed below the figure or if necessary, on the preceding or facing page. You should consult your instructor regarding her/his referred format for tables and figure.

A description of each of these sections follows.

A. The Title

The title should be brief but descriptive. APA journals limit titles to about 15 words or less; thus, you should avoid unnecessary phrases such as "A Study of ..." or "An Experiment Concerned with ..." The importance of a descriptive title often is underestimated. Scientists do not have time to read all of the reports in a professional journal, but may have time to read the titles. They must be able to determine from those titles whether the report is relevant to their own research, courses they teach, and so on. Thus, titles have substantial influence over who reads the report.

A good title describes the variables of interest, as in this example:

Self-Control in Adult Humans:
Variation in Positive Reinforcer Amount and Delay

This title expresses the dependent variable (self-control) and the two independent variables (reinforcer amount, reinforcer delay). Note that this title also includes the type of subject (adult human). The decision to include this information depends on the author's judgment. If the type of subject is an important, interesting, or unusual aspect of a study, then that information probably should be in the title.

Another somewhat less common but still effective approach is to express the major results of the study as well as the relevant variables, as in:

The Ineffectiveness of Shock Avoidance
Under Long and Short Response-Shock Intervals

This title tells a lot: The dependent variable was avoidance behavior, the independent variable was the length of the response-shock interval of the avoidance schedule, and the main finding was that avoidance behavior was poor when the intervals were long or short.

B. The Abstract

The abstract is a one-paragraph summary of the article. Its purpose is to give readers a synoptic preview of what follows. For many readers, abstracts determine whether papers are of interest and worth reading. As a guide to current research in psychology, abstracts of published papers also are published in Psychological Abstracts, a journal that published only abstracts.

As with the title, the abstract must be both brief and informative. APA journals limit abstracts of research reports to 150 words or less. A good abstract summarizes the following aspects of the research:

1. Problem under investigation, in one sentence if possible. You would be wise to begin your abstract with a sentence that reads "The purpose of this study was to ..."

2. Essential features of the method. Obviously, space does not permit a description of the details. Which features are "essential" varies from study to study. You should consider the following: (a) the subjects (including pertinent characteristics such as number, type, age, sex, species); (b) some mention of the apparatus, to the extent needed to summarize the procedure (this usually can be incorporated into the description of the procedure); (c) the main feature of the design and procedure.

3. Major findings. Here the emphasis usually should be on a qualitative (or verbal) description of the results; in general, numerical findings are not provided in the abstract.

4. Major conclusions. Whenever possible, the abstract should give implications of the research, whether empirical, theoretical, or practical.

Thus, the abstract concisely states purpose, method, major results, and conclusions of the research. The first three are most important; the conclusions may have to be omitted because of space limitations.

The abstract should be self-contained. Authors must keep in mind that it will be read before the other sections of the paper (except, of course, the title). Readers must be able to understand every word of the abstract without referring any other part of the paper. Thus, the APA Publication Manual offers the following instructions:

> Define all abbreviations and acronyms. Spell out names of tests and drugs (use generic names for drugs). Define unique terms. Paraphrase rather than quote. (APA, 1994, p. 9).

By the same token, readers must be able to understand every word of the rest of the paper without referring to the abstract. Thus, special terms must be defined again in the body of the paper, even if they have already been defined in the abstract. The abstract must be able to stand apart from the rest of the paper, and the rest of the paper must be able to stand apart from the abstract.

Here is an sample of an abstract from a published paper entitled "Effects of Ethanol and Naltrexone on Aggressive Display in the Siamese Fighting Fish, Betta splendens."

Abstract

The present study used the aggressive display of Betta splendens in response to a mirror as an index of the effects of ethanol and the opiate antagonist, naltrexone. Naltrexone produces an opiate receptor blockade and thus provided a test of the hypothesis that ethanol effects on aggression are mediated by the opioid system. Eighty fish were randomly assigned to one of eight groups in a 4x2 factorial design with Ethanol (0, 0.25, 0.50, and 0.75 g%) and Naltrexone (0 and 5 mg/l) as the main factors. The 0.75 g% dose of ethanol reliably suppressed aggressive display as measured by number of gill-show responses, but lower doses had no effect or tended to increase aggressive display. At the same time, all doses of ethanol increased arousal in the fish as measured by airgulping. Naltrexone alone did not have effects on aggression or arousal, and did not interact with ethanol on either measure. Thus the results did not support the ethanol-opioid common-link hypothesis.

In this example, the first two sentences summarize the purpose of the experiment. The third sentence describes basic aspects of the method. The fourth through the sixth sentences present the major results, and the last sentence expresses the author's interpretation of the results.

C. The Introduction

The introduction orients the reader to the problem examined by the research. A statement of purpose and review of previous findings helps the reader appreciate the reason for the research. Efforts should be made to place the study in a broader context, for example, by pointing out how the study developed out of a practical or theoretical problem.

The introduction should be organized as an "inverted pyramid," broad at first and increasingly more specific later. The earlier parts should deal with the general problem, the issues involved, and general references to the literature. For example, the introduction to a study of reaction time might begin by defining reaction time and describing some of the reasons why it is of interest.

Later parts should review the published literature that is specifically relevant to the topic at hand. What other experiments have been conducted? What were the procedures? What were the results and how have they been interpreted? This review should set the stage for the specific questions to be addressed by your study. That is, this part should lead the reader to appreciate why the questions addressed in your study are interesting and worthy of being answered.

The introduction should end with a statement of the precise purpose of the study and a summary of the procedures. The statement of purpose could be in the form of a summary statement beginning with "The purpose of the present experiment was..." or in the form of specific questions, hypothesis, predictions, or a combination of these. (You should not, however, state any hypotheses or predictions unless the study really was designed to test them.) In doing this, it generally is necessary to give the reader a brief application of the procedure that was followed. Even in complex experiments, this can be done in a few sentences. Do not make the mistake of entering into extended explanations of the procedure, which are given the method section.

Below, by way of example, is the introduction to a published paper entitled "Effects of Live Modeled Sex-Inappropriate Play Behavior in a Naturalistic Setting." Note the transition from a general consideration of sex-typed behavior to statements about the specific details of the research. Because concern is with both sex differences and modeling, the middle two paragraphs review the literature in each of these areas. Only the first sentence or two of each paragraph is given:

There are a variety of theoretical interpretations of the acquisition of sex-typed behaviors (see, e.g., Mussen, 1969). Cognitive-developmental theorists maintain that children label themselves as "boys" or "girls" and this self-categorization then becomes the major organizer of the child's sex-typed behaviors...

Previous findings from laboratory studies indicate that boys display earlier and more clearly defined sex-appropriate behavior

than girls. Many girls between the ages of 3 and 10 show a strong preference for masculine games, activities, and objects; whereas it is unusual to find many boys who prefer feminine activities (Brown, 1957; Hartup & Zook, 1960)...

The perceived similarity between the model and observer has been shown to influence the amount of observational learning in laboratory studies (e.g., Kagan, 1958; Rosenkrans, 1967). Children have been shown to attend more closely to same-sex models...

In contrast to the above laboratory studies, few studies have been conducted in naturalistic settings. The present study used a naturalistic setting to determine the effects on children of modeled sex-inappropriate play behavior. Children were exposed to a live peer model who played with a toy that was sexually inappropriate for the children. It was hypothesized that: (a) children would imitate a same-sex model to a greater extent than an opposite sex model, and (b) girls would display sex-inappropriate behavior to a greater extent than boys.

D. The Method Section

The method section precisely describes the way the research was performed. Enough information must be included so that another researcher can replicate the study. The method section is critical; a reader who cannot understand exactly what was done will be unable to comprehend the remainder of the paper.

Although it is important to include considerable detail about the method, the information provided should be relevant. For example, information that an experiment was conducted on a Monday example, information that an experiment was conducted on a Monday morning in a green room illuminated by fluorescent lighting would not appear to have any bearing upon the outcome of a study of learning in rats (but it could be relevant if concern was with the motivation of industrial workers). By presenting irrelevant information, you not only bog the reader down in details, but also suggest that the details had an important bearing on the study.

The method section usually is divided into three standard subsections:

1. Subjects. The number of subjects and information about any subject characteristics that might influence the outcome of the study are reported here. Examples of such characteristics are: species, sex, age, and (depending on the research) educational level, social class, religion, intellectual level, and the university affiliation of human subjects. The method of obtaining subjects should be specified (e.g., whether they volunteered or were recruited). It often is important to know whether the individuals involved had previous experience as subjects.

2. Apparatus (or Materials). This subsection describes any apparatus that was used together with its relevant characteristics. If the procedure involves word lists, slides, questionnaires, and so on, but does not make use of hardware such as computers, slide projectors, or memory drums, then this section would be labelled Materials. Less detail is needed when standard commercial units are employed (because specification of the unit is available in catalogs) than when the apparatus has been custom-made. So that other investigators could duplicate the procedure, the manufacturer's name and the model number of commercial equipment are generally provided. In the case of custom-made equipment, a diagram may be necessary if a precise description cannot be made verbally. Sufficient detail should be given so that the reader can visualize the conditions to which the subject was exposed. Information about the dimensions, even in the case of a commercial piece of equipment, is important in this regard. Do not include commonplace objects such as chairs and tables or obvious items such as data sheets and pencils.

3. Procedure. This subsection provides a step-by-step description of the conduct of the experiment. The APA Publication Manual advises:

> Include the instructions to the participants, the formation of the groups, and the specific experimental manipulations. Describe randomization, counterbalancing, and other control features in the design. Summarize or paraphrase instructions, unless they are unusual or compose an experimental manipulation, in which cases they may be presented verbatim...(The) method section should tell the reader what you did and how you did it. (APA, 1983, p. 26).

An incomplete example of a hypothetical method section is given below. Further information about some of the details (e.g., abbreviations, underlining, headings, etc.) may be found in Parts II and III of this Guide.

Method

Subjects

Twenty-four male albino Wistar rats, 90-120 days of age, were obtained from the Holtzman Company (Madison, Wisconsin). They had been used in a previous study of exploratory behavior...

Apparatus

A straight alley, 76 cm long, 36 cm high, and 13 cm high, was used. The floor and ceiling were 1.27-cm hardware cloth; the walls, constructed of wood, were painted flat black.

Procedure

The rats were randomly assigned to the four cells of 2 x 2 factorial design, with six rats per cell. The two independent variables were reinforcement schedule, either continuous reinforcement or partial reinforcement, and drive level, either high drive (23-hr deprivation) or low drive (2-hr deprivation). The dependent variable was speed of running in a straight alley. The experiment was conducted in a series of six replications of four rats each, with one rat per cell serving in each replication.

The feeding schedule began five days before the start of alley training. On each training day, rats were permitted to eat for 30 mins either 2 or 23 hr before the start of the day's trials...

Each rat was given 10 trials per day for 10 days under the appropriate reinforcement and drive conditions. Trials were given at 10-min intervals. At the start of each trial, the rat was placed in the startbox. The startbox door was raised 3 s later...

E. The Results Section

The results section presents the findings. Two, or perhaps three, kinds of information should be included: qualitative, quantitative, and, in some cases, statistical.

1. Qualitative descriptions are verbal statements of the effects or relationships that were observed.

2. Quantitative descriptions are summaries of the data, usually in the form of figures or tables, to substantiate the qualitative descriptions.

3. Statistical tests applied to the data should be reported if such tests are appropriate to the design and analysis of the study. Statistical tests do not, in themselves, describe the results of a study; rather, they are used verify that the described differences or relationships are reliable.

Because the primary purpose of the research report is to communicate, qualitative descriptions must accompany tables or figures. The quantitative material in the tables or figures usually cannot be understood fully without explanation, and such material often includes information tangential to the main point of the study.

The reader must be directed to the salient features of the tables or figures. Each figure and table should be explicitly introduced and its format described. For example, one might write "Figure 1 shows the mean score on the Eysenck Personality Inventory for each experimental group. Scores for males and females are represented by black and white circles, respectively..."

Reports of statistical analyses should be presented after the reader has had a chance to grasp the nature of the differences or relationships that are being evaluated. That is, statements about statistics should support the quantitative and qualitative descriptions of the results.

If the study is complex (e.g., an experiment concerned with several variables), presentation of the findings is best divided. A simple and effective way to organize the results section is to devote a coherent paragraph or two to each aspect of the results. In such a case, all three kinds of information described above (verbal statements, references to figures or tables, statistical tests) are presented for each aspect of the results sequentially.

The function of the results section is to present the findings, not discuss them. Interpretation is reserved for the discussion section. You may encounter published articles in which the results and discussion are combined in a single section headed "Results and Discussion," but this arrangement is tricky and best avoided by students.

An important decision concerns how much data to present and in what form. These questions have no simple answers, and research reports may be criticized because important data are omitted or because irrelevant data are included. With respect to graphs and tables, authors must decide whether the quantitative information can be conveyed more easily in the text, which usually should be done with relatively few values. For example: "Fewer trials were required for learning by the experimental group than by the control group. The means and standard deviations of the trials to criteria were: Experimental Group, *M* = 10.6, *SD* = 3.1; Control Group, *M* = 22.5, *SD* = 4.3."

Tables and figures summarize the data; they are not used for presenting all the data (the so-called "raw data," a term implying that they have not been analyzed). In constructing a table or figure, authors consider the questions, What are the main points and what is the most economical way of making these points in a meaningful fashion? Tables and figures should not be redundant with each other or with data presented quantitatively in the text. Data should be presented once only (but must be presented once!).

Although tables and figures are considered part of the results section, they should be placed toward the end of the typed manuscript as described in a later section of this Guide.

An incomplete example of a results section is presented below. Note that references to statistical tests include the type of test, the number of degrees of freedom, and the resulting probability. Note also the instruction to "insert the table." This instruction marks the approximate location where the table (or figure, as the case may be) should be printed if the paper were to be published.

Results

Both reinforcement schedule and drive condition had major influences upon performance. The continuous reinforcement subgroups reached the learning criterion (9 out of 10 correct responses) more rapidly than the partially reinforced subgroups, and learning was more rapid under high drive than low drive conditions. These differences may be seen in Table 1, which presents the means and standard deviations of trials to criterion for the four subgroups.

Analysis of variance confirmed the statistical significance of differences attributable to reinforcement schedule, $F(1,20) = 9.13$, $p < .01$, and drive, $F(1,20) = 6.24$, $p < .05$. As suggested by the data in Table 1, schedule and drive did not show a significant interaction, $F(1,20) = 1.34$, $p > .05$.

F. The Discussion Section

The discussion section follows and explains the results. Of all sections of the report, the discussion calls for the greatest ingenuity and creative effort.

The organization of the discussion is opposite to that of the introduction--Whereas the introduction has an "inverted pyramid" organization, the discussion has a "pyramid" organization. Initial statements deal with matters highly specific to the procedure and results of the study. Subsequent statements become increasingly broad and consider the present results in light of other results published in the literature and their possible implications, either empirical, practical, or theoretical.

You should begin the discussion with a simple summary of the main findings. This summary provides a basis for a comparison of the results with those of other studies. This comparison should attempt to integrate your findings with those of the others; if you did not replicate previous work, possible reasons (e.g., procedural differences) should be given.

If your study is concerned with a hypothesis or prediction derived from a formal theory, you should consider the extent to which your findings support or argue against the theory. In any case, you should consider the implications of your results. What processes, mechanisms, or relationships do they illustrate? To what extent can the findings be generalized to other subjects and/or situations? What practical use might be made of the findings? Try to anticipate the criticism that the results of your study are specific to the procedures followed, and thus reveal little or nothing about "real-life situations" or behavior in general. Other potential topics for consideration in the discussion include: an analysis of possible limitations of the

procedure (e.g., uncontrolled variables), ways in which the procedure may be improved, and future directions for research on the issue under study.

Experimenters have problems with "negative" results, when the hypothesis under test was not confirmed or when no significant results were obtained. Whatever the reason for the outcome, resist the temptation to engage in apologies, excuses, or extensive speculative statements about "uncontrolled" variables. It is, however, appropriate to attempt a brief explanation.

Of importance, avoid statements which, upon examination, convey little information. For example, to say that "further research is needed" belabors the obvious.

Here is the abbreviated discussion section of a published paper whose title was "Inhelder and Piaget's Pendulum Problem: Teaching Preadolescents to Act as Scientists." Note that the first two paragraphs are devoted to a restatement of the results and an analysis, in terms of the logic of the experiment, of their implications. The third paragraph relates the findings to previous studies. The discussion concludes with a consideration of the broad implications of the results and provides reasons for further examination of the question under study.

Discussion

Preadolescents could master the pendulum problem if given appropriate instruction. Of the 38 subjects, 28 stated that the length dimension alone was important and that short strings invariably "returned" (i.e., to the peak of their arcs) more quickly than long ones. It also appears that successful instruction does not require the entire set of three factors employed: the training procedure remained effective if either conceptual training or the analogue training was deleted but not when both were absent...

These results are interpreted as indicating that the conceptual framework and analogue procedures served somewhat redundant functions...

The performance of the control group supported Inhelder and Piaget's (1958) observation that unaided 10- and 11-year-olds do not grasp quickly the strategy required to solve the pendulum problem...

The strategy that enabled subjects to succeed can be viewed as an application of the statistician's familiar analysis of variance logic; if one level of a factor is consistently superior to another level, then that factor is termed significant. An extended exploration is now needed--and warranted--concerning other training methods that may result in relatively young students applying appropriate strategies to scientific problems, that is, strategies that help them function as effective scientists.

G. The Reference Section

The reference section lists published work cited in the body of the paper. Accuracy of citation is important since the purpose of listing the references is to document the statements made and to permit their use by the reader. Special attention should be given to the spelling of authors' names, and the title, year, volume, and page numbers of the reference.

Note that the reference section lists all and only those references cited in the text.

Entries are arranged alphabetically by author's last name (or, for multiple authors, the last name of the first author). Arrange multiple papers by the same author or group of authors, chronologically. Do not replace the author's name with a dash when a name is repeated in the following citation.

The three major types of references are: papers published in journals, books, and chapters published in edited books. References to such works should include the following information (in order):

1. Journal article: Author(s) last name and initials, year of publication, title, journal name, volume number, first and last pages of the article.

2. Book: Author(s) last name and initials, year of publication, title, city (and state, if not obvious) of publication, publisher. If the book is in its second or later edition, that

information is placed in parentheses immediately after the title. If the reference is to an edited book, the word "Ed." is placed in parentheses after the editor's initials ("Eds." in the case of two editors).

3. Chapter in an edited book: Author(s) last name and initials, year of publication, chapter title, editor(s) initials and last name, book title, first and last pages of the chapter, city (and state, if not obvious) of publication, publisher.

Examples of each type are given below. (The information in brackets after each is to help you. It is not part of the reference itself should not be included when you prepare a reference section). Note these practices:

1. The ampersand ("&") is used to stand for "and."

2. The first line of each reference is indented. The subsequent lines are at the left margin.

3. Journal names, book titles, and volume numbers are underlined.

4. In the titles of journal articles, book chapters, and books, only the first word is capitalized. Exceptions are made for proper names, of course, and for the first word after a colon (if the title includes a colon).

5. In journal names, all major words are capitalized.

6. If two works have been published in the same year by same author or authors, a letter is appended to the year of publication to distinguish them (e.g., 1987a, 1987b). This is done in both the text and the reference section.

References

Bell, J. T. (1962). Reversible cortical depression and avoidance behavior in the rat. Journal of comparative and Physiological Psychology, 55, 306-308. **[This is the form for a typical journal article.]**

Bower, G. H., & Hilgard, E. R. (Eds.). (1981). Theories of learning (5th ed.). Englewood Cliffs, NJ: Prentice-Hall. **[This is an example for an edited book.]**

Bures, J. (1959). Functional decortication and behavior. In M. A. Brazier (Ed.), Conference of the central nervous system and behavior (pp. 115-147). New York: Josiah Macy, Jr. Foundation. **[Chapter in edited book.]**

Giles, W. F. (1977). Volunteering for job enrichment: A test of expectancy-theory predictions. Personnel Psychology, 30, 427-435. **[Another journal article; note capitalization of word after colon.]**

Weiner, H. (1964a). Modification of escape responding in humans by increasing the magnitude of the aversive event. Journal of the Experimental Analysis of Behavior, 7, 277-279. **[Journal article, first of two published in same year by same author.]**

Weiner, H. (1964b). Conditioning history and human fixed-interval performance. Journal of the experimental Analysis of Behavior, 7, 383-385. **[Journal article, second of two published in same year by same author.]**

Woodworth, R. S., & Scholsberg, H. (1955). Experimental psychology. New York: Holt. **[Authored book.]**

H. Tables and Figures

To make meaningful statements about data collected in an experiment, researchers must first organize, summarize, and analyze the data with reference to the aims or hypotheses of the study. We have many ways to do this. One suggestion is to try several ways of organizing the data and see which gives the clearest picture of the relationship between the variables of interest. Usually, results are best presented in tables, graphs, or a combination of the two.

Tables

Tables can be difficult to interpret, and so are best reserved for important data which cannot otherwise be presented in the text of the report. Nevertheless, a well-constructed table can be economical in that it compresses data and allows the reader to see relationships not readily discernible in the text.

A good table supplements, not duplicates, the text. When writing the text of a report, you must refer to every table and its contents. However, describe only the highlights; if every item is described in detail, the table becomes unnecessary.

Depending on its complexity, a table may have as many as five major parts:

1. Table Number. Number all tables with arabic numerals in the order in which they are first mentioned in the text. If you have only one table, it is still "Table 1."

2. Title. Give every table a brief but clearly explanatory title.

3. Headings. A table compares or classifies related items. Data form the body of the table. Correct headings can establish the logic of the body and organize it efficiently. Depending on the complexity of the table, headings may be subheads, boxheads, column heads, or spanner heads.

   Stubheads. The left-hand column usually lists the major independent variables. This column always has a heading--called the stubhead--which describes the elements listed in that column.

   Boxheads and column heads. The heading at the top of the table--called the boxhead--identifies the entries in the vertical columns in the body of the table. A boxhead may cover just one column or be subdivided to cover several columns which carry column heads. Often a boxhead can be used to avoid repeating column headings. For example:

Grade 3	Grade 4	Grade 5

could be replaced with

	Grade		
	3	4	5

   Spanner heads. A few tables may require spanner heads in the body of the table. These headings span the entire width, allowing for further divisions within the table. Also, spanners can be used to combine two tables into one.

4. Body. The body contains the numerical data. Express the values only to the number of significant figures that accuracy of measurement justifies. Do not change the unit of measure in a column.

5. Footnotes. Tables may use three types of footnotes, each with a separate function and form. A central note qualifies, explains, or provides information relating to the table as a whole. It is designated by the underlined word "Note" followed by a period. A specific note refers to a particular column or individual entry. It is indicated by superscript lowercase letters. Specific notes to a table are independent of any other table and begin with the letter "a" in each table. A probability level note indicates the results of tests of significance. Asterisks (*) indicate this type of note. When more than one probability level is used in a table, use one asterisk for the lowest level (e.g., *$p<.05$) and progress upward (e.g., **$p<.01$). Probability levels and number of asterisks need not be consistent among tables.

Table 1 illustrates the various parts that a table may have.

Table 1

Mean Number of Correct Responses by Children With and Without Pretraining.

Group	n[a]	Grade 3	4	5	6
		Verbal tests			
Girls					
With	20(18)	280*	297	319	301
Without	20(19)	240*	251	260	263
Boys					
With	20(19)	281	290	306	317**
Without	20(20)	232	264	221	262
		Mathematical tests			
Girls					
With	20(20)	201**	214	221	237
Without	20(17)	189	194	216	135[b]
Boys					
With	20(19)	210*	236	239	250
Without	20(18)	199**	210	213	224

Note. Maximum score = 320

[a] Numbers in parentheses indicate the number of children who completed all tests.

[b] One girl in this group made only 2 correct responses.

* $p < .05$
** $p < .01$

Remember, however, that rarely will a table have so many headings and footnotes. Be economical. Make your tables as simple and uncluttered as possible. Your goal is the clear, concise communication of results. When the title, headings, body, and footnotes (if any) of a table are properly arranged, the contents of the table will be intelligible to the reader without reference to the text of the report.

Graph

A graph is a pictorial representation of the relationship among two or more variables. Like tables, graphs allow the reader of a scientific report to grasp the results of an experiment at a glance, without having to refer to the text.

Most graphs have two axes. The horizontal axis is known as the abscissa or x-axis. The vertical axis is called the ordinate or y-axis. In figures of the results of experimental studies, the independent variable is always represented on the x-axis and the dependent variable on the y-axis, thus showing how the dependent variable behaves as a function of the independent variable.

In general, the ratio of the length of the y-axis to that of the x-axis should be in the range 2:3 to 3:4. This rule, known as the "three-quarters rule," may seem trivial, but it is important because changing the relative sizes of the axes can drastically alter the apparent relationship between the variables.

All graphs have a label for each axis, a number, and a caption.

1. Axis labels should describe what each axis represents (for example, IQ scores, percentages, frequencies, etc.) and the numerical values of each. Indicate the values by grid marks placed on each axis at the appropriate intervals.

2. Numbers. All graphs, as well as any charts or illustrations, must have numbers. Like tables, figures should be numbered consecutively with arabic numerals according to the order of their first mention in a report. Thus, the first graph, chart, or illustration should be called "Figure 1," the second should be called "Figure 2," and so on.

3. Captions. A good caption is concise, but should be complete enough so that the graph can be understood without reference to the text. It should describe the format of the figure in a brief sentence or phrase. In published reports, the caption usually appears below the x-axis, and is always preceded by the figure number. In a typed manuscript, however, figure numbers and captions appear on a separate page (see Part II of this Guide for further details).

Two general types of graphs, bar and line, are considered below. The proper selection of one over the other depends on the scale of measurement used in the experiment. Here is a brief review of each scale of measurement (nominal, ordinal, interval, and ratio):

Scales of Measurement

The so-called nominal scale is not really a scale at all since it involves nothing more than classifying individuals into qualitatively different categories, with no ordering implied. For example, you could categorize people with respect to sex (male or female) or nationality (French, American, Chinese, etc.). In contrast, the ordinal scale connotes an ordering with rank-order positions usually specified by numerals. The numerals used in connection with ordinal scales are nonquantitative, however. They indicate only positions on an ordered series and not how much of a difference exists between successive positions on the scale. Examples of ordinal scaling include the rank ordering of football players according their value on the team, the rank ordering of albino rats according to their speed in learning to run a maze, and the rank ordering of human subjects by socioeconomic status. An interval scale is one for which equal units can be claimed, as, for example, when the interval 15-25 represents exactly the same amount as the interval 130-140. Such is the case if we are measuring temperature on a Celsius scale. For a scale to be called a ratio scale it must have a true zero point, in addition to qualifying as an interval scale. Consequently, only the ratio scale permits us to make statements concerning the ratios of numbers in the scale; for example 4 Newtons are to 2 Newtons as 2 Newtons are to 1 Newton. Note that the numerical values associated with both interval and ratio scales are truly quantitative and therefore permit the use of arithmetic operations such as addition, subtraction, and so on.

Bar Graphs

When the independent variable is on either a nominal or ordinal scale, a bar graph is usually appropriate. In constructing a bar graph, you may find the following procedure helpful:

1. X-axis. Select a convenient length for the horizontal or x-axis. Remember that you will have to label each axis and provide a caption for the graph, so allow room for these at the bottom and sides of the page. Divide the x-axis into equal intervals according to the number of levels, conditions, or categories of the independent variable. Keep in mind that no order is assumed to underlie nominally-scaled variables. Thus, the various categories can be represented along the x-axis in any order you choose. However, some researchers arrange the categories alphabetically, to eliminate personal factors from entering into the decision. Remember also that the bars should be separated rather than contiguous to avoid any implication of continuity among the categories. Ordinally-scaled variables should be treated in the same way as nominally-scaled

variables except that the categories should be placed in their naturally occurring order along the x-axis.

2. Y-axis. Now that the length of the x-axis has been determined, find the maximum value of the dependent variable. Then arrange the intervals of the vertical or y-axis such that the height of the maximum point is approximately equal to two-thirds to three-fourths of the length of the x-axis.

Figures 1 and 2 provide examples of bar graphs using nominally and ordinally scaled independent variables, respectively. Note the use of the axis labels, a figure number, and a caption to identify fully each graph.

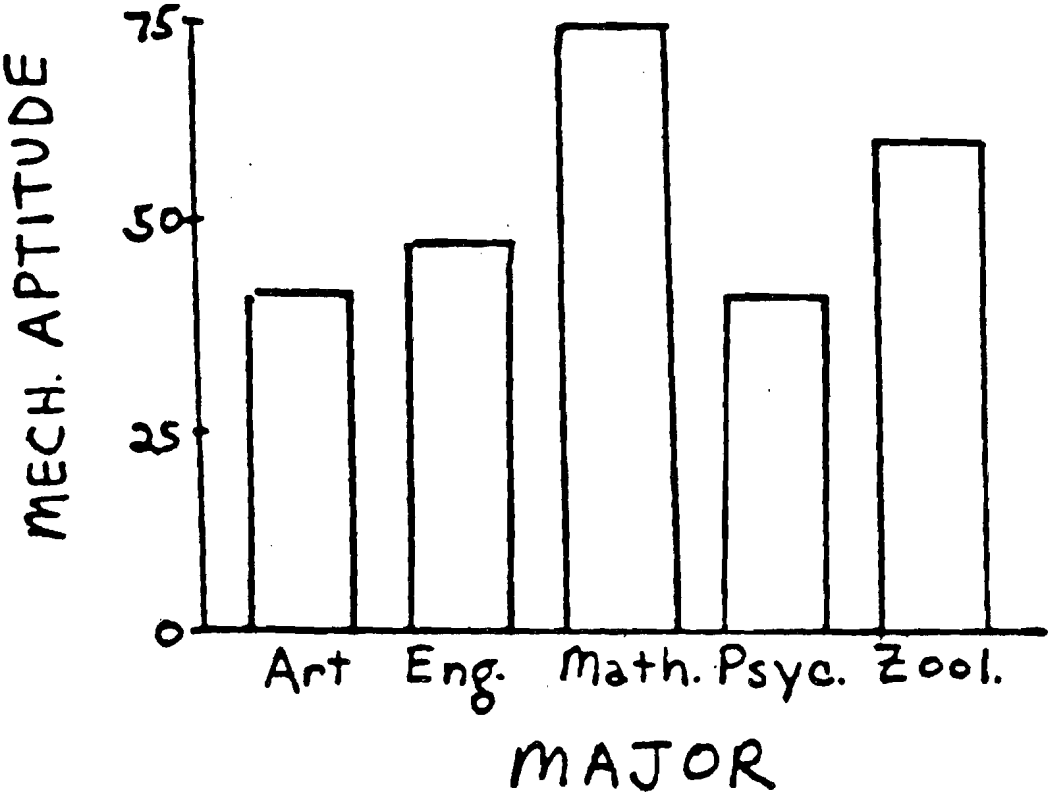

Figure 1. Mean mechanical aptitude scores of college seniors, organized according to academic major.

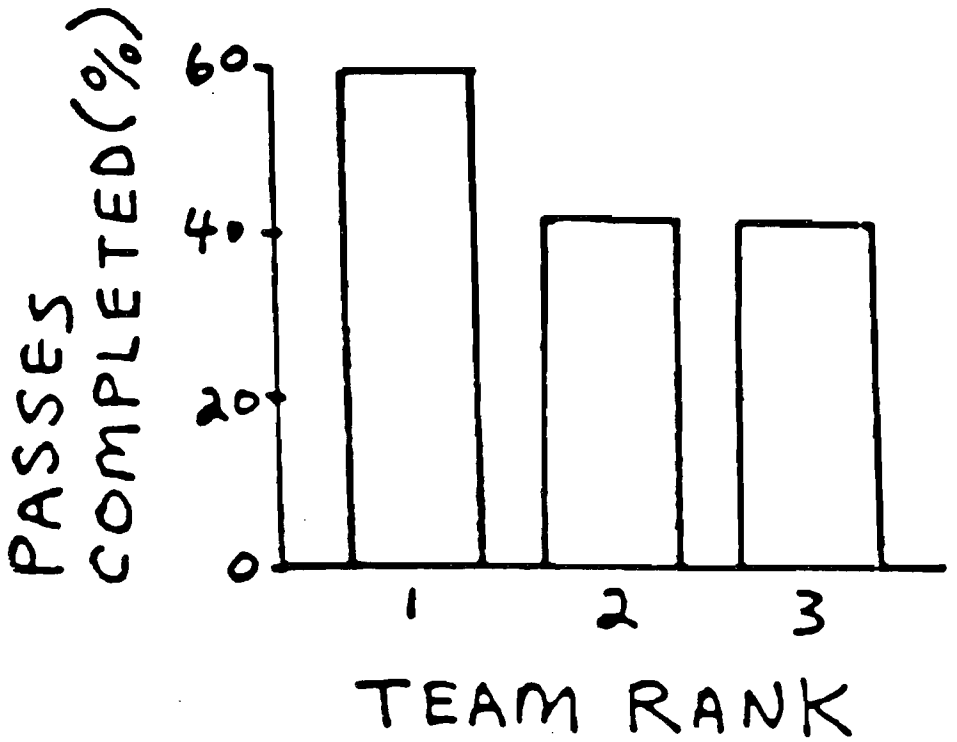

Figure 2. Percentage of forward passes completed by the first-, second-, and third-string quarterbacks of the Pittsburgh Steelers during four exhibition games.

3. Graphing two or more independent variables. This procedure involves putting one of the independent variables on the x-axis and differentiating the other in the body of the graph. In Figure 3 the nominally scaled variable of national origin is represented on the x-axis. A second nominally-scaled variable, sex, is differentiated in the body of the graph by shading. A key explaining the meaning of the shadings is also provided.

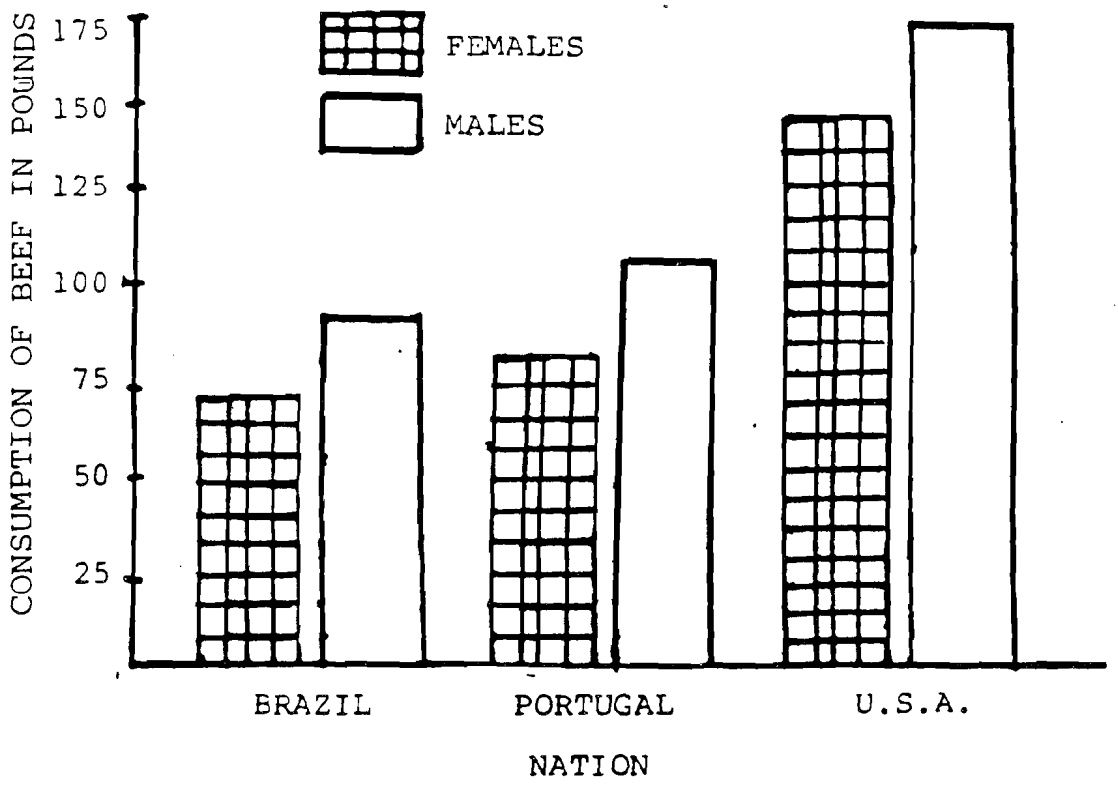

Figure 3. Annual per capital beef consumption by adult men and women in three countries.

Line Graphs

When independent variables take on values that lie on a numerical continuum, as is the case with interval and ratio scales, then line graphs are typically used.

1. X-axis and y-axis. The procedure used to construct line graphs is essentially the same as that used to construct bar graphs. However, note that the x-axes of line graphs are usually marked off with numbers. When numbers are used to divide an x-axis into intervals, the left-hand corner of the graph should correspond to zero. If the numerical values do not span equal intervals (for example, motivation is often studied using food deprivation schedules of 1, 6, 12, and 23 hours), mark the x-axis according to the units used, keeping the number-distance relationship intact throughout:

---

0 3 6 12 23

Note that the distance from the left-hand corner to "12" is 12 times as great as the distance from the corner to "1."

An example of a line graph is given in Figure 4.

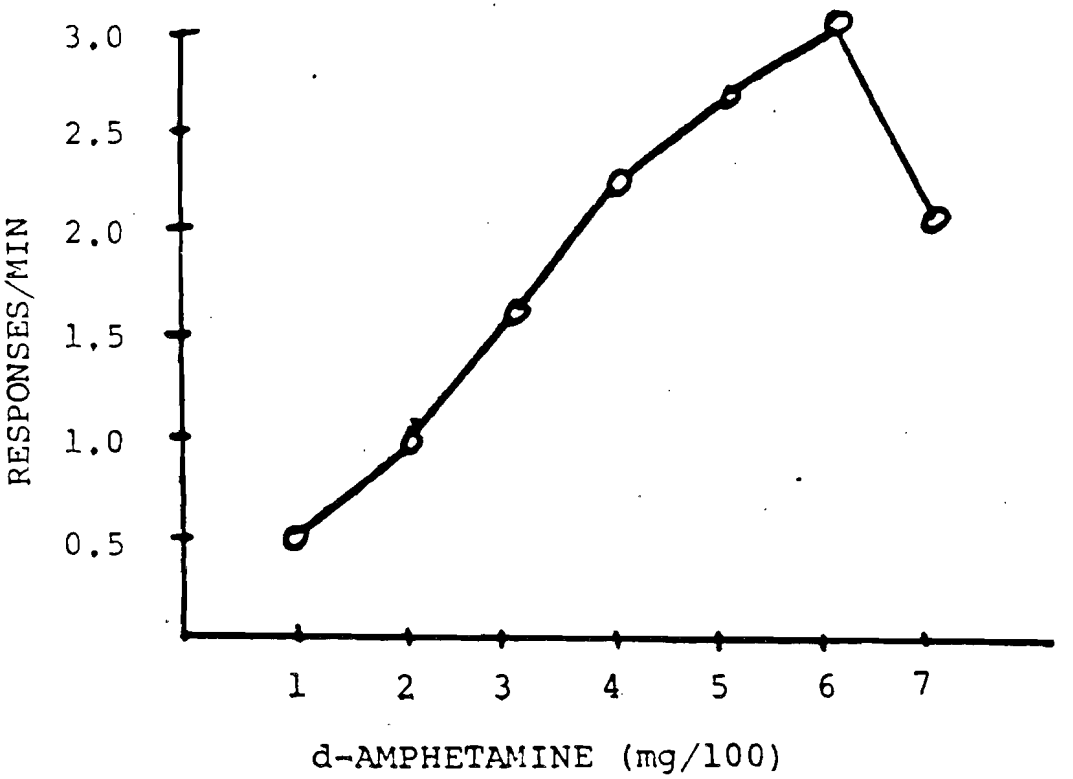

Figure 4. Lever-pressing rate for one group of four rats as a function of d-amphetamine dose-level. Each point represents the mean of the last three sessions at each dose.

2. Graphing two or more independent variables. As with bar graphs, use the x-axis to represent one variable. Differentiate additional variables by the use of different symbols or line types, or both. Do not differentiate additional variables with different colors because most scientific journals print only with black ink. Figure 5 is an example of a line graph with two independent variables. The independent variables are amphetamine dosage, indicated on the x-axis, and subject type, indicated by different line types and symbols. Note the two categories of the second independent variable--albino rats and hooded rats.

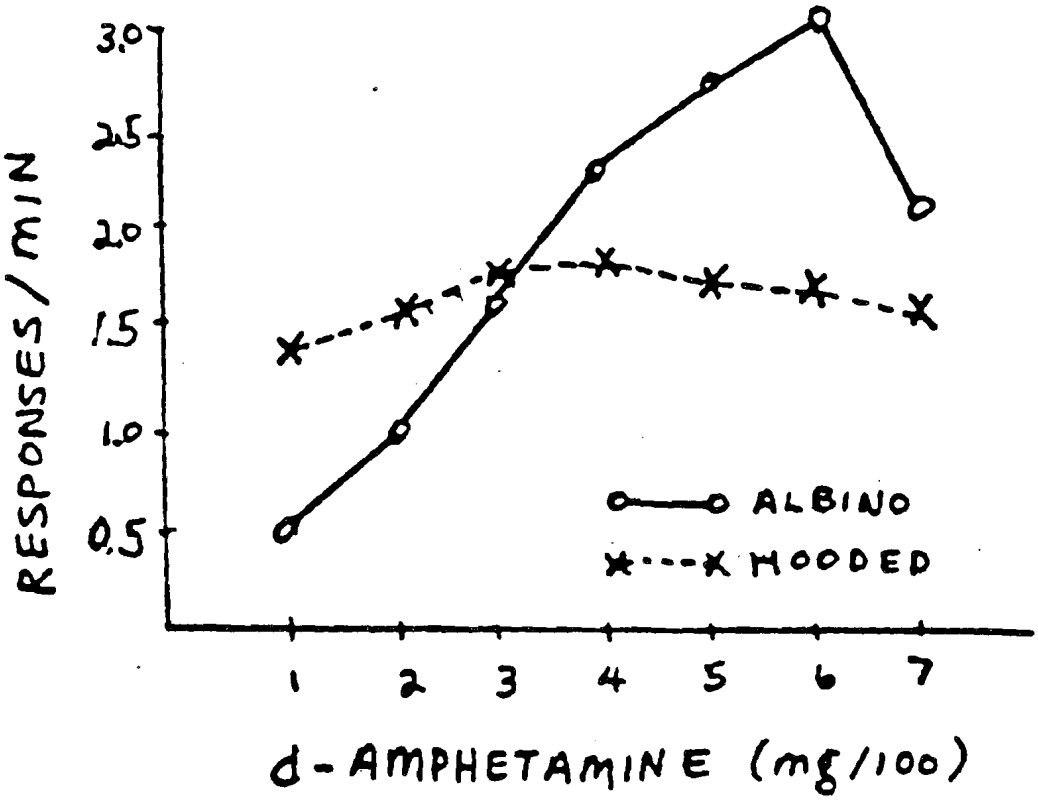

Figure 5. Lever-pressing rate for two groups of four rats at increasing dose-levels of d-amphetamine. Each point is the mean of the last three sessions at each dose.

With both bar and line graphs, indication of the variability of the dependent measure is sometimes useful. One common indicator is the crude range, which is simply the scale distance between the largest and the smallest value of the dependent measure. Interquartile range or standard deviation may also be used. In a graph, these measures of variability are represented by a vertical line that passes through the data point representing the average (mean or median) value. In the case of the crude range, the vertical line would extend from the lowest observed value to the highest. In the case of the interquartile range, the line would extend from the value at the 25th percentile to the value at the 75th percentile. Finally, in the case of the standard deviation, the line would extend from one standard deviation above the mean to one standard deviation below the mean.

==========

PART II:

EDITORIAL STYLE

==========

This section considers the general style of research reports. Many of the requirements mentioned below are also considered in the APA Publication Manual, and you may wish to refer to it if you cannot find the answer to a problem here. You also may find answers by consulting published papers on the topic of your research. If you take the latter approach, be careful to consult papers that have been published after about 1995, when the latest version of APA style came into common use.

A. Citing References in the Text

In the text, references are made to the published literature by giving the author's last name and date of the work's publication. Exact page numbers also are given when material is quoted.

A variety of citations are common, including citations of references with more than one author, references to authors who have published more than one paper during the same year, and citation of several papers at the same point in the text. All are described below:

1. Show references in the text by citing in parentheses the author's surname and the year of publication as entered in the list of references at the end of the article. Example: "... a recent study (Jones, 1958) has shown ..."

2. If the name of the author occurs in the sentence proper, the reference citation in the parentheses includes only the year of publication (the author's last name is not repeated). Example: "Jones (1958) has shown ..."

3. If a reference has two authors, the citation includes the last names of both authors each time the citation appears in the text. Example: "A recent study (Jones & Smith, 1958) has shown ..." or "Jones and Smith (1958) have shown ..." Note that the names within parentheses are separated by an ampersand ("&") as an abbreviation of "and."

4. If the reference has more than two authors, the citation includes the last names of all the authors the first time the citation appears in the text; later citations of the same reference include only the last name of the first author and the abbreviation "et al." (Latin for "and others"). Example: "A recent study (Jones, Smith, Brown, & White, 1958) has shown ..." "The study previously cited (Jones, et al., 1958) has suggested ..."

5. If the reference list includes publications by two or more authors with the same last name, citations in the text include their initials, examples: A recent study (C. L. Jones, 1958) has shown ..." "... but A. G. Jones (1956) has suggested ..."

6. If the reference list includes more than one publication in the same year by a given author or given multiple authors, citations are distinguished by adding lower case letters (a, b, etc.) to the year of publication in both the text and the reference list at the end of the paper. Example: "Recent studies (Jones, 1988a, 1988b) have shown ..."

7. Several references cited at the same point in the text are separated by semicolons and enclosed in one pair of parentheses. The order is alphabetical by the first author's last name. Example: "Recent studies (Brown, 1958; Jones, 1988; Smith, 1976) have shown ..." If the references are two works by the same author (or set of authors), give the authors' last names once and then give the years of publication in chronological order, separated by commas. Examples: "Recent studies (Jones, 1979, 1983, 1988) have shown ..." "Jones (1979, 1983, 1988) found ..." "Research in several laboratories (Ardemore, 1988a, 1988b; Blake & Smith, 1979, 1986; Jones, 1985; Smith & Blake, 1988) has achieved consensus concerning ..."

8. To refer to a particular page or pages of a reference, give the page number(s) following the reference citation. Examples: (Jones, 1958, p. 410), (Jones, 1958, pp. 410-412), (Brown, 1958, p. 410; Smith, 1956, pp. 410-422). This must be done after a direct quotation; it rarely is done otherwise.

B. Headings

Research reports usually contain three orders of headings and rarely more than four.

1. First-order headings are used for the title of the paper and for headings of the method, results, discussion, reference, and figure caption sections. They are centered and typed with only the initial letters of main words capitalized. First-order headings are not underlined, and they are not followed by a period.

2. Second-order headings are typed flush to the left margin in capital and small letters with the main words capitalized. These headings also are not followed by a period but they are underlined. The text follows second-order headings on the next double-spaced line and receives paragraph indentation.

3. Third-order headings are termed "paragraph" or "run-in sideheads." They are typed with a paragraph indentation, are underlined, and have only the initial letter of the first word capitalized. They end with a period and the text follows on the same line without extra spacing.

Headings of articles are not numbered or lettered. However, if further subordination is needed (beyond the third order heading), this is done through seriation, that is, use of letters or arabic numerals directly in the text.

C. Symbols and Abbreviations

1. The common abbreviations S, E, and O for "subject," "experimenter," and "observer" are not now used in APA journals. If a generic term, such as "patients," "children," or "rats," better describes the experimental group, use that term rather than "subjects."

2. The following Latin abbreviations are usually used in parenthetical material:

cf.	compare to	i.e.,	that is, namely
et al.	and others	viz.,	namely
etc.	and so forth	vs.	versus, against
e.g.,	for example		

3. Some standard abbreviations for units of measurement are:

centimeter	cm	hour	hr
meter	m	minute	min
millimeter	mm	week	wk

Note that periods do not follow these abbreviations.

4. Letters used as symbols for statistical concepts are underlined. Examples: *t*, *N*, *F*.

5. Technical terms, if they occur frequently in a particular paper, may be spelled out when first used and followed by their abbreviations in parentheses. Thereafter, only the abbreviation need be used. The abbreviations consist of all capital letters without spaces or periods. Example: "The study compared reaction time (RT) after training on fixed-ratio (FR) and variable-ratio (VR) schedules. The RT was measured by ..."

6. Abbreviations for many widely understood psychological terms are typewritten in all capital letters without spaces or periods between them. Examples: IQ (intelligence quotient), FR (fixed ratio), MA (mental age), EEG (electroencephalogram).

D. General Matters of Expression and Grammar

Instructors must take for granted that you have mastered the basic skills imparted in college English courses, including written expression and composition, spelling, grammar, and punctuation. Review of such material may be helpful to you in preparing to write research reports. The following problem areas are common enough among students to warrant mention here.

Tense

Scientific reports are written mainly in the past tense. The literature cited has already been written, the procedure of the study has been carried out, and the results have been obtained. Therefore, the reference to previous research, the description of the procedure, and the statement of the results should be stated in the past tense. Here are some examples:

Literature: "Smith's (1986) study found (not "finds") ..."

Procedure: "The judges were (not are) told ..."

Results: "The mean difference was (not is) 12.3 points ..."

Introduction: "The purpose of the present study was (not is) ..."

Certain statements should be written in the present tense. In a research report, the present tense is used for statements that have continuing or general applicability. In stating the results of an experimental, whether your own study or an earlier one, the past tense refers to particular results obtained in a given study, whereas the present tense refers to general or timeless results or conclusions that have been well established by a series of studies. Thus:

"The results of the present study confirmed (past tense, particular study) the results of other studies which showed (past tense, particular studies) that reaction time is (present tense, general finding) more rapid to auditory than to visual stimuli."

The present tense also is used when reference is made to tables and figures in the report insofar as one is referring to the table or the figure itself, rather than to the behavior or the procedures upon which the table was based. Thus:

"Table 1 presents (not presented, since the presentation is occurring at the moment) the mean number of responses made (past tense) by subjects who received (past tense) either 0, 4, or 12 shocks ..."

An analysis of the data was conducted (past tense), the results of which are shown (present tense) in Table 1 ..."

Finally, certain discursive statements are placed in the present tense when they refer to descriptions or comparisons that presumably are being made by the author (or the reader) at the time of the writing or reading of the report. Thus:

"The fact that the findings of the present study differed (past tense) from those of prior studies merits (present tense, not merited) some discussion."

Accurate Use of Pronouns

Every pronoun must have a specific non-ambiguous referent. Violation of this rule creates considerable confusion. Try to make sense out of this following unfortunate example:

> "In a study with rats, Ehrenfreud (1962) found a direct relationship between running speed and deprivation while Cross and Boyer (1964) found a similar relationship between running speed and amount of reinforcement. This indicates that they are sensitive to variations in drive when it is manipulated by changing their amount of reward or their amount of deprivation."

A particular problem is the word "this," which should be used as a pronoun infrequently, if at all. Beginning a paragraph with "This showed..." or "This study showed..." is especially bad. The topic sentence of a paragraph should be comprehensible in itself even at the cost of repeating a name or concept. Thus: "Smith's study showed..."

Topic Sentences and Paragraph Organization

The division of your report into paragraphs should be logical. Each paragraph should have a clear topic sentence which begins the paragraph. The topic sentence defines the rest of the paragraph; all subsequent material is subordinate to the topic sentence.

Numbers

Numbers less than 10 are ordinarily spelled out. Write "The experiment involved three (not 3) groups..." However, note some specific exceptions:

Numbers less than 10 are given as numerals when they (a) come in a series such as 3, 8, 11, and 17; (b) express scores, means, percentages, and so on; (c) precede an abbreviation indicating quantity (e.g., "3 ft"); (d) indicate a page in a bibliographic reference; (e) are comparable to two-digit numbers used in the same paragraph (e.g, "In each group were 9 males and 11 females...").

Never begin a sentence with a numeral even if other numbers follow. For example you must write: "Forty-three men and 38 women replied"

Word Usage

Refer to the dictionary to ensure that you are spelling and using words correctly. Scientific reports never include slang or contractions.

Verbs must agree with their subjects in terms of number. Inexperienced writers often have trouble with plural words of Latin origin that end in "a," especially data and criteria. Data and criteria are plural nouns and take the plural verb. The singular forms are datum and criterion. Note also that the noun stimulus is singular; the plural form is stimuli. Thus, "One stimulus (not stimuli) was used..."

Another confusion is with respect to the words effect and affect. The word effect when used as a noun means a result or consequence. Thus: "The effect (not affect) of the independent variable was to..." or "The independent variable had the following effects (not affects)..." The word affect when used as a verb means to influence or to act upon (in other words, to bring about an effect. Thus: "The independent variable affected (not effected) the subjects in several ways..."

Person

Scientific communications usually are written in the third person. Use of the first person ("I" or "we") is best avoided. Writing in the third person introduces objectivity into the report. You may try pretending that someone else performed the research and that you are reporting what he or she did or found.

Bad: "I classified the subjects' responses by dividing them..." (Do not write in the first person.)

Bad: "We classified the subjects' responses by dividing them..." ("We" should not be used as a substitute for "I," particularly when only one individual was involved.)

Better: "The investigator classified the subjects' responses by dividing the..." (This statement, which is in the third person, tells who classified the responses, but without self-consciousness.)

Commas

Technical writing should be "tight;" use commas freely. In an enumeration of three or more items, use a comma before an and: "...the height, width, and depth..."

Whether a clause should be set off by commas is often confusing. A defining clause, which limits the meaning of the word it modifies, does not use commas. (Example: "...the switch that stopped the recording device..." A non-defining clause, not limiting the meaning, is set off by commas. (Examples: "...the switch, which was mounted on a panel, stopped the...")

Hyphens

Fractional expressions use the hyphen: one-half, four and five-sevenths.

A compound modifier is hyphenated to avoid ambiguity: stimulus-presentation equipment; exceeded the control-group mean; bar-press training; a 1-hr rest session.

The same word groups, however, are not hyphenated when they do not constitute a modifier: stimulus presentation was...; used a control group; each bar press was followed by...; the test session lasted for 1 hr.

When two or more compound words have a common base, the base may be indicated in all but the last by a hyphen. Note the space following the first hyphen in these illustration: the pre- and post-tests; a fourth- or fifth-grade class.

Some compound words are always hyphenated (when in doubt, check a standard dictionary): self-conscious; right-handed; intra-uterine.

Parentheses

One set of parentheses is never enclosed within another. Brackets are used in place of parentheses within parentheses. Example: "(For a further discussion, see Smith, Smith & Jones, [1970].)"

Quotations

Direct quotations are rarely used, and should be limited to cases where the purpose is to relate the author's exact expression of an idea rather than the idea itself. In the latter case, you should paraphrase (with appropriate citation of the original author). When appropriate, short quotations of one or two sentences should be incorporated in the text and set off by quotation marks. Longer quotations should be presented as a separate paragraph, indented at least five spaces on both the left

and right margins, without quotation marks. In either case, the source, including the specific page or pages, should be cited at the end of the quotation.

==========

PART III:

TYPING INSTRUCTIONS

==========

A. General Requirements

Reports must be typewritten and double-spaced throughout. Use good quality white paper (8.5 x 11 inches) and type in dark ink on only one side of that page. "Erasable bond" paper is acceptable. Computer printers also may be used if the typeface is clear and white 8.5 x 11 inch paper is used (do not use paper with green bars).

Leave a margin of about 1 1/2 inch at the top, bottom, and sides of each page. Indent the first line of all paragraphs five spaces. Number every page in the upper right-hand corner, including the cover page and pages containing tables, figure captions, and figures).

A neat, accurately typed paper with few or no corrections makes a better impression than does a carelessly produced one with many corrections. When a correction is unavoidable, it should be as legible as the typing.

B. Specific Directions

Before reading the material below, you may finding helpful to review the material on headings in Part II of the Guide.

1. Title. The title should be centered near the top of the first page. Centered below the title is the author's name and, below that, the name of the institution where the research was conducted. Do not underline this material.

2. Abstract. At the top of the second page, center the word "Abstract" (no underline). Below it, type your one-paragraph abstract.

3. Introduction. Repeat the title at the top of the third page (centered). The introduction immediately follows. Do not provide a heading for the introduction.

4. Method, Results, and Discussion. The method section immediately follows the introduction; do not skip to a new page. This section begins with the centered heading "Method" (no underline). Each subsection ("Subjects," etc.) is headed by a second-order heading (with underline). The results

section immediately follows the method section, and the discussion section immediately follows the results; do not skip to a new page. The results and discussion sections also have centered headings (no underline).

5. References. Begin the reference list on a new page, with the centered heading "References" (no underline). Be sure to indent the first line of each reference. The subsequent lines should be returned to the left margin.

6. Please check with your instructor if you have specific questions regarding APA style.