

**Guidelines for Writing Lab Reports in Experimental Psychology:  
Applications**

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## Guidelines for Writing Lab Reports in Experimental Psychology

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The following information is intended as a guide in writing your assignments. The information in this handout provides a detailed structure for writing each part of an APA manuscript. I have also included common errors that students make when writing their reports. The many examples of “mistakes” were extracted from reports written by other students in this class in previous years. These mistakes represent the vast majority of errors that I have found over the many years of correcting student lab reports. It is expected that you will read this entire handout very carefully each time you write a report and make corrections before you submit an assignment. Do not make mistakes that others have made. The one comment that you don't want to see on your lab reports is "see my Blue Book". Spell check and proof-read your papers carefully before submitting them. Write several drafts before handing your papers in. Spelling errors will be considered APA errors and will cost you one point for each error. You will lose one point in your paper for each APA error. Many students consistently lose an entire grade just because they do not follow proper APA format. When I give back your assignments after grading I put a check mark next to each APA error. It is your responsibility to find the error in the manual and make sure that you do not repeat the same error.

All misspellings, spacing errors, contractions, or use of a wrong word (e.g., effect for affect, data for datum, will) indicate poor proofreading and will cost you one APA point.

Any student who want more detailed feedback concerning my comments on your reports (e.g., what did I mean by "purpose missing", "no sense", "no transition to your study", "missing statement of hypotheses" or "wrong statistics") is invited to come to my office to discuss these matters further.

**Note:** Any instructions given in class that contradict information in this handout make the handout information null and void. I suggest that you point out any contradictions to me in class. **DO NOT USE THIS PAPER AS A GUIDELINE FOR APA ERRORS. YOUR MANUAL IS THE DEFINITIVE SOURCE. DO NOT USE ARTICLES FROM THE LIBRARY AS A GUIDE TO APA. Many journals are not 100% APA.**

**Note:** All assignments are graded “blind”. Put your name on the back of the **last page** of the paper. Do not put it on the Xeroxed articles that you submit for some assignments. Do not put your name on other parts of the paper where I might find it by accident. This is worth one point on your grade.

Paper clip all assignments, **do not staple. Do staple** the copies of the journal articles that you submit with your paper.

### Issues of Plagiarism

Plagiarism will result in a zero grade on your assignment.

What is plagiarism? It is simple. If I read a sentence in your paper, and this sentence resembles IN ANY WAY a sentence in your book or research article, then it is plagiarism.

For example you might read a sentence in an article that says “Underlying most research on learned control of physiological responses with machine-amplified feedback, whether visceral or striate musculature, is some implicit or explicit theoretical model of the processes involved in such learning.” If you change some words around and/or omit some words and say “Most studies on learning of bodily reactions with feedback, whether voluntary or involuntary, is a model of the exactness of this learning (Segreto, 1992)”, THIS IS PLAGIARISM. The sentences are not exactly alike but you did not write this sentence with your own initiative or creativity. You used someone else's creation. One reason that you are in this class is to learn how to write yourself. Copying others' writing circumvents this purpose and is basically dishonest.

In Summary,

- (a) Changing or omitting selected words in someone else's sentence IS PLAGIARISM.
- (b) IT IS PLAGIARISM even if you reference where you found the information (e.g., Smith & Jones, 1992).
- (c) Even when you give someone's definition it is plagiarism if you use their words. For example, you might write Smith (1992) defines anxiety as an increase in heart rate. THIS IS PLAGIARISM. If you are using their words, then you must use quotations.

**How to Avoid Plagiarism.** You must write in your own words. When you read someone's article or book, take sketchy notes of concepts and procedures. Never write complete or even half sentences. NEVER TAKE MORE THAN 3 WORDS FROM A SENTENCE WHEN TAKING NOTES. Summarize the meaning of the sentence in your words without using more than three of their words. When you write your paper, write from your notes. Never write your paper with the book or article open in front of you. If you need to clarify your notes, then refer to the article or book, but never write with the reference material in front of you. There is too much temptation to copy or paraphrase. If your notes are not sketchy, then you are likely to plagiarize. Your paper should not follow someone else's article sentence by sentence, even if you use different words.

Keep in mind that your professor finds it easy to notice if a student's paper is not written in the student's own words.

**The only time you can use someone's words is when you use quotation marks, give the reference, and give the page number.** Remember, I do not allow students to quote in papers except on rare occasions (e.g., when you are talking about some famous dead person and the quote is critical). This is my own personnel policy.

**Check out this website: <http://www.indiana.edu/~wts/wts/plagiarism.html>**

How to Recognize Unacceptable and Acceptable Paraphrases

Here's the ORIGINAL text, from page 1 of Lizzie Borden: A Case Book of Family and Crime in the 1890s by Joyce Williams et al.:

The rise of industry, the growth of cities, and the expansion of the population were the three great developments of late nineteenth century American history. As new, larger, steam-powered factories became a feature of the American landscape in the East, they transformed farm hands into industrial laborers, and provided jobs for a rising tide of immigrants. With industry came urbanization the growth of large cities (like Fall River, Massachusetts, where the Bordens lived) which became the centers of production as well as of commerce and trade.

Here's an UNACCEPTABLE paraphrase that is plagiarism:

The increase of industry, the growth of cities, and the explosion of the population were three large factors of nineteenth century America. As steam-driven companies became more visible in the eastern part of the country, they changed farm hands into factory workers and provided jobs for the large wave of immigrants. With industry came the growth of large cities like Fall River where the Bordens lived which turned into centers of commerce and trade as well as production.

What makes this passage plagiarism?

The preceding passage is considered plagiarism for two reasons:

The writer has only changed around a few words and phrases, or changed the order of the original's sentences. It is clear that the 2nd paragraph is a purposeful copy of the 1st paragraph.

## **Sample of notes taken after reading a research paper**

In order to illustrate how to avoid plagiarism, I read an article that might be included in a lab report. I am showing you how to take notes and then use those notes to write your paper. Observe and learn.

**Sample notes taken from a research paper in preparation to write an Abstract or Introduction. Note that only sketchy notes were written down. If you write your papers from sketchy notes, it is impossible to plagiarize.**

Case study, 52 yr old musician - flute player - tightness in throat, lips, cheek. Profession suffers, also an alcoholic and drug addict.

Given therapy - psychoanalytic based and drug treatment. Not work. Later given client-centered / behavioral therapy and EMG biofeedback suggested.

method. 7 lights vertical. Each light set at either 2.5, 5, 10, 20 , 30  $\mu\text{V}$ . So if gain set at 20  $\mu\text{V}$ , then when all lights on tension is 140, but with 2 lights on it is 40 - 59  $\mu\text{V}$ .

4 phases. Phase 1 (3- 40 min sessions). EMG frontalis muscle and other facial areas around eyes and cheek. gain set to 10 $\mu\text{V}$ . Instructions : turn off as many lights as you can by relaxing.

Phase 2 (3 sessions). EMG moved to throat area.

Phase 3 (4 sessions) : Same as Phase 2 but played flute while on EMG

Phase 4 (10 sessions). Same as Phase 3 but not in an acoustic chamber.

Follow up each month for 6 months.

Results. Phase 1 reduced tension from 70  $\mu\text{V}$  to 10 and 20. Reported less tension in face but more tension in throat. In phase 2 EMG of throat done and reduced EMG from 100 $\mu\text{V}$  to 25 and 40. In Phase 3 played flute and after playing reduced tension from 210 to 5 and 10  $\mu\text{V}$  within seconds. Reported more confidence and relaxed. Successful follow up.

Conclusion. Biofeedback works and can be used while a person is performing some motor task, not just sitting in an arm chair. Biofeedback should also be considered at the start of therapy.

## **Abstract written from the above notes**

### Abstract

Biofeedback is often used to treat individuals with muscle-related disorders. A case study was reported of a 52-year old flute player who was treated with electromyograph (EMG) biofeedback. The musician, who suffered from muscle tightness in the throat, lips, and cheek, also received client centered and behavioral therapy for alcoholism and drug addiction. Phase 1 consisted of 3, 40 min, daily sessions. EMG electrodes were connected to the frontalis muscle and muscles around the eyes and cheek. The participant was seated facing 7 vertical lights and turned off as many lights as possible by relaxing his muscles. In Phase 2 (3 sessions) EMG electrodes were moved to the throat muscles. In Phase 3 (4 sessions) the participant played the flute in an acoustic chamber and was immediately given EMG training of the throat muscles. Phase 4 (10 sessions) was identical to Phase 3 but occurred outside the acoustic chamber. A 6-month follow-up ended the study. In Phase 1 EMG was reduced from 70  $\mu\text{V}$  at the start of training to 10 and 20  $\mu\text{V}$ . In Phase 2 thoracic EMG was reduced from 100 to 25 and 40  $\mu\text{V}$ . After playing the flute in Phases 3 and 4, the participant immediately reduced muscle tension from 210 to 5  $\mu\text{V}$ . The follow up showed continued relaxation and reports of a successful music career. This study suggests that EMG biofeedback training is a successful treatment in cases where excessive muscle tension interferes with the performance of a motor task (e.g., flute playing, tennis, golf, etc).

## How to Write an Abstract

Make your abstract from 3/4 of a page to 1 page long. An Abstract is a brief summary of your paper, giving purpose, methods, results, and conclusions. The first 1 to 2 sentences should give the purpose of the study. Remember to talk in the past tense since you are writing an abstract to a study that was already completed. The next several sentences summarize your methods. Describe what you did. Include only important points since you do not have space for many details. It is important to describe your independent variables and their levels (not necessarily using the words IV and levels), and the behaviors that you measured (dependent variables). If appropriate, state the experimental design that was used (e.g., multiple-baseline across subjects, 2 x 3 one within, one between factor design). The next section is a description of the results. If your results are complicated, then you only have space for the most important points. Remember, do not include statistics (do not give F or t values or degrees of freedom). It is very common, and encouraged, to present the means of your groups as long as you don't have too many to present. The last section of your Abstract is a statement of the main conclusion(s) of your paper. A conclusion is not a statement of the results. Rather, it is a statement of the significance of the experiment, i.e., what does it contribute to the body of knowledge. This conclusion is done in 1 to 3 sentences. Also note that you do not typically give any references in your Abstract. The only time you might is when your paper is specifically designed to test some theory or model that was presented in the literature, and it is essential that you give that reference. Usually, you never see references in Abstracts. If you wrote the paper that you are abstracting, then it is permissible to copy sentences right from your paper and put it in the Abstract. Of course you can not do this if you are abstracting a paper that someone else wrote.

## Deciding on a title for your paper

**Your title must include an indication of the IV's and DV's.** Examples could include (a) The Effects of Monetary Reward and Music on Exercise, (b) The Effects of Frequency of Encouragement on Performance During Maximal Exercise Testing, (c) EMG Biofeedback: The Effects of CRF, FR, VR, FI, and VI Schedules of Reinforcement on the Acquisition and Extinction of Increases in Forearm muscle Tension, (d) Behavioral Momentum of Typing Behavior in College Students, and (e) Differential Effects of a High-Carbohydrate Diet on the Activity of Male and Female Rats.

**Note:** If your entire title fits on one line, then use one line. If you must go to line 2, then balance the number of words on both lines so that the first line is a little longer than the second (e.g., do not have nine words on Line 1 and one word on Line 2). Never go to two lines if you can fit the title on one line. Never go to three lines if you can fit the title on two.

Checklist for the Abstract:

1. Does the title clearly identify the IV(s) and DV(s)?
2. Have you stated the most important purpose(s) of article in first 1 or 2 sentences?
3. Is experimental design identified?
4. Are IV, levels of IV, and DV(s) clearly identified?
5. Is assignment of subjects to groups described?
6. Are data presented that clearly specify the effects of IV? Do you have means presented?
7. Have you described the outcome of graphs in your article?
8. Have you stated the most important conclusion of your paper?

9. Did you proof read your paper 3 or 4 times, cleaning up every sentence for proper grammar and meaning.
10. Did you go through your APA manual and check on numbers, abbreviations, etc.

Below is an example of a cover page and an abstract page. (It should be double spaced with a page break). Note how my example conforms to my guidelines above.

Reinforcement and Exercise 1

Running head: REINFORCEMENT SCHEDULES AND OBESITY

The Effects of Variable-Ratio Schedules of Reinforcement on Exercising on a Stationary  
Bicycle in Obese and Nonobese boys  
Steven L. Cohen  
Bloomsburg University of Pennsylvania

Reinforcement and Exercise 2

#### Abstract

The purpose of this study was to determine if variable-ratio (VR) schedules of reinforcement could increase exercising behavior of 6 male 11-year old boys (3 obese and 3 nonobese) on a stationary bicycle. A changing criterion design was used. A baseline was established for 8 sessions where the boys rode for as long as they wanted, up to 30 min. In Phases 2, 3, and 4 (8 sessions each) pedaling was reinforced according to a VR schedule. Under the VR schedule an average number of revolutions on the bike earned points that were later traded in for toys. The value of the first VR was 15% of the mean pedaling rate during baseline, and the VR increased again by 15% in each of the VR phases. Phase 5 was a return to baseline (no reinforcement) and the VR was reinstated in Phase 6. For all participants pedaling rates were low during Baseline 1 (59 and 72 responses per min for obese and nonobese boys, respectively). During the three VR phases response rates increased to about 85, 101, and 117 for obese, and 99, 114, and 130 for nonobese boys, respectively. Rates decreased during the second baseline (84 and 95 responses per min for obese and nonobese boys, respectively) and increase again during the last VR condition (about 124 and 139 for obese and nonobese boys, respectively). The boys rode for the entire 30 min during VR, but not during baseline conditions. The data suggest that VR schedules of reinforcement can be effective in increasing exercise, and they might provide a means of combating obesity in young children.

Another example of an Abstract

#### Abstract

The effects of playing music and delivering response-contingent money to participants riding a stationary exercise cycle were examined. Twenty-five college students rode a stationary exercise cycle to exhaustion or 45 min. Each participant cycled under each of 4 conditions. In the music condition the participant's favorite music was played. In the money condition, the participant earned \$0.15 every 40

pedal rotations. Under the music plus money condition, participants earned money while background music played. In the control condition neither music nor money were presented. The order of conditions was completely counterbalanced. The number of minutes riding the cycle and the rate of riding were significantly higher under the money ( $M = 40$  min and 85 revolutions per min, respectively) and the money plus music ( $M = 40$  and 88, respectively) conditions compared to the control ( $M = 33$  and 76, respectively) and the music ( $M = 35$  and 78, respectively) conditions. There was no significant difference between the control and music conditions or between the money and money plus music conditions. Playing someone's favorite music during an exercise session does not improve performance, but response-contingent money can significantly increase a participant's workout effort.

## How to write an Introduction

There are 5 parts to address in your Introduction.

1. **Introduce the topic.** Open your paragraph by defining your topic and giving a detailed example. For example, if your topic is on ADHD, describe a typical hyperactive child in a classroom. A historical perspective is often employed. Find the first study (if possible) that was done on your topic and present it. A book, a chapter in an edited book, or a review article on your topic may serve as a reference and provide a nice introduction and historical perspective (e.g., what is depression, how is it treated, describe a depressed person, how is depression measured, etc.). This part should be about **3/4 to 1.5 pages**. If you use information from a book in this first paragraph, then by necessity you will be using secondary source information. This is OK for this assignment. Make sure that you only reference the book (or chapter in the edited book) that you are using. Do not reference the secondary source. When you use a book, give the page number where you got your information (e.g., Smith, 1999, p. 23).
2. **Paragraph 2:** Present an empirical study (a laboratory experiment with data) in your second paragraph. (If your article is a survey report, correlation study, or a case study, you cover these same issues I address below.) Include four points in order: (a) Purpose of study, (b) Methods of study (identify the independent variables and their levels as well as the dependent variables), (c) Results of study, and (d) Conclusion or main points of study.

Don't forget the overall purpose of referencing an article in your introduction. The purpose is to **help the reader understand more about the experiment** that you did and are reporting. You are providing background information on what has been discovered before you did your study and what lead you to do your study. Do not go through the motions of reporting your article without keeping in mind this purpose (i.e., do **not** present a study because you have to, and any study will do). When you present a study (i.e., the article you got from the library), devote the beginning of the paragraph to explaining why the study was done. What was it intended to prove? Give the paper's purpose. This might take 5 lines or it might take 20 lines. It is **not** done in just one sentence or two sentences. For example, I had my students do an experiment on biofeedback where subjects were given feedback for relaxing and at the same time they performed mental arithmetic and a "cold pressor" test by putting their hand in ice water. When introducing a research article on this topic, you must describe cold-pressor tests and mental arithmetic and show how they are related to biofeedback and EMG. **The purpose cannot be done in 1 or 2 sentences.** You just don't say Smith (1995) examined the effects of a cold pressor test and mental math on EMG.

You must also summarize the methods of your library article. State the experimental design that was used. Present the basic IV's and their levels. Describe the groups and what was done to them. You must omit little details. Give only enough to show the "big picture". It is up to you to select important facts and leave out facts that do not give the overall picture. Can the reader **visualize** what the subject had to do?

When you summarize the results of the article that you are referencing do not include statistics such as t tests or F tests. It is not uncommon, however, to present the means of different groups. Never say "...groups were significantly different", but instead say "... the placebo group had significantly faster reaction times than the 10 mg amphetamine group". Saying that one group was different from another does not say what group had higher scores. It is usually wise to present some real data when you discuss the results. For example, the mean reaction time of 45 year olds was 234 ms compared to 222 for the 20 year olds. It is also common to describe trends in the graphs that are presented in your article. Look at the graphs and describe them to the reader (e.g., the percentage of correctly memorized words decreased as the delay between the presentation of the word and recall increased). Graphs usually summarize the most important result in any article. The key to your results is in the graph!

The last piece of information that you want to present is the conclusion. What I mean by a conclusion of the article that you are referencing is the big important point of the study. A conclusion is not a restatement of the results, such as "No differences were found between the control and incentive groups." You probably already said this in your results section. The key question is WHY is it important that differences (or no differences) were found between the control and experimental groups. How does this new information add to our knowledge of the topic being studied?

When you are referencing an article write in **past tense** since you are talking about a study that was already done.

**If I keep circling the word "is" (or some other present tense word) throughout your paper it means that you should have said "was" (or some other past tense word).**

If you are reading a very complex article, perhaps with several experiments, it is not necessary to discuss the entire study. Simply extract the important issues, results, and conclusion that relate to the study that you are doing. If you are doing an experiment on reaction time, you might find an article that looked at the effects of amphetamine on reaction time. Don't focus on the effects of amphetamine. Instead focus on the placebo control group that did not get amphetamine, since your subjects did not get amphetamine. You have to mention that there were amphetamine groups in the study but then add that your paper does not report those data since they were not relevant. If you have an article with several experiments, you might only want to discuss the most important experiment.

**3. Paragraph 3:** In your next paragraph present another empirical study as in step #2.

If you want to use another research article (i.e., more than the minimum), then add another paragraph.

**4. Paragraph 4, The Problem.** In the next paragraph establish a problem that needs solving. In short, you have to explain why you did your experiment. For example, in comparing your studies above (steps 1 and 2) you might find conflicting results. The Smith (1999) study showed that amphetamine improves hyperactive behavior but the Cohen (1989) study showed that amphetamine has no effect. In this paragraph you need to discuss or point out these conflicting results. Explain why you think the results of your two or three studies are in conflict. You also might discover that one of your studies is somehow flawed or limited. Perhaps the Smith (1999) study did not have a good control group. You might also discover that one of your studies did not look at the IV in sufficient detail. You might point out that the sleep deprivation study you cited only deprived people of sleep for 24 hr and that a wider range of deprivation times should be used such as 48 and 96 hr. Avoid being trivial!! Don't give as a reason for your study that the sample size was too small or the session length was only 20 min. Be creative. Be Logical.

**4a. Transition to your study:** In this same paragraph explain how your study attempted to solve this "problem". What did you do that others did not do? Explain what your study attempted to do to answer the problem that you defined. Describe your IV's and explain how these IV's were chosen to solve the problem.

**4b. Hypotheses.** In this same paragraph state your hypothesis or hypotheses. What outcome did you expect in your study if, for example, you used 48 hr of sleep deprivation compared to only 0, 12, and 24 hr? Your

hypotheses must be based on some knowledge that you derived from your previously-cited articles, or it must be based on some kind of logical reasoning. Do not simply state your hypothesis because you "think" it is correct or because it is "interesting".

5. Paragraph 5: Final summary. The final paragraph of your Introduction should be a brief (usually 5-6 lines) summary of your methods. This simply briefs your reader what to expect in the Method section.

Requirements. You need a minimum of 3 references from the library in your lab report. Find 2 research articles. You will also need a reference that will give you an overview of your topic and identify important variables that have been examined. A book or a review article will serve as a 3rd reference. If you can't find a book then you will need other research articles. Make your Introduction 3 to 5 pages in length. Do not make it 2 3/4 of a page. At the least, get over to page 4 in your introduction. Include a title page. Include a References page. Submit your three references with your paper. Use the PDF files for your research articles. Copy only the pages from your book that you used. Be sure to also Xerox the page in front of the book giving the title, author, book company. Staple them individually and put your name on the back of each. When referencing the book, include the page number where you found your information. Hand everything in with one **large clip**.

**Only articles from professional journals are acceptable. This means that you cannot have any references from magazines such as Time or Discover. Only books written for professionals are acceptable. You cannot have an encyclopedia or a general psychology text. If you want to use Internet articles, they must be the entire PDF file from a professional journal, not just an article that someone wrote and put on the Net.**

Remember, the depth of detail that you use when you discuss your articles will be affected by the overall length of your paper. When we do an experiment in class your paper will get a better grade if you find articles that are directly relevant to the topic being studied. Thus, try to find articles that use the same independent and dependent variables that we used.

**Before you start writing your Introduction you should read the comments that I gave to my prior students after grading their first complete "Human Lab".**

Also Consider these points when writing an Introduction

When you submit your paper you will need a cover page. You must create a title for your experiment. Remember to include in your title the Independent and Dependent variables of your study (e.g., The effects of hours of sleep deprivation on dream recall in college students).

Type your reports in 12 Font size. Geneva or Helvetica are common fonts.

Set the margins on your word processor to 1 inch all around. Print off a practice page. If you discover that your margin is too big (e.g., 1.25 inches), then adjust your margin to .75 inches. Regardless of what your wordprocessor says, the end product should have 1 in. margins.

Make sure that your key words and page number are inside the 1-inch margin. Use the "header/footer" command.

Never say "The first study conducted by Smith (1999) showed...." Or "In the second study conducted by....."

When you reference an article, APA says that you must use an "&" when the authors are in parentheses (Cohen & Smith, 1999). However, when you have other information within a parentheses, you should use an "and" and not an "&". For example, rats were given several doses of amphetamine (0, 2, and 4 mg).

One of the most important things to consider in an Intro is that the articles that you read must prepare the reader to understand your experiment that will follow. For instance, if your experiment is on short term

memory just don't throw any article in your introduction with the word short term memory in it because your instructor said you had to have 3 articles on short term memory. Find relevant articles. You may have to go through 20 articles before you find 3 that you can use. Read these 3 articles many time and know them thoroughly. Extract important facts from the article relating to the purpose of the study, pertinent methods, relevant results, and a conclusion. Don't waste space talking about noncritical information. For example, don't spend 3 lines talking about the subjects when a half of a line will do. Don't spend 5 lines talking about the apparatus when 1 line will do. Focus on the critical independent variables. Focus on results that are most relevant to what you did in your experiment. Don't get a study on the effects of drugs on memory and spend time talking about the drugs and the physiological effects of the drugs and the histology's when the study that you are doing in class is just on memory and has nothing to do with drugs.

If you have a paragraph in your paper that is discussing some library article, then you should include the reference in the first sentence of the paragraph, not somewhere at the end paragraph (e.g., Cohen (1993) showed that...).

**I hate the words "In a study by...". They are four wasted words. Do Not Write "In a study by Cohen (1993) he showed.." Just write "Cohen (1993) showed..." or "Cohen (1994) investigated..." Also avoid writing "In the Smith and Jones (1998) study, it was shown..". Instead you write "Smith and Jones (1998) showed....."**

The word significant, significantly, or significance should be followed by a descriptive word such as larger or smaller. Do not leave the word significant by itself.

You do not say "...there was no statistical significance between the two groups". Instead you might say that "there was no "significant differences between the groups" or you might say "significantly larger" or "significantly smaller".

Avoid the use of "a lot of". Use words like "considerable" or "a great deal of".

The use of non. "Non" does not stand alone but it is attached to a word. It is nonchosen, not non chosen.

Never make references to statistics in the articles that you cite. Don't say "The analysis of variance showed that ....." Never give an F or t values.

Go "would" hunting. Not always, but most of the time stay away from the word "would". Too many students describe a procedure and say that "The computer program would turn off". The correct way is "The computer program turned off". Or someone might write "The reinforcer would be given after a delay" rather than "The reinforcer was given after a delay". The avoidance of "would" also applies to writing your own Methods section. I'll circle your inappropriate "woulds".

Speak in the active voice rather than the passive voice. Fewer words are better than more words. Rather than saying "This study was done to investigate the effects....you should say "This study investigated the effects...." Simplicity, fewer words is the way to go.

Rather than saying " Participants had to count backward" you should say "Participants counted backward".

When you are talking about one reference (e.g., Cohen, 1999), use only one paragraph to do it. Do not break it up into paragraphs.

Make sure you know the difference between effect and affect. The word "the" or "an" typically precedes the word effect. If should be able to substitute the word "results" for "effect" without changing the meaning. The result was a decrease in rate.

When referencing a book in the Introduction or the Discussion, give the page number along with the year (e.g., Smith, 1992, p. 89). Do not have a range of page number (e.g., Smith, 1992, p. 79-89).

Never use contractions (e.g., didn't or shouldn't). Don't use it's. This will cost you 3 APA errors.

Do not use the word "it" as a noun when you start a sentence. Using the word "it" makes it unclear what "it" refers to. For example, instead of saying "It increased from the 0 to 20 mg conditions", you should say "Response rate increased from the.....". You run into this problem very often when you write a results section.

Go "will" hunting. **Do not use future tense:** Not "this study will show" but "this study showed". I never want to see the word "will" in any of your papers. "Will" will cost you 1 point off.

In the key words next to the page number do not use The Effect but use 2 words from the title with information.

In the last paragraph of your Introduction when talking about your own study say, "The present study ..." to clearly indicate that you are now talking about your study and not someone else's.

Typically, you only use the reference (e.g., Cohen, 1994) once in a paragraph. Don't continue referencing throughout the same paragraph.

Don't say "The test results were recorded." It is obvious that they were.

Don't say "Twenty subjects were randomly assigned to two groups in this study". You don't need ...in this study.

Don't say "I hope to prove...". Say "The present study attempted to show..."

Don't say "They used three doses: 1, 2, and 4 mg." Say "They used 1, 2, and 4 mg." The first sentence is too wordy.

**Never** say "In 1989 Smith did a study and showed...". Say "Smith (1989) showed..."

Avoid "I think" or "I found". Simply say what you think or found.

Avoid "Each group contained 25 participants who were randomly assigned to three groups. These groups were...." Say "Each group contained 25 participants who were randomly assigned to a control group, a visual feedback group, and an auditory feedback group." The second preferred way is much more informative and in fewer words.

When you summarize your library articles in your Introduction or Discussion do not refer to Study 1 and Study 2 or Experiment 1 and Experiment 2 or the first experiment and the second article. This approach is very confusing. Instead use author names when discussing studies, such as Smith (1995) and Cohen (1989) showed....

Avoid the phrase "In a study by..." For example, Never say "In a study by Cohen (1994), rats were....". Instead, you might say "Cohen (1994) studied responding in rats that were given....."

Avoid "After reviewing the previous studies, there are a couple of questions to look at." This is a waste of words and says nothing. Just get on to the issues or questions.

Avoid "An interesting study by Smith (1994) showed..." and just say "Smith (1994) showed..." This is another waste of words.

**However!!!** Don't make two sentences into one sentence with the word "however". Look at the following sentence. Sighted participants did not receive acoustic training, however they were administered tests to determine their spatial updating and localization abilities. These are two separate sentences. A period should replace the comma after training. The word "however" should be capitalized and begin a new sentence.

Avoid "The data showed that there was a large...." and say "There was a large...."

**Do not include the Results of your experiment in your Introduction.** Let your reader read the results to find out what happened.

Do not say Smith (1998) did a study on the effects of..... Instead say, Smith (1998) studied the effects of .....

Don't say Another study was done to see.... Instead say Smith (1998) studied....

Make sure you put a space between numbers and quantity designation. 2 s, not 2s; 444 mg, not 444mg.

Say responses per minute, not responses/min.

When discussing someone's experiment in your Introduction, do not tell what statistical analyses they did on their data (e.g., no t tests, or F tests). Just discuss the effects of the IV.

Make sure that you have a noun and a verb in every sentence!!!

## **Primary and Secondary Sources**

When you do research for your paper, only use primary sources. Primary sources are articles or books that you read. If you read someone else's summary of a paper (e.g., you read Smith's 1995 summary of Cohen's 1992 experiment) then the summary of the (Cohen's) experiment is a secondary source. Only Smith is a primary source. The only time that you are permitted to use secondary sources (for the most part) is when you are writing about the history of psychology, and you want to talk about someone's theory or philosophy (e.g., Hull's theory, Freud's model, or Plato's philosophy). If you really want to be impressive, then read the original. When you do use a secondary source there is a way to reference it. For example, you read about Freud's defense mechanisms in Smith's (1967) book, "A primer of Freudian Psychology". In your paper, when you talk about Freud's model, you reference it in the following way: .....(as cited in Smith, 1967). Or you might say that Watson showed that Little Albert's behavior supported the behavioristic theory (as cited in Jones & Cohen, 1993). You did not read the original Watson study on Little Albert, so **don't** reference Watson as if you did (e.g., Watson, 1932)

When you write your introduction, and you are working on Paragraph 1 (introduce the topic) the information that you summarize will most likely be secondary sources. After all, when a book talks about the basic facts of some topic (e.g., depression) it gets its information from specific sources that the book cites. When you summarize this information, I want you to cite the book that provided that information. You do not cite the original articles where the book's authors found the information. I am allowing you to use secondary sources in this opening paragraph if you reference it as I have indicated.

Note that other professors might have different policies about using secondary sources, so check with them before writing a paper. My policy is very clear: Do not use secondary sources. And while I'm at it, do not use any Dissertations or Dissertation Abstracts as references.

## **Writing the Method**

Submit a title page and the Method section. The length will vary but will most likely be around 3 pages. Write everything in the past tense.

**You have to give enough information so that your study can be replicated by someone at another university some time in the future. You can't give every detail. You must decide what is relevant and what is not relevant (i.e., would not have any impact on the outcome of the study). This requires your judgment.**

### **Participants**

Include age and gender (the number of males and females) of the participants. For example, "There were 7 male and 14 female 18 to 22 year old Introductory Psychology students who participated".

Include incentives for participation in your study. For example, were the volunteers answering an add from the newspaper, a request from a professor, or a requirement of the course? Were they given extra credit in class, or were they paid \$5 an hour?

Do not say that participants were from the Experimental Psychology: Applications class, just say experimental psychology class. The Applications class will make no sense to someone from another university.

Do not put any procedure in the Participant section (e.g., Do not say that participants were randomly assigned to the self-adjusting and other-adjusting groups.).

Do not say "The participants for this experiment were college students."  
Instead say "The participants were college students." In this experiment or in this study is obvious and should not be included.

In a study with humans, mention that consent forms were signed and that the Institutional Review Board approved the protocol. With animals, say the Institutional Animal Care and Use Committee approved the protocol. Don't abbreviate IRB or IACUC.

Don't forget the existence of apostrophes. The participant's chair... or The participants' instructions included...

### **Apparatus**

Give a manufacture name and model number and city (if available) of anything purchased. For example, "Temperature was measured by a biofeedback system from J & J Engineering (Model I-300, Pousboro, WA) attached to a Gateway 2000 386 computer (Pontiac, MI). The reinforcers were 45 mg Noyes food pellets (Noyes Precision Food Pellet Company, Edgewater, NJ). If you construct a device then you need to describe it in detail. Notice that the model number and company location are both in parentheses after stating the name of the device.

Describe the room where the experiment was done (e.g., lighting, size, etc.).

Include descriptions of any questionnaire, scale, psychological test, or survey that you used.

### **Procedure**

Make sure all details are included so that the study can be replicated later.

**State your experimental design (you should review your Exp Methods notes. Everything in this handout has already been discussed in detail in your Methods class).**

Start off by identifying your experimental design. Then briefly describe the IV's and the levels of the IV's. For example you might begin your procedure by saying: A 4 x 2, two between factor design was used. The independent variables were alcohol dose (0, 1, 3, and 6 mg/ml) and type of feedback (audio and visual). Another example might start: A 3 x 2, one between, one within factor design was used. The between factor was methods of education (lecture, self-paced, and seminar) and the within factor was method of examination (essay tests and multiple choice tests). In a single-subject design you might say "A single subject experimental design was used. The independent variables were reinforcement delay (0, 0.5, 1, and 4 s) and the type of brief stimulus (paired and nonpaired). Under the initial baseline condition a 0-s delay was used along with a nonpaired brief stimulus."

When writing a Procedure section, try to write it in the order that events happened. For example, Subjects are assigned to groups before they enter the room to be tested, so you wouldn't say "Participants entered the room and were greeted by the experimenter. Participants were randomly assigned to the three treatment groups." Try to keep a temporal order in your procedure as best you can. Don't say "There were three colored lights presented to each subject. Participants sat before the computer screen with their index finger on the space bar." This sequence is backward.

Don't say the dose was 0 mg, 4 mg, and 8 mg. Say the dose was 0, 4, and 8 mg.

Do not say "hooked up": Participants were hooked up to a recorder. Instead say "attached": Participants were attached to a recorder.

Do not say "Participants were randomly assigned by a toss of a coin." Omit how you randomized. Do not mention a table of random digits or a coin toss.

When you give instructions to participants in your experiment, summarize all of them in the same place, either by quoting word for word or summarizing in detail.

In a 3 x 2 design, you have six groups. Do not name each of the 6 groups in order. Don't say you had six groups and participants were randomly assigned to each one. Group 1 got the auditory stimulus and 0 mg dose, Group 2 got the auditory stimulus and 10 mg dose, Group 3 got... Instead say "There were 60 participants that were randomly assigned to each dose level (0, 2, and 4 mg/kg) with 20 in each group. Each of these groups were randomly divided into two equal groups of visual feedback ( $n = 10$ ) and auditory feedback ( $n = 10$ )." My method is simpler, shorter, and clearer.

Do not say the "The experiment was conducted in a classroom in the McCormick Human Services Building." It really doesn't matter in what building the experiment took place.

If counterbalancing is used, state the type of counterbalancing (i.e., ABBA, complete, incomplete). Then describe how counterbalancing was achieved (i.e., Complete counterbalancing was used. Every person was exposed to all four doses of amphetamine in a different order. With four levels of the independent variable, 24 different sequences were used. etc). Avoid reference to counterbalancing using only letters ( AB/BA design or a ABC, ACB, etc design). Describe the act of counterbalancing. How did you do it? For example, "The order of the vision test was counterbalanced by randomly assigning half of the participants in each group to be tested with monocular vision first and then with binocular vision, while the other half were tested in the reverse order." This last sentence actually avoids using the term AB/BA. By the way, AB/BA is actually a form of complete counterbalancing with two levels of one IV.

Decide on the IV(s). Are there 1, 2, 3, or 4 IV's? Identify each one by name.

Decide on the levels of **each** IV. Are there 2, 3, 4, or more levels of each IV? Identify each level by name.

Decide on an overall experimental design.

### **Separate -Group Designs**

#### **One IV: One-way between factor or one-way within factor design**

Address each of these issues: How many groups are there? How many subjects do you need overall for the entire experiment? How will subjects be assigned to groups? How many subjects are in each group? If a within factor is used, is it the same subject tested on all levels of the IV or do you use separate subjects in each level that have been matched on some pretest or subject-relevant variable? If you match different subjects, how did you do it? If the same subjects are used under all treatment levels describe your counterbalancing methods (e.g., complete, incomplete).

#### **Two IV:**

Two between factors: Is your design a 2 x 2, 2 x 3, 3 x 3, 4 x 2, etc?

Two within factors: Is your design a 2 x 2, 2 x 3, 3 x 3, 4 x 2, etc?

One between, one within factor: Is your design a 2 x 2, 2 x 3, 3 x 3, 4 x 2, etc?

If you use a pretest/posttest method, then "Test" is one of your IV's and is of course a within-factor. Your other manipulated IV can be either a within or between factor.

All of the questions asked under the One IV section above are relevant in these designs, only now you have to discuss these issues with each IV separately (e.g., how are subjects assigned to groups? counterbalancing?). Another important issue is whether or not one of your two IV's is a selected IV (e.g., gender, age) and the other manipulated (e.g., drug dose) or if both IV's are manipulated (e.g., drug dose and color of stimulus). You should never use two selected IV's. If you did, then you don't have an experimental design.

#### **Three IV:**

Three between factors. Is your design a 2 x 2 x 2, 2 x 3 x 4, 3 x 3 x 3, 4 x 2 x 2, etc?

Two between, one within factors: Is your design a 2 x 2 x 2, 2 x 3 x 4, 3 x 3 x 3, 4 x 2 x 2, etc?

One between, two within factors. Is your design a 2 x 2 x 2, 2 x 3 x 4, 3 x 3 x 3, 4 x 2 x 2, etc?

Three within factors. Is your design a 2 x 2 x 2, 2 x 3 x 4, 3 x 3 x 3, 4 x 2 x 2, etc?

Address all of the questions raised with under one and two factor designs.

### **Single-subjects Designs**

ABAB type of design using 3 or 4 subjects (Discuss issues of baseline, number of sessions, stability criterion, replications)

Alternating treatment designs

Changing-criterion design

Multiple-baseline across subjects, situations, or behaviors

If the SSD is one of the four above, then give the name of the design. If the SSD does not fit any of these designs, then just say that a SSD was used.

## Writing a Results section

(Note: There are different ways to accomplish this task. This is the one I recommend for beginners.)

**IMPORTANT: Review your Experimental Methods notebook and review what you were taught about main effects and interactions!!**

In Paragraph 1 start by specifying how you measured your dependent variable(s). For example, say “Each participant kept their hand in ice water until they had to remove it. The number of seconds their hand was in the ice water was measured for each participant.” Another example might be “Each person was given a list of 10 nonsense syllables to memorize. Each word list was presented until the person memorized the list to 100% accuracy. The number of trials to reach this learning criterion was measured for each person.” Another example might be “The number of times the rat pressed the lever was recorded every 5 min across the 60 min session. The number of presses was divided by 5 min to determine responses per minute for each of these 5-min periods.”

Within this same first paragraph specify your experimental design, your independent variable(s) and the levels of each IV. For example you may say that “This experiment used a 3 x 3 two between factor design. The two factors were dose of amphetamine (0, 10, and 20 mg/kg) and type of reinforcer (food, water, and brain stimulation).” Or you might say “A 3 x 2 mixed, one within, one between factor design was used. The between factor was difficulty of word list (easy, moderate, and hard) and the within factor was number of trials (1 to 6).” Or you might say “A randomized two group design was used. The independent variable was shock intensity (2 and 4 mA).”

In Paragraph 2 of your Results introduce your figure. Start out by saying “Figure 1 shows the effects of amphetamine dose and type of reinforcer on monkey’s response rate.”. Or “The number of trials to learn the list of nonsense syllables is presented in Figure 1.” Or “Figure 1 shows rats’ response rate in six 5 min segments of the 30 min experimental session.” You are not describing the data in the figure. You are only introducing the figure to the reader.

Follow this (in the same paragraph) introduction by telling what each point represents in the figure. For example, say something like “The points in the figure are means of each group and the vertical lines are standard deviations. (Note: Instead of giving standard deviation, it is a common practice to use standard errors of the mean, simply called standard errors, which is the standard deviation divided by the square root of n). Open circles represent males rats and closed circles represent female rats.” Or “The data are response rates for individual subjects in each 5 min segment.” Or “The data are means and ranges for the last five sessions of each condition.”

The next item (also in paragraph 2) is a description of the data in the graph. Do not say to your reader “Look at the figure” and that is that. Take the reader by the hand while you thoroughly describe the trends in the figure. There is a system of doing this that I recommend. First, select the independent variable on the horizontal axis and describe its effect on the behavior that is controlled by the first level of the second IV. Repeat this with the second level of the second IV, and again with the third level of the second IV, etc. **Move systematically in the direction of left to right.** Next, describe the effects of the second IV (the one in the body of the figure). First, describe the second IV’s effects on the behavior controlled by the first level of the first IV (the one on the horizontal axis), then by the second level of the first IV, and by the last level of the first IV. For example, look at the figure below.

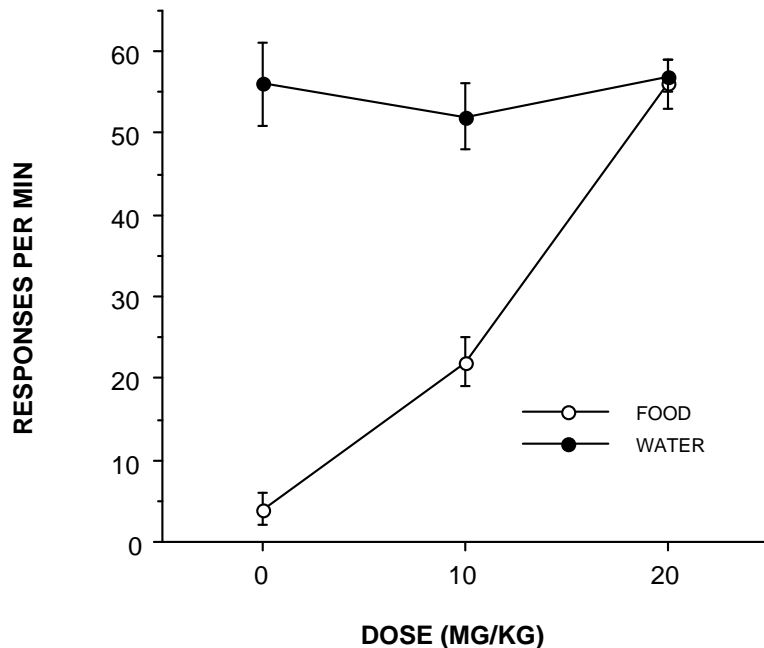


Figure 1 shows the effect of three doses of amphetamine and type of reinforcement (water and food) on monkeys' response rates. The data are mean response rates of each group. Response rate was calculated by dividing total responses by session time. Open circles represent response rates under food reinforcement and filled circles represent response rates under water reinforcement. Vertical lines are standard deviations of each group. When food reinforced responding, response rates were low ( $M = 4$  responses/min) after 0 mg/kg, increased after 10 mg/kg ( $M = 22$ ), and increased further after 20 mg/kg ( $M = 56$ ). When water reinforced responding changing the drug dose had relatively little effect on responding: Response rates were high after 0 mg/kg ( $M = 56$ ) and remained fairly constant after 10 mg/kg ( $M = 52$ ) and 20 mg/kg ( $M = 57$ ). Under 0 mg/kg dose responding for water ( $M = 56$  responses/min) was much higher than responding for food ( $M = 4$ ). Under 10 mg/kg response rates with water reinforcement ( $M = 52$ ) were still considerably higher than rates with food reinforcement ( $M = 22$ ). However, at 20 mg/kg, there was little difference between response rates with food ( $M = 56$ ) and water ( $M = 57$ ) reinforcement. Standard deviations within each group were relatively small, with a tendency for more variability with water reinforcement. Overlap in the standard deviations between the food and water conditions were not observed except under the 20 mg/kg condition. The standard deviations in the three water groups overlapped each other. However, there was no overlap in the standard deviations among the three groups that received food as a reinforcer.

Remember to include the quantity values next to the number, such as 57 responses per min, not just 57, or 344 ms, or 29 words. Also if the number is in parentheses use / , but if it is in a sentence use the word per. For example, data were measures as response per minute and response rates were high (56 response/min).

**Note:** Many times you present the means and measures of variability (e.g., standard deviations, error bars) in a graph and a table. When you describe the graphs or tables, you first focus on the means and ignore the variability measures. Then when you are done with the means, you say something about the variability measures, but don't say a lot. Point out groups that have large variability or low variability, point out the overlap or absence of overlap. Don't forget to say what conditions you are referring to when comparing

overlap (e.g., overlap between response rates under the food and water conditions at 0 mg/kg). You do not have to systematically go through the variability of every group.

## Presenting your statistical analysis

### Example of 2 x 3 mixed design

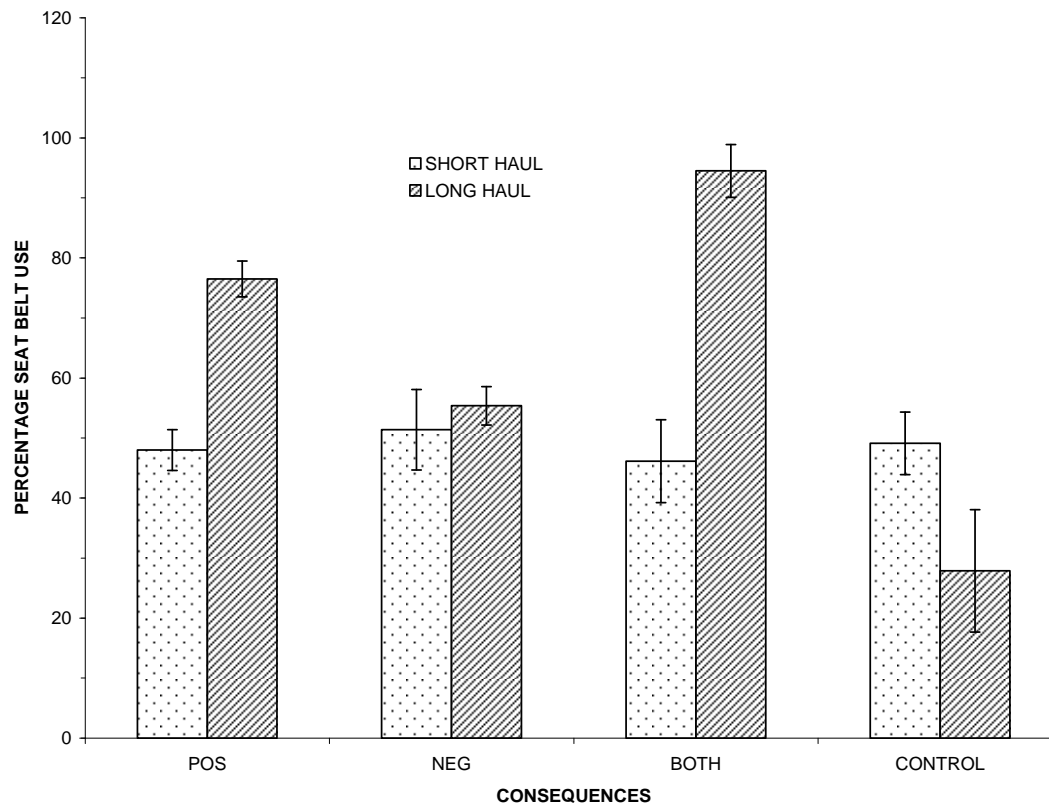
The above paragraph is an example of how you would describe the data in a figure. In the same paragraph complete your description by specifying the statistical analysis that you did. For example, on the graph on the previous page you might say "The data were analyzed with a 2 x 3, one within one between factor analysis of variance. The between factor was type of reinforcement (food and water) and the within factor was drug dose (0, 10, and 20 mg/kg). There was no significant effect of drug dose,  $F(2, 24) = 3.44$ ,  $p = .267$ . The overall mean response rate at 0, 10, and 20 mg/kg was 30, 37, and 56.5 responses per minute, respectively. Effect size (Partial Eta Squared) for drug dose was very low (0.11). **(Note that these 3 means are called Marginal Means, and they are provided in the ANOVA. Marginal means are the overall means in each Main Effect. No Bonferroni post-hoc comparisons were done because the F was not significant).** Overall, responding for water ( $M = 54.67$  responses/min) was significantly higher than responding for food ( $M = 27.33$ ),  $F(1, 35) = 5.66$ ,  $p < .001$ . **(Note that these two means are also Main Effect Marginal Means giving overall rate under water and food.)** Effect size for type of reinforcement was relatively large (0.88). There was a significant interaction between type of reinforcement and drug dose,  $F(1, 35) = 4.55$ ,  $p = .025$ . The effect of drug dose depended upon the type of reinforcer. Response rates increased as a function of drug dose when food was the reinforcer, but drug dose had no effect on responding when water was the reinforcer." The effect size of the interaction was moderately strong (0.56). Notice that I described the interaction in sentence format. This is a simple interaction and easy to describe. Other interactions may require much more description.

Comparison of means using Bonferroni post-hoc tests. When you do the ANOVA you were instructed to select "compare means" using the Bonferroni adjustment. For each main effect this post-hoc statistic compares the marginal means to each other. For example, if you had a 3 x 4 ANOVA, you have 3 marginal means on the first IV and 4 marginal means on the second IV. The Bonferroni comparison will compare marginal means 1 - 2, 1 - 3, and 2 - 3 on the first IV, and it will compare marginal means 1-2, 1-3, 1-4, 2-3, 2-4, and 3-4 of the second IV and tell you whether the differences are significant. When you write the statistical section of your Results, include these Bonferroni comparisons when talking about your marginal means. See below.

### Example of 3 x 4, two between factor design

The data were analyzed by a 3 x 4, two between factor design. The first factor was drug dose (0, 10, and 20 mg/kg) and the second factor was type of reinforcer (food, water, light, and brain stimulation). There was a significant effect of drug dose,  $F(2, 24) = 3.44$ ,  $p = .021$ . Marginal means were compared using a post-hoc Bonferroni adjustment. The overall mean response rate at 0 mg ( $M = 55$  responses/min) was significantly higher ( $p < .001$ ) than the overall response rate under 10 mg ( $M = 34$ ,  $p = .023$ ) and 20 mg ( $M = 31$ ,  $p = .005$ ), but there was no significant difference between the overall mean response rate under 10 and 20 mg ( $p = .23$ ). Effect size (Partial Eta Squared) of drug dose was relatively large (0.89). There was a significant effect of type of reinforcement,  $F(3, 34) = 5.66$ ,  $p < .001$ . The overall mean response rate for food reinforcement ( $M = 24.6$  responses/min) was not significantly different ( $p = .112$ ) from rates under water reinforcement ( $M = 23.4$ ), but was significantly higher than rates under light ( $M = 4.5$ ,  $p < .001$ ) and brain stimulation reinforcement ( $M = 12.2$ ,  $p = .003$ ). The overall mean response rate for water reinforcement was also significantly higher than rates under light ( $p = .04$ ) and brain stimulation ( $p = .03$ ). The overall mean response rates for light was not significantly different ( $p = .334$ ) from rates with brain stimulation. Effect size for type of reinforcement was large (1.22). There was a significant interaction between drug dose and type of reinforcement,  $F(3, 45) = 23.33$ ,  $p < .001$ . The effects of drug dose depended upon the type of reinforcer. With food and water reinforcers drug dose had no effect: Response rates were constant across all drug doses. However, for light and brain stimulation response rates were low under 0 mg/kg and increased under 10 and again under 20 mg/kg. Effect size for the interaction was large (0.89).

**Remember:** Present both main effect F's first and then the interaction F. It doesn't matter which of the two main effects are presented first.



### Example of stating an interaction

Here is how I would describe the interaction in the above graph. "There was a significant interaction between the type of consequence provided for wearing seat belts and the type of driver,  $F(3, 56) = 106.97, p < .001$ . The effect of driver type depended on the type of consequence for wearing seat belts: The percentage of seat-belt use under positive reinforcement and a combination of reinforcement and punishment was higher for long-distance drivers than short-haul drivers. However, there was no difference in seat belt use between drivers under negative punishment. Moreover, under the control condition the percentage of seat belt use was *higher* with short-haul drivers compared to long-haul drivers. The effect size for the interaction was moderate (0.46)."

Note that the introduction of the figure, description of the figure, and statistics are all separate parts of the same paragraph. When you get to be an experience writer, you can integrate the stats with the description of the data in the figure. The way that I have you do it now is rather redundant but it is the best way to teach the concept.

If you have another figure to present, you repeat the whole process in the next paragraph.

If you have a table you repeat the same process again (Table 1 shows.....).

ANOVA is an abbreviation and should only be used if first spelled out and only if you use it 3 or more times in the paper.

A common problem is that students continue to say that the ANOVA showed a significant effect. This provides little information as to what the effect was. Instead, say something like the ANOVA showed that temperature significantly increased over the 15 min of the session. Or that there was a significant increase followed by a decrease during the length of the session.

Present all of the F's that you have done even if they are not significant.

When doing a graph, do not label the lines AND have labels in the legend. This would be redundant.

If you have a significant interaction, make sure that you explain in words where the interaction is present in the figure. For example, "The significant dose x age interaction was evident by response rates increasing from 0 to 10 mg per kg for aged rats but decreasing for young rats over the same dose range."

In the text, when you write the names of designs, use numbers not words. For example, the design is a 4 x 4 factorial, not a four by four factorial. Note the spaces between the 4 x 4. Note the small x, not the capital X.

When doing a graph you usually choose between a line graph or a bar graph. The general rule to be used is this: If you have a quantitative IV on the horizontal axis, use a line graph; with a qualitative IV use a bar graph. When you have two IV's only one goes on the horizontal axis. The question is which one? The general rule is that if you have a qualitative and a quantitative IV, the quantitative IV goes on the horizontal axis. (Most people prefer to see line graphs rather than bar graphs.) If you have two **quantitative** variables, the one with the most levels goes on the horizontal axis. If you have two **qualitative** variables, the one with the most levels goes on the horizontal axis.

Don't forget your figure caption page. With more than one figure all the captions are typed on the SAME page, and the page is labeled Figure Captions, not Figure Caption.

When reporting results, do not say "There was not a significant difference between...". Instead say "There was no significant difference between..."

When doing a table, usually you only take your numbers out to 2 decimal places. You treat tables in a fashion similar to figures. You first introduce your table and then describe the data within the table. For example, the hypothetical table below might be introduced by saying "Table 1 shows the reaction time of 6 college students who pressed a space bar on a computer when different colored lights were flashed on the screen. If you read this sentence and come to my office and show me this sentence, I will give you 6 bonus points on your grade. Don't tell any other student of this sentence. Only the first 3 students who come will get the points. The data are means and standard deviations of each condition. The data showed that reaction time was fastest when an orange light was presented ....."

Below are two examples of a table, one with one IV and one with two IV's. The table will be placed in its proper place in the table section of your paper. Fashion your tables after examples shown in the APA manual. Notice the table caption above the table.

Round numbers in your tables. When rounding numbers, just go **two** numbers beyond the counting unit.

Table 1

*Mean Reaction Time (milliseconds) for College Students  
by Color of Target*

<u>Target Color</u>	<u>M</u>	<u>SD</u>
Blue	240.50	30.38
Yellow	171.67	43.17
Red	368.83	43.07
White	143.83	43.59
Orange	138.00	32.56

*Note.*  $n = 6$

Notice in the above table that the number of subjects in each group was 6 and that was indicated in a note at the bottom of the table. If the number was different for each group (e.g., 6 in the yellow group, 12 in the Red group, etc.) then put another column in the table called N. See APA manual for details.

Table 1

*Mean and Standard Deviation Responses Per Minutes for Rats Responding Under Fixed Ratio (FR) 10 and FR 20 Schedules of Reinforcement After Receiving 0, 2, 4, and 8 mg of Amphetamine.*

---

		Dose (mg)			
		<u>0</u>	<u>2</u>	<u>4</u>	<u>8</u>
FR 10	<i>M</i>	20.43	45.00	96.57	15.74
	<i>SD</i>	4.58	8.23	8.22	5.09
FR 20	<i>M</i>	122.86	98.74	55.00	104.71
	<i>SD</i>	14.70	15.97	6.83	11.97

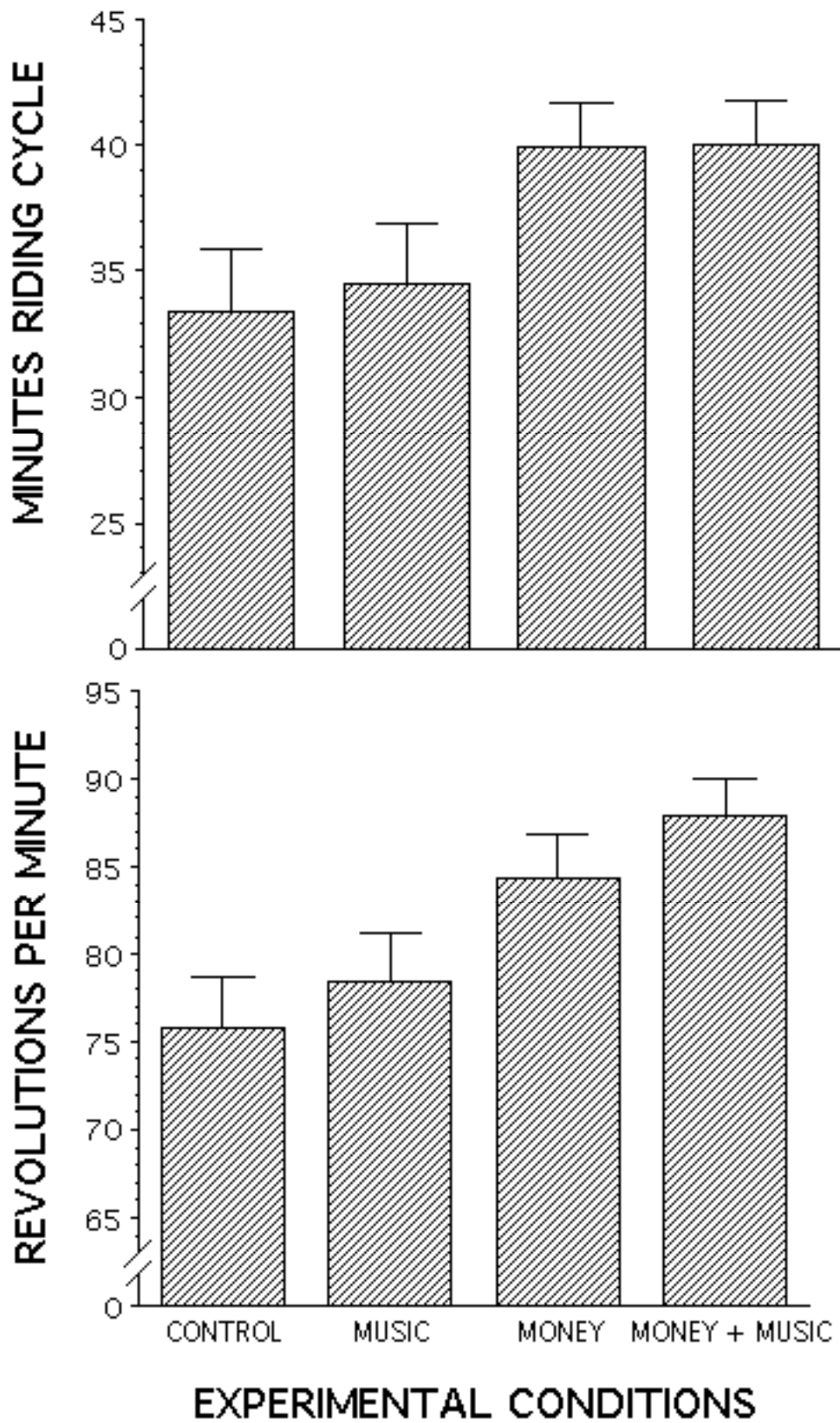
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*Note. n = 7*

**Note** that the above figure could have been done by placing the four doses along the left side, putting FR 10 and FR 20 on top, with M and SD next to each other under each FR schedule. Notice on the above table that (mg) is placed after dose, and you should not put mg four times, once after each number.

## Combining the statistical presentation with the graph: Advanced topic

For the sake of instruction, I have taught you to start your Result section with a description of the figure and then follow this by a separate section of the statistics. In reality you would integrate your statistical analysis with your graph. Below I am presenting part of a Result section from one of my publications. I will show you the graph first and then the analysis will follow. The figure summarizes an experiment where students rode an exercise cycle on four separate occasions. They either rode with no stimuli (control) or they listened to music, received money for every 40 pedal rotations, or received money while the music played. The design was a 2 x 2, two within factor design. When you describe your results you present your overall main effects. If you have a significant interaction, then you go on to describe your simple main effects. From there you describe your post-hoc comparisons.



## Results

The number of minutes each participant rode the cycle and the number of revolutions of the pedals were recorded. Riding rate (revolutions per minute) was calculated by dividing the number of pedal revolutions by session time. The time and rate data were analyzed separately by a 2 x 2 within-factor analysis of variance. The factors were monetary incentive (no money, money) and the presentation of an auditory stimulus (no music, music). *A priori* dependent *t* tests were conducted to compare performance under the control condition with the music condition, and performance under the money condition with the money plus music condition. The percentage of change in cycling time and cycling rate under the music, money, and money plus music conditions from the control condition was calculated for each participant. The percentage of change from control data were analyzed by one-sample *t* tests to determine if the change in performance was significantly different from 0% (i.e., no change from control).

Figure 1 (upper panel) shows the number of minutes participants rode the cycle under control (no music and no money), music, money, and money plus music conditions. Data are means of each group and standard errors of the mean. Monetary incentive significantly increased cycling time,  $F(1, 24) = 13.60, p = .0012$ . The effect size (partial Eta squared) for monetary incentive was 0.36, and power was .96. The overall mean cycling time under the two no-money conditions was 34.0 min compared to 40.0 min under the two money conditions. There was no significant effect of auditory stimulus,  $F(1, 24) = 0.16$ , and no monetary incentive x auditory stimulus interaction,  $F(1, 24) = 0.34$ , on cycling time. *A priori* comparison dependent *t* tests showed no significant difference in cycling time between control and music conditions or between money and money plus music conditions. The mean increase in cycling time from the control condition was 9.3%, 33.4%, and 35.8% for the music, money, and money plus music conditions, respectively. One-sample *t* tests showed that a change of 9.3% in the music condition from the control condition was not a significant increase from 0%,  $t(24) = 1.31$ . The percentage increases under the money and money plus music conditions were

significantly greater than 0%,  $t(24) = 3.07$ ,  $p = .0053$  and  $t(24) = 3.01$ ,  $p = .0061$ , respectively.

Figure 1 (bottom panel) shows the revolutions per minute under control, music, money, and money plus music conditions. Data are means of each group and standard errors of the mean. Monetary incentive significantly increased the rate of cycling,  $F(1, 24) = 46.41$ ,  $p < .0001$ . The effect size for monetary incentive was 0.66, and power was .99. The overall mean cycling rate under the two no-money conditions was 77.1 revolutions per min compared to 86.0 revolutions per min under the two money conditions. Playing music significantly increased the rate of cycling,  $F(1, 24) = 5.64$ ,  $p = .0259$ . The effect size for auditory stimulation was 0.19, and power was .62. The overall mean cycling rate under the two no-music conditions was 80.0 revolutions per min compared to 83.1 revolutions per min under the two music conditions. The monetary incentive x auditory stimulus interaction,  $F(1, 24) = 0.123$ , was not significant. *A priori* comparison dependent  $t$  tests showed no significant differences in cycling rate between control and music conditions or between money and money plus music conditions. The mean increase in the rate of cycling from the control condition was 4.5%, 12.8%, and 18.1% for the music, money, and money plus music conditions, respectively. A 4.5% change under the music condition from the control condition was significantly higher than 0%,  $t(24) = 2.07$ ,  $p = .0493$ . The percentage increases under the money and money plus music conditions were also significantly greater than 0%,  $t(24) = 4.139$ ,  $p = .0004$  and  $t(24) = 6.131$ ,  $p < .0001$ , respectively.

### **Practice problems in statistics using SPSS Computer Package : Getting ready to write your results.**

Assume that people were given different drugs and they were asked to memorize words for 20 minutes. Below is the number of words memorized. Also, assume that people in the Prozac group were given a Beck Depression Test. Below are their scores. Assume also that the mean depression score of all people is 68.

Placebo	Xanax	Ridelin	Prozac	Depression
12	23	33	56	34
14	18	43	57	36
23	26	34	34	77
16	29	23	35	54
12	12	28	46	37

18	6	36	48	45
19	17	37	55	48
13	25	29	58	41
13	28	44	59	24

Practice the following on SPSS. Do the statistics and express the results in APA format. Indicate if the results are significant or not significant.

1. Descriptive statistics on the depression scores.
2. Independent t on Placebo vs Xantax groups:  $t(16) = 1.693, p = .11$
3. Mann-Whitney U on the same data as Question 2:  $U(9, 9) = 23, p = .12$
4. Dependent t on Xantax vs Prozac:  $t(8) = 6.70, p = .0002$
5. Wilcoxon T on same data as Question 4.  $T(9) = 0, p = .0077$
6. One way between factor anova:  $F(3, 32) = 39.223, p < .0001$
- 6a. Do a Kruskal Wallis test on the same data:  $H(3) = 27.459, p < .0001$
7. One way within factor anova:  $F(3, 24) = 39.359, p < .0001$
8. Pearson r examining the relationship between memory scores under Prozac and Depression:  $r(9) = -.81$
9. From above analysis, if a person who takes Prozac has a score of 30 on their memory test predict their depression score .

$$\text{depression} = 106.72 - 1.26 * \text{Prozac}$$

$$\text{depression} = 106.72 - 1.26 (30)$$

10. Spearman rho on same data as question 8.  $r_s(9) = -.783$
11. Do a one-sample t to see if the Depression scores are significantly lower than the population depression scores.  $t(8) = 4.763, p = .0014$ .
12. Assume that you don't know what the population depression mean is. Using the data of depression scores above, do a 99% confidence interval to estimate the mean depression score in the population.  
27.093 - 60.907

13. . Take two strains of rats (Sprague-Dawley and Wistar) and have them press a lever for food. Divide them into two types of responders: low responders and high responders. The question is whether the level of responding (low vs. high) depends on the strain of rats (Sprague-Dawley vs. Wistar). Here are the number of rats who are low and high responders: High responder, Sprague-Dawley = 35; Low responder, Sprague-Dawley = 10; High responder, Wistar = 15; ; Low responder, Wistar = 18.

$$\chi^2 (1, N = 78) = 8.644, p = .0033$$

**More practice problems for statistics in Experimental Applications. These questions will prepare you for your stat quiz. For each problem name the statistic that you did, present results in APA format, and say whether the effect is significant or not significant.**

Consider the following 4 groups of data. Assume that we did an experiment where people were on an exercise bike. Each revolution of the bike is one response. Reinforcement (10 s of music played through a speaker) was delivered according to fixed-ratio (FR) schedules. The four levels were FR 0 (no reinforcement), FR 10, FR 40, and FR 80. The DV was responses (revolutions, rpm) per minute. Below are the data. We are going to use these data to run a variety of statistical analyses. I will give you certain assumptions for each test.

FR 0	FR 10	FR 40	FR 80
23	40	89	43
32	44	89	35
20	39	99	42
21	35	101	50
18	44	84	37
19	38	88	38
30	42	93	40

1. Calculate the Mean, Median, Mode of the FR 10 data.
2. Calculate the standard deviation and range of the FR 80 data.
3. Assume that the same people were used in the 0 group and the FR 10 group. Determine the relationship between the performance in both conditions.
4. After doing Question 3 do the following: If a person rides the bike at 22 revolutions per min under 0 level, predict what speed they will ride under the FR 10 level.
5. Assume that the average person rides the bike with a mean speed of 23 rpm. Assume that people in the FR 80 groups were given a drug that should affect riding speed. Do the statistical test to see if the drug affected performance.
6. Assume that we do not know what the speed of bike riders is in the population. Take the data from the 0 group and use it to estimate what the population speed is. Be correct with a probability of .99.
7. Assume that 14 people were randomly assigned to the FR 0 and FR 40 groups. Do the statistical test to see if the speeds of these two groups are significantly different.
8. If the data in Question 7 were rank ordered, do another test to answer the same question.
9. Assume that we used the same people under the FR 10 and FR 80 groups and tested them twice. Do the statistical test to see if the speeds of these two groups are significantly different.

10. If the data in Question 9 were rank ordered, do another test to answer the same question.
11. Assume that we randomly assigned 28 subjects to the 4 FR groups above. Do the statistical test to compare the scores in the four FR groups.
12. Now with these same data compare every group with every other group using the appropriate test (e.g., FR 0 vs. FR 10, FR 0 vs. FR 40, etc.).
13. Assume that we used the same 7 subjects in the 4 FR groups above and tested each person four times. Do the statistical test to compare the scores in the four FR groups.
14. Let us take a look at different kind of data. Put 40 people each of three ages on a bike (i.e., forty 14 year olds, forty 28 year olds, forty 56 year olds) and see how many continue riding for 1 hour. 34 fourteen year olds completed the 1 hr session, 35 twenty-eight year olds completed the session, and 14 fifty-six year olds completed the session. Do the statistical analysis to see if there was a significant difference among the age groups with respect to the number of people who rode the bike for 1 hr.
15. Let us see if the age that someone can complete a 1 hr biking session is contingent upon the person's profession. Take 40 people each of three age groups (30, 40, and 50 years old) from two different professions (college professors and bank presidents). Put all of these people on the bike and see who rides for 1 hr. Here are the data. 30 yr old profs = 33 who finish, 40 yr old profs = 35; 50 yr old profs = 34; 30 yr old bankers = 38 who finish, 40 yr old bankers = 25; 50 yr old bankers = 8. Do the statistics.

## WRITING A DISCUSSION

Write a 3-4 page Discussion. At a minimum, get to page 3.

Open up the discussion with a summary of your findings. Do not refer to statistics here. State all the effects of your IV's that you found, whether they were significant or not. For example, "When shock was presented to each person, response rates declined over the course of the experiment. When no shock was presented response rates were about 45 responses per min. When shock was 0.5 mA, response rate declined. When shock intensity increased to 2 ma, response rates stopped completely. After hypnosis, shock had no effect on behavior. Participants continued to respond across the 15 min session.....".

Another example: "No significant effects were observed. Four doses of amphetamine had no effects on memory. There were no significant differences in response rate between the FR 10 and FR 20 conditions, and there was no interactions between dose and fixed ratio size."

I want to read this paragraph and see the "big" picture, uncomplicated by all the numbers and statistics. Was there as overall increase in response rates across sessions? Was response rate under the VI schedule higher than response rates under the FI schedule? Just don't summarize the one main finding. Summarize all of the findings.

**The next paragraph should address your hypotheses.** You stated your hypotheses in your introduction. Here, you present them again and tell whether or not they were confirmed. You might have ideas as to why they were not confirmed. Give those ideas

**MAKE COMPARISONS!!!!** The rest of the Discussion is devoted to comparing your experiment with previous research. Take two of your studies in your intro and make explicit comparisons between **their** methods and results and **your** methods and results. Have one paragraph when comparing one study and a separate paragraph when comparing the other. **In your Discussion you should reintroduce the article that you are citing.** If you already outlined a research article in your Introduction, then don't repeat **all** of the same information in the Discussion. Just focus on the comparisons of methods and results. Do not just start your paragraph comparing procedures. First specify what the study was about and then start your comparisons.

Smith (1993) may have used all females in her study. Her study may have measured temperature from the right index finger for a 25 min baseline followed by a 35 min feedback session. Your study may have used both male and female subjects, measured temperature from the left ring finger, used a 3 min baseline followed by a 15 min feedback session. Smith may have found that temperature during baseline averaged 85 F and increased to 92 F during the feedback session. You found that the mean baseline was 81 F and temperature increased to 89 F during the baseline. Perhaps Smith had her subjects imagine being on a beach during biofeedback and you had your subjects stare at a word "HOT" taped to the wall. Perhaps the differences in imagery, finger placement, and session length could account for the differences in results between the Smith study and your study.

**Compare your results with others' results and use numbers in making comparisons.** In comparing the results of some research paper to your paper look at the effects of their IV, describe these effects, and then describe the effects of your IV. Compare actual data. For example " Smith showed that the mean reaction for the visual stimulus for males and for females was 344 ms and 433 ms, respectively. In the present study the mean reaction for the visual stimulus for males and for females was 241 ms and 422 ms, respectively." Try to think of reasons why the results aren't the same.

**Where to find data in someone's article:** If the data are presented in graphic format in some article, you can estimate the means or data values from the graphs and compare these values to your data. **Show me the numbers!!**

**Avoid trivial comparisons.** It is typically irrelevant that your study had 8 subjects and their study had 12, or that both your rats and their rats were kept at 80% body weight and put in a Coulbourn chamber with a lever.

When making comparisons of your study to the other study you might have six points of comparison in your Method and six points in your Results. Don't do a one to one comparison, such as Smith did this, the present study did this, Smith did this, the present study did this, Smith did this, the present study did this, etc. Also don't present all the Smith procedures and then all of yours. The best way is to present 2 or 3 procedural facts about Smith and then compare them to 2 or 3 procedural facts about your study. Then another 2 or 3 Smith details and 2 or 3 of your details.

When comparing 2 articles with your own experiment, compare one at a time. Don't mix the two up. Use separate paragraphs for each article.

At the end of your discussion, try to state the overall significance of your experiment. Give one or more concluding remarks such as "The data of this experiment suggest that delay of reinforcement has a strong effect on response rate: The longer the delay between the response and the reinforcer the lower the response rate. These data agree with several findings reported in the literature, and further suggest that even very short delays lower response rate."

**Some comments to students on their first complete Human Lab Report.  
This section should help improve your grade.**

**Some general comments on your papers**

**(Students did an experiment where they had subjects attached to electrodes on both forearms and EMG was measured. Phase 1 was a baseline. Phase 2 the subjects had to squeeze an exercise ball to increase their EMG above a baseline and both arms produced continuous feedback. In Phase 3 only one arm produced feedback and the other did not. Each arm switched every 60 s. Feedback was given to the arm according to a fixed ratio 5 schedule (one group) or a fixed interval 5-s schedule (a different group)).**

**Introduction:** Better Introductions are generated from better research articles. Some of your research papers, while acceptable in the sense that they involved EMG and biofeedback, were not the best selections. More searching would have uncovered studies that gave more data on EMG and more details of biofeedback procedures. Even when you didn't have the greatest articles many did not focus on the biofeedback procedures (what type of feedback was delivered, what schedule of feedback was used, how many sessions, length of baseline and treatment, exactly what muscles were controlled?) or on the biofeedback results (what were the EMG scores in each condition, did the scores change over time, what was the EMG during baseline and treatment?). Rather, too many focused on other issues like Type A and B personality or the ability to play music. If your research studies did not have sufficient methods or results, then you should have selected another paper.

Perhaps the biggest problem was the failure to connect your research studies to your present experiment. Almost everyone recognized that our study had two major IV's. One was the schedule of reinforcement (CRF, FR, FI) and the other was the discrimination between the arm that was reinforced in the last phase of the study (targeted) and the arm that was not reinforced (nontargeted). It makes sense to talk about these things in your Introduction. These were your two IV's, yet too many people did not say anything about these variables in the Introduction until they got to the last summary paragraph, the paragraph that gives a brief procedure summary. All of the studies you cited used a continuous reinforcement schedule of feedback and most just reinforced one body part. Therefore, a useful comparison would be to examine different ways of giving feedback to see if better control over EMG could be obtained. From here you would discuss different ways of reinforcing behavior. From any psychology book on Learning you could get information on fixed ratio, fixed interval, and continuous reinforcement schedules. Define these schedules, give examples and other facts about the behavior you expected under these schedules. Then make hypotheses about what type of EMG you would expect under these schedules. In this assignment I didn't expect great detail of these issues, but certainly an attempt to provide some information was appropriate.

Only after providing this information about your IV's from your library readings would you be able to state meaningful hypothesis about your IVs. You should have hypotheses about every IV used in your study. Your hypothesis should derive from the information you collected about the IVs in your library articles. Too many people just made a prediction about an IV but did not give any reasons for this prediction. Make sure that you give reasons.

Another consistent problem was the failure to provide adequate information on the purpose of the research articles that you cite. Don't skimp on giving the purpose of your research articles. You cannot give a purpose in 1 or 2 lines so don't try.

Results. In your Results section you had a figure with three phases (Baseline, CRF, and intermittent schedules). When you describe the data in the figure, complete your description of the first phase before moving to the second, and complete the second phase before going to the third. Don't forget that each phase has two types of analyses, each focusing on a separate IV.

Discussion. The Discussion needs a minimum of 2 pages (get to 3rd page). Too many people didn't meet this minimum. You need to summarize your results in the first paragraph. Not only summarize the statistically significant or nonsignificant results but also look closely for interesting trends in your data that might not reach significance and discuss those trends. For example, in your figure there was a trend for EMG to be higher in the reinforced arm than the nonreinforced arm during the later trials. Most didn't even mention this, even though it is clearly seen in the figure. Remember to compare at least 2 studies with your study and give details of procedures and data. Many people just compared procedure and had very little or no results. Complete your comparisons of one study before going on to the comparison of a second study. Do not mix them up.

## Rat Study

Your rat is a Sprague-Dawley albino from Zivic Laboratory breeding house (Zelienople, PA). It is male. It may or may not be experimentally naïve. If the rat was used in the previous semester, summarize its experience. It is maintained on free water and 80% or 85% of its free-feeding body. You feed your rats postsession to maintain body weight.

Be specific in your title. Do not use "The effects of various reinforcement schedules..." This is too vague. Something like "The effects of shaping, continuous reinforcement, and fixed ratio schedules on rats' lever pressing" is much more informative" or "The effects of number and type of distracters on vigilance performance.

The following is the proper way to write abbreviation for schedules: VI 10-s schedule or VI 10 s. And do not write VI-10 s

Do not use human studies as references. I prefer rats but you can also use pigeons, monkeys, or other nonhuman animals.

Responses per minute is a response rate. It is incorrect to say response rate per minute.

**Do a "would" search before handing in your paper.** Do not say "The rat would press...", but say "The rat pressed...". Talk in the active voice, not the passive voice.

Remember, the Introduction for your rat paper is not different from any other introduction. For example start off defining your topic and give an example. Write about 1.5 pages that summarize as many relevant facts about your topic as you can. You must also present a "problem" that you found through your readings, and tell how you intend to solve the problem with your study. You must also state your hypotheses. This is no different from your other Introductions. Develop hypotheses thoroughly. Argue your hypotheses. Explain

why you think your hypotheses are correct. Just don't say, here is what is expected. What do you base your expectation upon?

**Library Search for conditioning paper.** Simply stated, if you select weak articles you will get a poor grade. The further removed your library articles are from your experiment, the worse your grade will be. Most of the research that we do in this class is very basic. In searching for articles in the library you are more likely to be successful with older literature. Articles more current may be too complex for you. I advise you to first find books on operant conditioning, learning, animal learning, Conditioning and Learning. Locate the textbook that is used for the Psychology of Learning class. Read the sections related to your schedule of reinforcement. Learn about the behaviors expected under different schedules of reinforcement that you use (e.g., FR, VI, VR, FI, multiple schedules, progressive schedules, DRL). Do this before you go searching through the computer. The odds are very high that the books that you read will lead you to references that will be useful. These references are usually the most important in the field and usually make good references for your paper. Don't be addicted to the Net. Check the references in the text, look up the reference in the back of the book, and locate the reference, either on the internet, the shelves, or on microfich. I have several books on reserve in the library just for this purpose.

### **Outline of the Introduction for the operant conditioning experiment: Feedback to students during Fall, 2004**

Students trained rats to nose poke and had them under a multiple VI 20-s FI 20-s schedule of reinforcement. They were charged with finding information on rates and patterns under VI, FI, and multiple schedules reinforcement on lever pressing (key pecking). They also had to find one study that used a nose poke response.

What should I tell my reader in Page 1 to Page 1.5?

What is operant conditioning? What is a reinforcer?

Transition to schedules

What is a schedule of reinforcement?

What is a VI, what response rates and patterns does a VI give you?

What is an FI, and what response rates and patterns does a FI give you?

Transition to the multiple schedule (e.g., simple schedule may be combined to form multiple schedules. Under a multiple schedule....").

What is a multiple schedule of reinforcement? What would you expect under a multiple VI FI?

Present the problem: Most research has looked at these schedules with lever press responses and key peck responses. One type of response that has not been given attention is the nose poke.

Discuss the nose poke and compare it to the lever/key peck.

Introduce your nose poke study.

Hypotheses: Compare VI and FI performance on the nose poke to each other. What differences in response patterns and rates are expected?

Compare VI and FI performance on the nose poke to lever press. What differences in response patterns and rates are expected?

Brief summary of procedure.

Critique

Your job was to find research articles that showed what happens to **response rates** and **patterns** in VI schedules and FI schedules so that you could compare them to each other and to your nose poke rates. For example, what happens when you go from a small VI to a larger VI and a smaller to larger FI?

Reed was not a good study. Its focus was on the effects of a brief stimulus that preceded the reinforcer. They had a multiple VI FI but they adjusted the values so the rates would be equal in order to study the effects the brief stimulus.

You were instructed to find basic studies that were conducted for the sole purpose of studying VI and FI schedules. It took me 5 minutes to find three excellent studies simply by looking in one of my Learning/Conditioning books. The reason you had such a hard time finding good articles was that you used the search engine when I advised against it.

Catania and Reynolds (1968), Clark (1958) was a good article. Schneider (1969).

Don't be so dependent on the Internet!!

Schindler et al. (1997) was acceptable study on the nose poke but more effort should have been made at getting others.

Number of nose pokes as a DV is not helpful at all. **You had to convert the number to response rates.**  
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Find the Journal of the Experimental Analysis of Behavior website and do a search just on their journals. Remember in our library this journal is under J then T(he) and I gave you the website where you can locate all JEAB PDF files on line.

In the Subject section give 80% weights (e.g., 300 g).

When describing the figures in your results, make frequent use of means.

When talking about shaping, define and give a simple illustration. Do the same with other topics such as VI schedules or multiple schedules (e.g., describe everything that makes up a multiple schedule).

Define each schedule in your procedure. In other words, describe the CRF or VI or FR (e.g., under the FR schedule every 10 lever presses produced a food pellet).

Focus on only relevant aspects of research articles that you read. If you find a study that looked at VI schedules and its relationship to amphetamine, your interest is on the VI and not on the drugs. Focus your methods on the VI values, session length, type of reward, etc. In the results section, focus on response rates under the VI during baseline or during placebo sessions. Talk about response patterns as well as response rates.

When you label the vertical axis of a graph that shows responses per minute you do not label it as RESPONSE RATE (RESPONSE PER MINUTE). It is just RESPONSE PER MINUTE. Responses per minute is response rate so RESPONSE RATE is redundant.

When describing a figure in your results section, do not use terms such as interaction and main effects. These terms are specific to analysis of variance. Since you do not use statistics, and since you only have your own rat, do not use these terms.

Be careful about the use of the word "significant" when describing changes in your graph. Unless you replicate your conditions and rule out rival hypotheses, you can't use this word. Don't use the word "significant increase" unless you are sure that the change didn't occur by "chance".

Measure the Operant chamber and give dimensions. Located important aspect of the chamber such as the lever, houselight, and foodhopper. Show their size and placement. The software program that is used to control your schedules was called Graph State from Coulbourn Instruments. The hardware was called Habitest System, also from CI.

Don't use "days" in your results or method sections when talking about what was done every day. Use the word Sessions. The subject was studied for five sessions, not 5 days.

When describing equipment give Company, model, and city in parenthesis. For example, "An operant conditioning chamber for rats (Coulbourn Instruments, Model E21-01, Allentown, PA) was used."

If you use an abbreviation in the Abstract such as variable interval (VI), you still have to repeat this process of defining the abbreviation the first time you use the abbreviation in the text (variable interval (VI)).

You say that 8 rats were used, not eight rats. This is because you are using sample size.

In your Results section you must focus on response rates, response patterns, and observable behaviors that you recorded in your lab book. Patterns refer to the distribution of responses from one reinforcer to the other, such as a postreinforcement pause followed by a high steady rate of responding.

Do not use research articles that involve concurrent schedules and do not use any that involve aversive stimuli such as punishment or conditioned suppression or avoidance.

When you choose a book as a reference, it cannot be a textbook that could be used in a course. For example, do not use General Psychology text or a Child Psychology text. An exception to this is a Learning textbook.

### In your Results

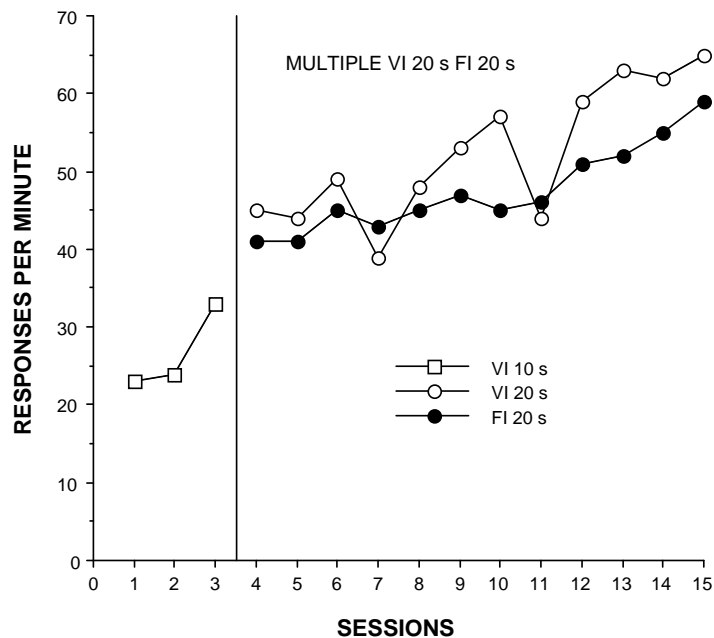
If you have a figure, it is often good to explain what the figure was intended to show. For example, in a study done previously students had a figure that looked at response rates every 3 min of the session. When introducing this figure, it is smart to say something about what this figure was intended to show. "Figure 2 shows response rate every 3 min across the 30 minute session. This figure shows how response rates changed from the start of the session to the end of the session."

You don't describe the data in the figure in the same way that you did for the figure in your group (human) study. In the group design there was a very mechanical way of describing your data (e.g., describe the IV on the horizontal axis for the first level of the second IV, go back and do it again for the next level of the second IV, etc.). Don't do it this way for the figure in your SSD study.

**Describing a figure from a single-subject design experiment.** Consider the figure below. Rats pressed a lever for three sessions under a VI 10-s schedule of reinforcement and then they were switched to a multiple VI 20-s FI 20-s schedule of reinforcement.

Figure 1 shows response rates under the VI 10-s schedule of reinforcement (left panel) and the multiple VI 20-s FI 20-s schedule of reinforcement (right panel). Open squares show overall response rates for three sessions under the VI 10-s schedule, open circles show rates under the VI 20-s schedule, and filled circles show rates under the FI 20-s schedule for the last 12 sessions of the multiple schedule. Response rates were relatively low for the first two sessions of the VI 10-s schedule (approximately 23 responses/min) and increased in Session 3 (34 responses/min). Response rates increases when the schedule was changed to a multiple schedule. Overall, response rates in both components of the multiple schedule increased from the first session (approximately 43 responses/min) to the last session (approximately 60 responses/min). In the first session of the VI 20-s schedule, response rate was 45 responses per min. Response rates increased to 50 responses per min in the third session of the multiple schedule, before decreasing in the fourth session to 40 responses per min. From Session 7 of the experiment to Session 15 response rates increased from 40 to 65 responses per min, with the exception of Session 11 where response rates decreased (44 responses/min). Under the FI 20-s schedule, response rates gradually increased from Session 4 (40 responses/min) to Session 11 (46 responses/min). Rates increased more sharply from Session 11 to Session 15 (59 responses/min). Figure 1 shows that response rates were higher under the VI 20-s schedule than the FI 20-s schedule in 10 out of 12 sessions. During Sessions 4 to 6 response rates

under the VI schedule were only about 5 responses per min higher than rates under the FI schedule. However, the differences increased during the last four sessions of the experiment: Under the VI schedule responses rates ranged from 59 to 65 responses per min during Sessions 12 to 15, respectively, whereas under the FI schedule rates ranged from 46 to 59 responses per min, respectively.



### In your Discussion

**Make relevant comparison** of your study to studies you found in the library.

**Here are some irrelevant comparisons that you don't want to make:** Both studies used shaping. Both studies used naïve subjects. Both studies had levers and 45 mg food pellets. Both studies used 80% deprivation levels and Coulbourn Instruments chambers. You ran rats 5 days a week and they ran rats 7 days a week. Both studies fed rats after the session. Your rat was in a cubicle, and they used a sound-attenuating box. Your session was 30 min long and their session was 45 min long.

**Relevant comparisons** would involve points like the actual schedules and schedule values. For example, Smith (1999) used five FI schedule values: FI 5, 15, 30, 60, and 120 s, whereas your study only examined FI 20 s. Smith conducted sessions for a minimum of 35 sessions or until behavior stabilized, whereas you only used five sessions and behavior was not stable. You used 45 mg pellets and Smith used water as a reinforcer. Smith used pigeons who were keypecking, and you used rats that were lever pressing. Smith studied FI schedules in combinations with a FR schedule using multiple schedules that alternated every 3 minutes. You used an FI schedule alone without any other schedule. You both used multiple schedules but your component durations were 3 min and Smith alternated components every 1 min. Or you used a progressive schedule that incremented every 4 responses and Smith used a progressive schedule that incremented every 20 responses.

**Making comparisons of results:** In your Discussion you must also compare your results to the results of other studies. You must use numbers to do this. For example, the average response rate of the last five sessions under the FI 20-s schedule in the present study was 45 responses per min. This rate was lower than

rates in Smith (1999). The average response rates of the three rats used by Smith under an FI 60-s schedule was 78, 92, and 112 responses per min, respectively. In addition, Smith's rats experienced FI 10-s and FI 3-min schedules of reinforcement. Response rates under the FI 10 s ranged from 123 to 155 responses per min for the three rats. Under the FI 3-min schedule the rates ranged from 23 to 44 responses per min for the three rats (mean of last five sessions). Perhaps the reason why response rates in the present study were lower than rates in the Smith study was that Smith's rats experienced 35 sessions under the FI 10 s schedule before switching to the FI 60 schedule. In the present study the rat only had five sessions of CRF, one session of FI 10 s, and only 15 sessions of FI 20 s. In addition to analyzing response rates, the postreinforcement pause was measured in the present study. The number of second between each reinforcement and the first response was measured for the last two sessions of the experiment. The mean PRP was 3.44 s. The value is consistent with the PRP's reported by Smith under the FI 60 s schedule. Smith's rats had PRP's of 4.44, 5.0, and 3.99 s, respectively.

**(Below I have included a sketchy example of a research article. Note that this page should be page 1. My comments are written in bold font).**

Running head: BEHAVIOR MOMENTUM THEORY AND SCHEDULES

Generality of Behavior-Momentum Theory and the Effects of Variable-Interval  
Schedules of Reinforcement

Steven L. Cohen, Deborah S. Riley, and Pat A. Weigle

Bloomsburg University of Pennsylvania

**(Note: This is a Title page, page 1. Do this exactly as I have it. Note what is capitalized and what is centered. Notice for example that The title itself is typed in uppercase and lowercase letters, centered on the page. The running head is an abbreviated title, NOT longer than one line. Also note two words (page header) next to page number.)**

### Abstract

This experiment examined the generality of the behavioral- momentum theory by measuring resistance to change in rats' and pigeons' responding under simple and multiple schedules of reinforcement. In Part 1, 28 rats responded under simple fixed ratio, variable ratio, fixed-interval, or variable-interval schedules of reinforcement. In Part 2, 3 pigeons responded under simple fixed-ratio schedules. Under each schedule, rate of reinforcement was

**Note: Abstract is on page 2. Include the purpose, method, results, and conclusion of the study in the abstract. Make the abstract 0.75 to 1 page. Technically, it should be around 120 words, but I like it a bit longer. Do not indent, include references, or statistics. The presentation of some means is acceptable.**

**(Note: This is page 3 and you start your Introduction. Note that instead of Introduction you rewrite the title of paper, centered. Notice the way references are written. I will have more information on this later. Notice when I abbreviate something, I first write it out and put it in parentheses, but later only use the abbreviation. You can only do this if you use the abbreviation 3 or more times.)**

## Generality of Behavior-Momentum Theory and the Effects of Variable-Interval Schedules of Reinforcement

Behavioral momentum is the product of response rate ("velocity" of behavior) and resistance to change ("mass") (Nevin, 1992). Whereas variables that affect the rate of operant responding have been examined extensively, less is known about variables that affect resistance to change, that is, the relative change in steady-state operant responding when it is disrupted by altering environmental conditions. Nevin (1974, 1979) has argued that responses producing higher rates of reinforcement, more immediate delivery of reinforcement, or greater amounts of reinforcement in the presence of a discriminative stimulus are more resistant to change than responses producing smaller amounts of reinforcement, less often, and with less immediacy. For example, Bouzas (1978) reinforced pigeons' responses according to a multiple (mult) variable-interval (VI) 1-min VI 4-min schedule of reinforcement and delivered response-contingent electric shocks in both components. As expected, this punishment procedure reduced response rates, but responding was reduced relatively less in the VI 1-min component. In another demonstration (Nevin, Mandell, & Yarensky, 1981), pigeons' responding was maintained under a chained schedule of reinforcement. Alternative reinforcement for responses on another key or feeding subjects before the session lowered response rates relatively more in the initial link than the terminal link. Resistance to change was also enhanced by providing more food in the terminal link or decreasing terminal-link duration.

Recent evidence suggests that response rate is determined by response-reinforcer contingencies and resistance to change is determined by stimulus-reinforcer (Pavlovian) contingencies (Mace et al., 1990; Nevin, 1984, 1992; Nevin, Smith, & Roberts, 1987; Nevin, Tota, Torquato, & Shull, 1990). In a clear demonstration of this, Nevin et al. (1990) reinforced pigeons' keypecks with food according to a mult VI 1-min VI 1-min schedule. In some conditions response-independent food was also delivered in one of the components.

## Method

### *Subjects*

Twenty-eight male Sprague-Dawley albino rats (Camm Research, Wayne, NJ) were used. Eight rats were experimentally naive, and 20 had been trained by undergraduate experimental psychology students for approximately 20 sessions under FR 40 schedules of reinforcement.

### *Apparatus*

Seven operant-conditioning chambers (Coulbourn Instruments) for rats were housed in sound-attenuated cubicles. Each chamber contained a recessed food cup in the bottom center of the work panel.

### *Procedure*

Rats were randomly divided into VR, FR, VI, and FI groups ( $n = 7$ ). The eight naive rats (two per group) were trained to press the lever by being placed into the operant chamber overnight, and exposed to a continuous reinforcement (FR 1) schedule, while a free food pellet also was delivered every 20 min independently of behavior. Each of these rats then received two 45-min sessions of FR 1 and one session of FR 2 before being

exposed to their assigned schedule. The 20 experienced rats, previously "hand-shaped" to lever press, were exposed directly to their assigned schedule of reinforcement.

Variable-ratio schedule. Each rat was assigned to an operant chamber, received one session of VR 5, two sessions of VR 10, and one session of VR 20. Responding then was maintained under a VR

## Results

Average response rate for each component was determined by dividing total responses during each component by time in the component (not including feeder cycles). Absolute response rates during each test (averaged in cases of redeterminations), and average response and reinforcement rates for sessions preceding each test session are presented in Appendices 6 to 7.

Prefeeding. Figure 1 (left panel) presents the effects of 3% and 50 g prefeeding on proportion of baseline response rates for rats under the mult FR FR schedule. Both prefeeding operations lowered response rates, with more suppression after 50 g access. Most importantly, rates were suppressed relatively more in the component with the large FR schedule (lower rate of reinforcement), and the slopes were steeper for the lines representing the larger FR schedule. Only 1 of 7 rats (Rat 38) failed to show this overall pattern. Proportion of baseline was compared with a 2 x 2 repeated measure analysis of variance, with FR (small and large) and prefeeding (3% and 50 g) as factors. Significantly greater response suppression occurred in the component with the larger FR [ $F(1, 6) = 32.3, p < .01$ ].

Extinction. Figure 2 shows the effects of extinction on proportion of baseline.....

## Discussion

The purpose of this study was to investigate variables that might account for the failure of momentum theory to predict the results of Cohen et al. (1990) and that might further suggest boundaries or changes in momentum theory. Several general conclusions can be derived from this investigation. First, there were no consistent differences between rats and pigeons with regard to momentum theory. Second, momentum theory did not predict the outcome of resistance-to-change tests when rates of reinforcement were varied across successive conditions. Furthermore, this failure of prediction was evident under simple FR, VR, FI, and VI schedules of reinforcement. Third, momentum theory predicted the outcome of most resistance-to-change tests when rates of reinforcement were varied within the context of multiple schedules. Fourth, most tests of resistance to change were consistent with momentum theory under multiple FR and FI schedules; this finding supports previous research examining multiple VI schedules of reinforcement. Although tentative, performance under multiple VI, FR, and FI schedules may differ when resistance to change is measured by presenting free food during the timeout separating components. Fifth, delivering response-independent food during the maintaining schedule disrupted responding, but the relative amount of disruption was not predicted by momentum theory, whether in simple- or multiple-schedule contexts.

Cohen et al. (1990) tested for resistance to change as the size of an FR schedule was varied across successive conditions. Response-independent food produced equal changes in proportion of baseline response rates under each FR schedule, and resistance to..

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## References

- Ayres, J. J. B. (1968). Differentially conditioned suppression as a function of shock intensity and incentive. *Journal of Comparative and Physiological Psychology*, 66, 208-210.
- Ayres, J. J. B., & Quinsey, V. L. (1970). Between-group incentive effects on conditioned suppression. *Psychonomic Science*, 21, 294-296.
- Blackman, D. (1968). Response rate, reinforcement frequency, and conditioned suppression. *Journal of the Experimental Analysis of Behavior*, 11, 503-516.
- Bouzas, A. (1978). The relative law of effect: Effects of shock intensity on response strength in multiple schedules. *Journal of the Experimental Analysis of Behavior*, 30, 307-314.
- Burgess, I. S., & Wearden, J. H. (1986). Superimposition of response-independent reinforcement. *Journal of the Experimental Analysis of Behavior*, 45, 76-82.
- Cohen, S. L. (1986). A pharmacological examination of the resistance-to-change hypothesis of response strength. *Journal of the Experimental Analysis of Behavior*, 46, 363-379.

Millenson, J. R., & deVilliers, P. A. (1972). Motivational properties of conditioned anxiety.

In R. M. Gilbert & J. R. Millenson (Eds.), *Reinforcement: Behavior analysis* (pp. 97 - 128). New York: Academic Press.

**(Note the above reference (and the one below) is a chapter in an edited book. It is quite different in format. Millenson, J. R., & deVilliers, P. A. wrote the chapter. The name of the chapter is Motivational properties of conditioned anxiety. It came from an edited book named Reinforcement: Behavior analysis that was edited by R. M. Gilbert & J. R. Millenson (Eds.). Note the name of the book is in italics.)**

Nevin, J. A. (1979). Reinforcement schedules and response strength. In M. D. Zeiler & P.

Harzem (Eds.), *Advances in analysis of behavior: Vol. 1. Reinforcement and the organization of behaviour* (pp. 117-158). Chichester, England: Wiley.

Skinner, B. F., & Ferster, C. B. (1957). Schedules of reinforcement. New York: Prentice Hall.

**(Note that this last reference is an entire book. The name of the book is underlined, only first letter capitalized, and then comes the city of the publisher and the name of the publisher. )**

## Figure Captions

*Figure 1.* The ratio of response rate during a resistance-to-change test to rate on the preceding session ("proportion of baseline") in Experiment 1 when response-independent food was delivered during the maintaining schedule according to RT 40-s (90 reinforcers per hour) and RT 20-s (180 reinforcers per hour) schedules. Data are shown for individual rats and average data for four successive conditions under VR, FI, FR, and VI schedules. The vertical axis is logarithmic.

*Figure 2.* This figure is identical to Figure 1 except that proportion of baseline was measured when rats were fed before the test.