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Appendix A: Resources

Appendix B: APA Format Checklist

Appendix C: Annotated Sample Lab Report
Mount Allison’s Psychology department follows the American Psychological Association (APA) format for most written assignments, essays, and lab reports. APA is the standard format used in psychology and therefore, students taking psychology courses at MTA are expected to master it. This guide is adapted from the *Publication Manual of the American Psychological Association, 6th Edition*, which establishes the full criteria for APA manuscripts.¹

This guide has been developed for students who are beginning to learn and apply APA format. Therefore, it gives the minimum information necessary for 2nd year reports and papers. Students will learn more formatting requirements in their upper year courses and if they choose to do independent research in their upper years, they will often purchase and use the full APA manual.

Keep in mind the following points when using this guide:

- Keep the guide nearby and refer to it often when writing, editing, and doing a final check of your work. In general, it is not necessary to memorize APA format.

- By providing an introductory APA guide, we have included the fundamentals and have left out many of the finer points of APA style. Follow this guide and your instructor’s requirements. APA formatting requirements that are presented in outside sources are not mandatory at the second year level and should not be added to your work. If you are uncertain, check with your instructor.

- Some instructors may want students to include some APA formatting or content that is not explained in this guide. Your professor or lab instructor will explain these additional requirements to you in class, lab, or in a written document (e.g., on an assignment, in the course syllabus, etc.). When in doubt, ask.

- In some instances, we have modified standard APA format to meet our needs. These modifications are rare and are noted in this guide. One primary example is on the title page, which we have modified to be more suitable for assignments and reports, rather than manuscripts for publication.

- There is a list of resources in Appendix A of this guide if you need further help with writing and grammar, detailed aspects of APA format, and so on.

- One final note of caution: APA format is a template that writers follow to create manuscripts *before* final publication. It ensures consistency in presentation and content so that journals can easily convert to their final format. Every journal has its own style and appearance; once journal articles have been published, they are no longer in APA manuscript style. Therefore, follow the instructions in the guide, not what is shown in published journal articles.

¹ This guide outlines and provides examples of APA formatting; however, we have deviated from some APA formatting in our presentation to make it easier to display examples and also to reduce the number of pages for printing.
Section 1: Formatting Basics

The following list outlines the general formatting requirements of all types of APA assignments, including essays, lab reports, and research proposals.

Formatting Basics: Setting up the Document

- Use one-inch (2.54 cm) margins on sides, top, and bottom.
- Number all pages above the margin in the top right corner, beginning with the title page as page 1. This can be done by inserting a page header.
- Use a 12 point SERIF style font (these are fonts that have “curls” on the letters, such as Times New Roman, Cambria, or Garamond).
- Use plain text formatting unless otherwise specified in the guide. Do not add extra design, colour, word art, underlining, and so on. Do not condense or expand the text.
- Type and double-space the entire document including the title page and references (exception: tables, drawings and/or math can be spaced smaller to make them easier to read).
- Left-justify, which means straight edges on left and jagged on the right.
- Indent every paragraph of text (except for the Abstract of a lab report).

Formatting Basics: The Title Page

- Write a unique and descriptive title (Note: there are additional title requirements for research reports, shown in Section 4).
  - “Lab Assignment” or “Abnormal Psychology Essay” are NOT good APA titles.
  - A descriptive title conveys the content and purpose of the paper and is about 10 – 12 words in length.

Example
  ✗ Insomnia Treatments
  ✓ A Critical Evaluation of Four Common Self-Help Methods to Treat Insomnia
  The second title clearly establishes the purpose and content of the paper.

- Capitalize important words (called “title case”).
- Number the title page as page 1.
- Include the title of the paper, your name, the course name and/or number, the name of the institution, and the date of submission, each on a separate double-spaced line, in plain 12 point font (not bolded, no fancy formatting).
- Do not include running headers, unless required by your instructor.
- If your instructor allows, you may add your name next to the page number in case your assignment pages become separated.
- Begin the title about one-third down from the top of the page and center everything. A sample title page is shown in Figure 1.

![A Critical Evaluation of Four Common Self-Help Methods to Treat Insomnia
Jane Doe
PSYC 1005
Mount Allison University
September 5, 2015](image)

*Figure 1. Sample APA-formatted title page for assignments and papers. There is additional formatting for titles of research reports, as discussed in Section 4.*

**Formatting Basics: Headings**

In APA format, heading are used to help readers follow along with the various sections of your paper or report. They can also be used to indicate major changes in focus or content within a section of your paper. This guide generally follows APA heading format, except we have added horizontal lines around major headings to make them stand out. There are 5 levels of headings and subheadings in APA format, as listed below. Most papers will only require the first two or three. Figure 2 provides an example of each level heading.

Note: In APA the main title, the word ‘abstract’ at the top of the abstract section and the word ‘references’ at the top of the references page(s) are not considered to be headings. They are all presented as plain text.
Figure 2. Levels of heading in APA papers. Although there are five levels, the first two or three are the most commonly used.
Formatting Basics: Special Considerations

There are many other very detailed formatting requirements outlined in the full APA manual. This list provides a few general rules of thumb that you should follow. Your instructor may give additional requirements in lab or class.

**Numbers.** Always spell out numbers that start a sentence. Except for the beginning of a sentence, present numbers 10 and above as numerals (e.g., 65) and spell out numbers under 10 (e.g., seven).

Example: The researchers administered three measures of depression to 67 participants.

- Other than at the beginning of a sentence, this rule does not apply to statistical or mathematical copy or to numbers presented in tables or figures.

- There are many exceptions to this general rule of thumb, especially if the use of numbers is difficult for the reader to follow. For example, when listing two numbers in a row, change the format of one number for clarity:

  Example: There were three, three-item surveys.

  This is confusing and can be changed to: There were three, 3-item surveys.

**Abbreviations.** Give the full text version of a word or phrase before using abbreviations, unless the abbreviation is commonly accepted as a word, such as IQ, ESP, and HIV (refer to the full APA manual or blog site for a full list of accepted abbreviations).

Example: The American Psychological Association (APA) publishes a style manual. The APA manual is used to…

**Lists.** Letters can be used to list items presented as part of a full sentence and paragraph. Bullet point lists are rarely included in APA-formatted documents.

Example (for a simple list without internal commas): The participants’ three choices were (a) working with another participant, (b) working with a team, and (c) working alone.

Example (use when there are commas within the phrases): We tested three groups: (a) low scorers, who scored fewer than 20 points; (b) moderate scorers, who scored between 20 and 50 points; and (c) high scorers, who scored more than 50 points.

**Math and statistics.** Measurements, such as distance or weight are presented in metric in APA format, and statistical copy follows specific formatting that is outlined in Section 4 below. Italicize mathematical and statistical symbols, even when they are included in tables and figures.

Example: There were 106 participants, with a mean age of 21.6 ($SD = 1.54$).
Section 2: Writing Style

APA documents are written in scientific style, which is often quite different than the style used in other disciplines and can take time and practice to master. Although this guide is not intended to teach students how to write, we have included brief explanations and examples for some aspects of scientific style below. You may wish to also consult other writing resources (some are shown in Appendix A).

In general, scientific style…

...is objective and factual. Paraphrase facts, details, and information from the sources without subjective commentary. Keep the original meaning without over-generalizing or over-simplifying.

Example

- Everyone knows that there are three memory processes: encoding, storage, and retrieval.
- There are three memory processes: encoding, storage, and retrieval.

Most likely, there are many people who do not know this about memory, so saying “everyone knows” is not correct, nor factual. In scientific writing, the words we write convey their literal meaning.

Example

- The researchers found amazing results. Their participants loved the task and it showed in their performance.
- The researchers’ results indicated that the task was well-received by participants, as evidenced by their performance.

The first version presents a subjective reaction (amazing result) and a supposition without evidence (it is unlikely that the researchers asked participants to rate their love of the task). The second version removes the reactionary wording and presents a more objective statement.

...uses formal grammar. Use full sentences with properly spelled words and proper punctuation. Use simple, clear words that convey the meaning (this is not the time to dig out a thesaurus). Avoid slang, terms used in everyday speech, and contractions.

Note: it is perfectly fine to say ‘I’ or ‘my’ when referring to yourself, as in “Based on the evidence, I think that….”

Example

- While one may advocate that perhaps the current research had overlooked the possibility of duplicity during the learning phase, it is however unlikely due to the fact that….
- Researchers might have missed the boat. Reason being is that people could of cheated. But they prolly didn’t because…
- It is possible that the current research failed to account for the possibility of cheating during the learning phase; however, this is unlikely because…

The first sentence is hard to follow, uses unnecessarily complicated phrases and terminology. The second sentence is much too informal and uses colloquialisms (‘missed the boat’), slang (‘prolly’),
and non-grammatical structure (‘reason being is’). The third sentence is formal, yet clear and to the point.

Example

✗ The testing effect happens when you test yourself as you study something.

✓ The testing effect happens when students test themselves as they study.

Avoid the use of ‘you’ in examples and explanations, because it is informal. Instead, use a group term for who ‘you’ is supposed to represent: people, teachers, students, etc.

...uses active voice. In active voice, the verb directly follows the subject. Avoid passive voice, in which the verb is in past tense and the subject is either not mentioned or follows the words “by the” as shown in the examples below. Passive voice is wordy and can be confusing to the reader.

Example

✗ The study passage was read and then the comprehension test was completed.

✓ Participants read the study passage then completed the comprehension test.

The subject of the first sentence is not clear (we do not know who is reading and taking the test). The subject of the second sentence is clear – participants read and took the test.

Example

✗ It was explained by the researchers that the second task was to have been performed as quickly as possible.

✓ The researchers explained that the second task should be performed as quickly as possible.

The first sentence is wordy and confusing, while the second sentence is direct and to the point.

...is concise, direct, and to the point (not prosaic). In scientific writing, it is better to say something in fewer words that clearly convey the idea than to write many words that “talk around” an idea. Eliminate words that are redundant, choose common words over rarely used ones, explain exactly what you want to say.

Example

✗ Because a great many of the words in this sentence are basically unnecessary, ideally it would really be a very good idea to edit somewhat for conciseness.

✓ We should edit this sentence because many of the words are unnecessary.

The first sentence has many redundant words that do not add unique meaning. Other examples include: the very same (the same); the exact same (the same); a large number of student participants (many participants), etc.

Example

✗ The use of hormone replacement therapy (HRT) has produced benefits for many women.

✓ Hormone-replacement therapy (HRT) has benefited many women.

Five words in the first sentence were unnecessary. The meaning of the sentence is the same without them.
Example

✗ We use memory strategies all the time when we want to remember things. In other words, memory strategies are good to use when we want to remember.

✓ Memory strategies are useful tools for recall.

The first set of sentences are wordy, repetitive, and do not clarify the authors’ main point. The final sentence states the point clearly and concisely.

...is evidence-based. It is not enough to simply provide the researchers’ findings; we must also provide their explanations and interpretations of the evidence; general statements such as “studies show” are not enough.

...is paraphrased. Paraphrasing demonstrates an understanding of the concepts which is important in scientific writing. It also allows the writer to integrate the ideas into coherent sentences and paragraphs, whereas a direct quote often interrupts the flow of writing and can be distracting to the reader. Most psychology instructors do not allow direct quotes in papers and reports.

...avoids biased language, such as using “men” to represent both males and females.

...uses accepted terms for minority groups, those with disabilities, various age groups, and sexual orientation.
Section 3: Acknowledging Sources to Avoid Plagiarism

Plagiarism is a form of academic dishonesty that occurs when another person’s words, phrases, or ideas are used without proper acknowledgement. The best way to avoid plagiarism is to paraphrase, cite, and reference all sources of facts and information. Mount Allison, like most other educational institutions, regards plagiarism as a form of academic dishonesty and the penalties for plagiarism can be severe. In writing, plagiarism may occur when:

- A direct quote from an author is presented without a citation and/or without quotation marks;
- An author’s work is paraphrased too closely, even if a citation is provided (often called mosaic plagiarism); or
- The overall structure and content of a source is followed too closely, even if it has been paraphrased and cited.

Acknowledging Sources: Paraphrasing

Paraphrasing means to put the material entirely into your own words. It is not quite the same as summarizing. Paraphrasing uses the ideas and information that are the most relevant for the purpose of the paper, whereas summarizing typically presents all of the ideas from a source, whether relevant or not.

The phrase “use your own words” is often very challenging for students, especially those in first and second year. It takes understanding of the material, practice, and effort to paraphrase properly. Here are some strategies to use:

- Make sure you understand the material very well before you start to write your paper. The more you understand it, the less likely you will be to plagiarize.
- Take notes in your own wording as you read the original work (better than highlighting the original).
- Be sure to note the source so you can cite and reference later.
- If you absolutely must write something word for word as you take notes, put quotation marks around it and write down the page number where the quote was found. Remember to paraphrase it when you add it to your paper; most instructors do not allow direct quotes on assignments or lab reports.
- Create an annotated bibliography to track the reference information and important ideas for each of your sources.
- Put the original sources out of sight when you write your assignment. Write from memory, using your notes and outline as a guide. If you cannot do this, you may not be ready to begin writing and should consider rereading, studying, and taking more notes from your source materials.

2 See Mount Allison’s Academic Calendar, section 10.6 “Academic Integrity” for more information: http://www.mta.ca/calendar/_10.html#_10.6 and also the Academic Integrity Policy found at http://www.mta.ca/Community/Governance_and_admin/Policies_and_procedures/Section_5000/Policy_5500/Policy_5500/
• When you have finished writing, compare your version to the originals to ensure that you have adequately paraphrased and have kept the meaning of the material. Also review to look for important ideas or concepts that you may have forgotten to include.

• There are some resources on how to recognize and prevent plagiarism in Appendix A. For quick reference, here are examples of improper and correct paraphrasing:

**Original Source**
Where most students err in terms of unintentional plagiarism is not in failing to acknowledge ideas, but in paraphrasing incorrectly. Many novice researchers assume that if paraphrasing means putting a passage "in your own words," this can be accomplished by simply substituting synonyms for key terms. Stealing syntax, or sentence structure, is as significant an offence as stealing an idea because, as you know from your own writing experience, trying to phrase a point exactly is a difficult art. Proper paraphrasing depends on thorough comprehension of material, not on a thesaurus.


**Improper Paraphrase (Mosaic Plagiarism)**
Where most students make the mistake of unintentional plagiarism is not by failing to cite, but in paraphrasing improperly. Many novice researchers assume that if paraphrasing means putting the material "in your own words," this can be done easily by substituting synonyms for key terms. Copying syntax, or sentence structure, is just as bad as stealing an idea because, as you know from your own writing experience, trying to phrase a point exactly is difficult. Proper paraphrasing requires thorough comprehension of material, not a thesaurus (Trent University, 2015).

Notice how most of the words, the sentence structures, and the order of the sentences are the same as the original. This is not properly paraphrased, even though there is a citation.

**Proper Paraphrase**
Unintentional plagiarism often occurs because novice researchers do not understand how to paraphrase properly. They have been told to put the material “into your own words” but they may assume that it is acceptable to merely replace a few words with synonyms or to change the sentences around. However, this still a theft of ideas, as it requires no real effort. Paraphrasing is difficult and requires a solid understanding of the material to be done correctly (Trent University, 2015).

Notice that the meaning of the original content is kept, but the word choice, sentence structure, and overall style is clearly different than the original and a citation is provided.

**Acknowledging Sources: Citations**
Citing means to add notations in the body of the paper to acknowledge the source of the material, even when it has been paraphrased. Citations can be integrated into the body of a sentence or inserted into parentheses at the end of a sentence, and most writers use a combination of both types of citation to maintain good writing style and flow.
In APA, citations are formatted using the last name(s) of the author(s) and the year in which the source was published. Page numbers are included only for direct quotes. Here are a few examples of citations:

- **In the body of the sentence:**
  
  Wilson (1998) proposed that the fundamental attribution error could be a cause of prejudice.

  As explained by Smith and Jones (2007), very young children often fail to retain a memory of their early life experiences.

- **At the end of the sentence in parentheses:**
  
  The fundamental attribution error is thought to be a major contributor to the creation of prejudice (Wilson, 1998).

  Very young children often fail to retain a memory of their early life experiences (Smith & Jones, 2007).

  There are some specific formatting rules to follow when citing in APA format. These depend on whether the citation is in text or parenthetical, the number of authors of a source, and whether the source is being cited for the first time in the paper.

  - **In text citations with more than one author use the word ‘and’ before the last name in the list. Parenthetical citations use an ampersand (&) before the last name in the list. The Oxford comma is used in both types of citations that have three or more authors, meaning that there is a comma before the ‘and’ or ‘&’ in the list.**
    
    Rogers, Kuiper, and Kirker (1977) demonstrated that…
    
    …supported by the results (Jamieson & Morris, 1994).

  - **One or two author sources: list their last names for all citations**
    
    Research by Jamieson and Morris (1994) supports...
    
    …supported by the research (Jamieson & Morris, 1994).

  - **Three to five author sources: cite all authors’ last names for the first citation. For subsequent citations, use the first author’s last name followed by ‘et al.’ which is a Latin abbreviation meaning ‘and others.’ Notice the punctuation for this short form: place a period after ‘al.’ not ‘et’ and keep the comma before the publication year in parenthetical citations. Do not italicize ‘et al.’**
    
    First citation:
    
    Kernis, Cornell, Sun, Berry, and Harlow (1993) discovered…
    
    …was discovered (Kernis, Cornell, Sun, Berry, & Harlow, 1993).

    Subsequent citations:
    
    Kernis et al. (1993) also found…
    
    …was also found (Kernis et al., 1993).

  - **Six or more author sources: use the short format for all citations.**
    
    First and all subsequent citations:
    
    Matthews et al. (2012) explained that…
Repeated citations can contribute to ‘choppiness’ and lack of flow in writing. To avoid this, use pronouns and a mix of in-text and parenthetical citations, as long as the source always remains clear. Each new paragraph of sourced information requires a citation, even when the source from the previous paragraph is still being discussed.

Example (two paragraphs from the same source):

Smith and Jones (2006) stated that children learn many social behaviours through imitation. They explained that… They also suggested that…”

To examine their hypothesis, Smith and Jones (2006) asked participants to…

Secondary source citations (citations within citations). Find and use original published sources whenever possible. When original sources are not available, such as for out-of-print materials, use a form of secondary citation. For example, if you read about Freud in a textbook by Lilienfeld et al. (2017), you might write:

Freud (as cited in Lilienfeld et al., 2011) claimed that…

You can also cite the general idea as explained in your source, without creating a secondary source. For example, if you have read journal article written by Everett and MacKenzie (2003), who discussed several past research studies, you can write:

Everett and MacKenzie (2003) presented the evidence from several studies and concluded that…

Important! Check with your instructors for their preferences regarding secondary source citations. Some prefer the first format, others prefer the second, and yet others will not allow secondary source citations.

Acknowledging Sources: Referencing

Referencing in APA means to add a separate page at the end of your document with a listing of the full publication information for each source you have cited. This allows the reader to find and obtain the original work if they wish. To create the reference page, begin on a new page after the end of the body of your paper and type the word ‘References’ on the center of the top line (do not bold this). Then, list each source that you cited by following these rules:

- Continue to double-space everything and do not add extra spaces between each source in the list.
- Use a hanging indent to present each listing. A hanging indent means that the first line is flush with the left margin and the remaining lines are indented.
- List the sources in alphabetical order by the last name of the first author of each work.
  - Do NOT re-order the names of authors within a single source. For example, if a paper is written by Samuels, Matthews, and Bourque, do not list as Bourque, Matthews, and Samuels.
  - If there are multiple sources by the same author(s), present them from earliest year to most recent year.


- When there are **seven or fewer** authors of a source, include all of their last names and initials in the reference information in the order that they appear on the source.

- Where there are **eight or more** authors of a source, list the first six authors followed by an ellipse and then by the last author.

Smith, H., Aaron, S., MacKenzie, T., Barns, M., Michaud, F., Leaman, P., … & Carlton, N.

- If the title of a source has punctuation that ends a sentence or clause such as a period, colon, question mark, or exclamation point, capitalize the first word after the punctuation as well.

  The post-traumatic stress disorder sourcebook: A guide to healing, recovery, and growth.

- Include the full publishing information for each source. In general, this means: the author(s) and year/date of publication, the name of the source, and information on where the source was published. The specific presentation and format of this information varies according to the type of source being referenced. The most common formats used in papers and reports are shown below. Each example shows the general template, followed by a specific example.\(^3\) Precise punctuation and format are very important, so you may wish to print these examples for easy reference.

**Journal articles.** Most of your sources will be from published journal articles. The publication information for journal articles often includes a digit object identifier (doi), which be found on the article along with the journal information. For older articles, the doi may not be on the article itself and can be often be found in a detailed listing for the article from an online database such as psycinfo. If no doi is listed in these databases, then none has been issued for the article. There are multiple formats for doi numbers; use any format that is provided but do not mix elements of the various formats (see the examples below).

<table>
<thead>
<tr>
<th>Author’s Last Name, Initial., 2nd Author’s Last Name, Initial,… &amp; Last Author’s Last Name, Initial. (year). Title of article in sentence case. Title of Journal in Italics and Title Case, Volume # in italics and no issue number, page numbers. doi: #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author’s Last Name, Initial., 2nd Author’s Last Name, Initial,… &amp; Last Author’s Last Name, Initial. (year). Title of article in sentence case. Title of Journal in Italics and Title Case, Volume # in italics and no issue number, page numbers. doi: #</td>
</tr>
</tbody>
</table>

\(^3\) There are many other types of sources; for those please consult the APA Manual or one of the resources listed in Appendix A.
Acceptable but not preferred:


**Journal article (advanced online edition).** Journal articles may often appear in electronic format before being printed. These are called advanced online editions. Always check whether an edition has been fully published before using this format. For example, you may have an old pdf copy of an ‘advanced’ publication from three years ago. It has likely been fully published since then and should be reported as a published article.

Author’s Last Name, Initial., 2nd Author’s Last Name, Initial., … & Last Author’s Last Name, Initial. (year). Title of article in sentence case. *Title of Journal in Italic and Title Case*. Advance online publication. doi: #


[https://doi.org/10.1057/palgrave.kmrp.8500141](https://doi.org/10.1057/palgrave.kmrp.8500141)

**Books/textbooks.** Use this format for books that have the same author(s) for all chapters.

Author’s Last Name, Initial., 2nd Author’s Last Name, Initial., … & Last Author’s Last Name, Initial. (year). *Title of book in italics and sentence case*. Location: Publisher.


**Chapter in an edited book.** Use this format for books that have a different author(s) for each chapter and that have been collated by an editor(s). If the book is edited, this information will be clearly shown on the book’s cover page and/or publishing information page.

Author’s Last Name, Initial., 2nd Author’s Last Name, Initial., … & Last Author’s Last Name, Initial. (year). Title of chapter or entry in sentence case. In A. Editor, B. Editor, & C. Editor (Eds.), *Title of book in italics and sentence case* (pp. xxx-xxx). Location: Publisher.
Websites. Finding the author information for a webpage can be difficult. Sometimes a specific author is listed but often there is no such indication. When no author name is available, use the publisher of the page in its place. For example, the American Psychological Association publishes the APA style blog, so they would be listed as the author. Check the ‘about us’ page of the website to find publisher information if it is not easily found on the page. In addition, use the date of publication when it is available; otherwise, use the date that the article was retrieved.

Name of the site author (year of article OR year, month day retrieved). Name of webpage article in sentence case. Retrieved from website URL


Government Reports. Government reports are similar to website pages in terms of authorship. Typically the author is the government agency that published the report; however, if there are individual author(s) list them instead.

Name of government department that published the report. (year). Report title in italics and sentence case (Publication number). Retrieved from Agency name website and URL info.

Section 4: APA Format for Lab Reports

APA lab reports are included in the work for most of our lab courses. When writing lab reports, follow the general APA formatting described above and also the specific requirements for lab reports that are detailed in this section. Before submitting the report, it is a good idea to double-check your work using the APA checklist in Appendix B and the sample annotated lab report in Appendix C.

Lab Reports: The Title Page (Modified from strict APA format)

Lab report title pages follow the same format described in Section 1, except that the titles describe the type of study that was conducted, the variables that were examined, and the population from which the sample was drawn. Here are some examples:

A Case Study of a Woman with Synesthesia

The Relationship between Math Anxiety and Performance in Calculus in Grade 12 Students

The Effect of Rereading versus Retesting on Long Term Recall in Undergraduate Students

Lab Reports: The Abstract

The abstract is a summary of the study. It is generally about 75 to 150 words long (about one-third to half of a double-spaced page) and should be clear and concise.

Format. Begin the abstract on a new page.

• Type the word ‘Abstract’ at the top centre of the page (not bolded and without quotation marks).

• Do not indent the first line of the abstract.

Content. There should be something from every major section of the paper included in the abstract (i.e., something from the introduction, method, results, and discussion). The APA manual suggests that abstracts for empirical reports should contain the information listed below:

• The problem investigated or purpose of the study.

• The participants (specifying important demographic characteristics such as age and sex, or genus and species for animal studies).

• The essential parts of the method and design (variables, general procedure).

• The basic findings or outcome of the study.

  o Findings may be worded as text only or may also include the statistical outcomes, as effect size, confidence intervals, etc. Check with your instructor regarding their expectations and requirements.

• The conclusions (may also add implications or applications if space allows).
Lab Reports: The Introduction

The introduction provides the reader with background information about the topic and presents the general design and expected outcomes of the current study.

Format. Follow these general rules:

- Start the introduction on a new page, after the abstract.
- Type the title of the paper in plain text (not bolded) at the top of the page and center it.
- Do not type the word “Introduction.”
- In general, write the introduction in past tense.

Content. A lab report introduction has a ‘flow’ of ideas beginning with the general purpose and context of the study and ending with the specific hypotheses being tested. There are typically four main sections:

- First, a short section/paragraph describing the general topic of interest or problem that exists.
- Second, a literature review section that presents and explains the relevant details of past research. It is similar to an essay and provides the reader with the background necessary to understand the topic and the rationale for the current study design and hypotheses. Coverage of past literature should be thorough with a focus on knowledge, theory, explanations, and conclusions from past research.
  - In general for beginning report writers, aim to present something from every section of an article, with a significant amount of content from an article’s introduction and discussion section, and a just a few sentences describing a study’s method and results.
  - Someone reading your literature review should gain an overall understanding of what is known and understood about the topic, how it has been examined in the past, the theories that have been proposed to explain the results of past research, the conclusions of past researchers and/or an indication of any theoretical debates that exist, and whether there are any areas of research that remain to be examined.
- Third, a short summary the main points from the literature review and the details of the study design. This helps explain the rationale and reasoning for the current study so the reader can understand the hypotheses that follow.
- Fourth, the hypothesis/es of the study. In research reports, a hypothesis:
  - Should follow logically from the literature, rationale, and design.
  - Should be clear, specific, and operationalized.

Lab Reports: The Method

This section provides a detailed description of how the study was conducted. The overall goal is to provide enough detail so another researcher could replicate the method.

Format. Follow these general rules:

- Begin the method section after the end of the introduction (not on a new page)
- Type the word ‘Method’ (bold and no quotation marks) centered on the next line right after the
last sentence of the introduction.

- Write the method section in past tense.

**Content.** Method sections are broken down into subsections that are formatted with APA style headers. The typical subsections are for participants, materials, and procedure; however, other options can be used, such as: apparatus, survey design, data coding, and so on. There may also be third-level subsections (Level 3 heading, as described in Section A). For example, a materials section may include a subsection for each type of material used. In general, use third-level headings sparingly and only if they help with conciseness and clarity.

The kind of information that is included in each of the most common subsections is outlined below. Check with your instructor before adding other subsections to ensure that they are appropriate for your report.

**Method section: Participants.** The purpose of this section is to describe the study sample. In general, the participant section includes the following information:

- Eligibility and exclusion criteria;
- Total number of participants;
- Major demographic characteristics (e.g., age, sex, education, etc.);
- Other characteristics relevant to the study (e.g., number of left-handed and right-handed participants);
- Recruitment and sampling procedures, including an explanation of whether incentives were given for participation (e.g., course credit, monetary compensation, gift draw, etc.);
- For animals, provide the genus, species, strain number or other specific identification (e.g., name and location of supplier), as well as sex, age, weight, and physiological condition. Note that for animal studies, the section heading is ‘Subjects’ rather than ‘Participants’;
- For experiments, the number of participants in each group of the experimental manipulation (e.g., “Of the 130 participants, 43 were in the low caffeine group, 44 were in the high caffeine group, and 43 were in the control group.”). This information is sometimes included in the procedure instead of participants section.
- Include the number participants who dropped out of the study as it was in progress, and reasons why when possible (e.g., “One participant had a broken wrist and could not take part in the mirror tracing portion of study,” or “One male rat developed an illness on the third day of testing and was removed from further trials.”).

**Method section: Materials.** The purpose of this section is to describe the materials in enough detail so that another researcher can gather or recreate them. There is a wide variety of materials that may be included in a study; therefore this list provides a general overview of the most common materials.

- In general, include things like questionnaires, booklets, tests, or equipment that were unique to the study.
- Describe the materials, including how they were obtained or designed (e.g., reliability and validity of questionnaires, range of scores and what the scores signify, procedures established for observational methods, etc.).
• Describe any apparatus used, including publisher/company information.

• Describe any other relevant materials (e.g., if booklets were assembled, the order of the contents; if voice recordings of word lists, the type of voice, speed, etc.).

• When describing, include enough information so that someone could obtain or create similar materials to replicate the study.

• Provide appropriate citations (e.g., test publishers, source articles from which questionnaires were taken, instrument company information, etc.).

• Do not include common materials such as chairs, desks, paper, pencils or pens for writing, etc., unless these items adhered to specific criteria (e.g., “Each participant used a black pen for the note-taking condition and a blue pen for the underlining condition.”).

Method section: Procedure. The purpose of this section is to summarize each step of the research including instructions to participants, randomization (how participants were assigned to groups), counterbalancing and other control features of the design.

• For research involving human participants, include a simple statement regarding consent and debriefing (e.g., “Participants were informed about the nature of the study and provided written consent.” “Participants were debriefed.”). Specific details are not necessary.

• Include the steps that are necessary to reproduce the specific procedure of the study. Leave out unimportant information (e.g., do not include that you said “hello” to the participants, that it was a rainy day, that it was a Wednesday at 1:30, etc.).

• Describe the type of design – within-subject, between-subject, correlational, mixed?

• For experiments, describe how the various conditions were manipulated.

• Describe the instructions given to participants (if very detailed or if they must be repeated exactly as in the experiment, add the verbatim instructions in an appendix).

• Include information on the setting, duration, timespan, etc.

• Be as concise as possible and avoid repetition. Example:
  
  o This: “First, the participants completed the demographic questionnaire. After they completed this questionnaire, the participants read the study passages.”

  o Can be condensed to this: “Participants first completed the demographic questionnaire and then they read the study passages.”

NOTE: In lab studies, the instructor often provides specific information to include in each subsection of the method. Always follow your lab notes to ensure that you are meeting your instructor’s requirements.

Lab Reports: The Results

Format. Follow these general rules:

• Start after the end of the method section (not on a new page) and type the word ‘Results’ in bold (no quotation marks) in the center of the next double-spaced line after the end of the method section.

• Write the section in past tense.
• Italicize all statistical symbols.
• Report numbers consistently, usually to two or three decimal places.
• Place a zero in front of the decimal when appropriate:
  o When a statistic can have a range of values greater than 1 or less than -1, place a zero in front of the decimal (e.g., \( M = 0.37 \)).
  o When a statistic has a restricted range of values between +1 and -1, do not place a zero in front of the decimal (e.g., \( p = .084 \), \( r = .75 \)).
• Report exact \( p \)-values and effect sizes. One exception occurs when statistical software reports the \( p \) value as .000. In this case, report as \( p < .001 \). If you have hand-calculated the statistics, report the \( p \) value that was used to decide significance (e.g., \( p < .05 \)).
  o A note on \( p \) values: The APA manual is not clear on the standard for reporting these values, except to say that authors should be consistent in how they are reported, and that exact values should be reported. Follow the norm established by your instructor. Typically, they will ask for 2 places or 3 places past the decimal.
• Here is the format for commonly used statistics:
  \[ F \text{ test: } F(4,43) = 3.54, \ p = .004, \ \eta^2 = .092 \]
  \[ t \text{ test: } t(68) = 5.29, \ p = .033, \ d = .213 \]
  \[ \text{Correlation: } r(58) = .87, \ p = .001 \]
  \[ \text{Chi-square test: } X^2 (4, N = 90) = 3.51, \ p = .024 \]

**Content.** In general, the content of the results section presents a description of how the data were prepared for analysis\(^4\), the descriptive information about the results, the statistical analysis and outcomes, and a statement of support (or non-support) for each hypothesis. Follow the guidelines below:

• Mention all results, even those that run counter to expectation or those that are non-significant.
• Do not report individual scores or raw data.
• Do not duplicate information; display descriptive information in a sentence or in a table, or in a figure.
• Report sample sizes, means, and standard deviations for each category.
• Include the test statistic value, degrees of freedom, probability (exact \( p \) value), effect size and direction of effect, and confidence intervals.
• Report in sufficient detail to justify your conclusions.
• Present results in sentence format that clearly explains what was found, including the direction of effect for significant results and a statement of support (or non-support) for each hypothesis tested.

---

\(^4\) Data preparation and planned analyses may also be added as a subsection of the Method.
Example

The effect for age was statistically significant, $F(4,43) = 3.54, p = .042, \eta^2 = .21$. On average, older participants ($M = 29.45, SD = 2.14$) performed better on the verbal task compared to younger participants ($M = 22.45, SD = 1.87$). Therefore, the hypothesis that older participants would outperform younger participants on this task was supported.

Tables and figures. Tables and figures may be used to present the results. Choose the format that presents the results in the clearest way: Tables are good for reporting descriptive information such as means and standard deviations, especially when there are many numbers to summarize and present. Figures are good for displaying differences or interactions among conditions, trends, flowcharts, etc. Tables and figures each have specific APA formatting guidelines.

Placement of tables and figures. The APA guidelines indicate that tables and figures should be placed in the order that they appear, each on a separate page after the references section of the report. We prefer that you integrate tables and figures into the body of the report instead. This means that you should wrap the text above and below the table or figure (kind of like what is seen in newspapers). When doing so, do not split tables and figures across pages and do not leave large amounts of blank space before or after a figure.

- If a figure or table will not fit at the bottom of a page, continue typing the text until to the end of the page, even if you need to begin the discussion section. Place the table or figure at the top of the next page, and continue typing the content below the figure.

Formatting tables. Following an established format for tables makes it easier for the reader to understand the results. It also makes it easier for journals to reproduce the tables when publishing. To create simple, effective tables, follow these points. A sample APA-formatted table is shown in Table 1.

- Introduce the table in the text that precedes it, using whole numbers to identify each table as it appears in the paper. The word ‘Table’ should be capitalized.

Example

Table 1 shows participants’ mean test scores according to gender and drug level.

- To create the table, first type the table label in plain text and then on the line below that, type the table title, which should be formatted in title case and italicized.

- Use tabs to line up the table columns and horizontal lines to distinguish the top, bottom, and subsections of the table. Do not use vertical lines.

- Tables may be single-spaced or may use combinations of spacing for clarity. It is not necessary to double-space the entire table.

- Tables, table numbers, and captions are usually left-justified with respect to the margins of your paper.

- Tables are often accompanied by table notes. Your instructor will explain the types of notes and how to format them if they are required for the report.
Table 1

*Sample APA Table Showing Good Use APA Formatting Requirements*

<table>
<thead>
<tr>
<th>Group</th>
<th>Females</th>
<th>Males</th>
<th>Mean Age (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo</td>
<td>6</td>
<td>7</td>
<td>28.43 (3.19)</td>
</tr>
<tr>
<td>Low dose</td>
<td>6</td>
<td>5</td>
<td>29.12 (3.83)</td>
</tr>
<tr>
<td>High dose</td>
<td>7</td>
<td>8</td>
<td>27.97 (3.89)</td>
</tr>
</tbody>
</table>

*Formatting figures.* APA figures are clear, clean-looking, and display results as simply as possible. As for tables, good formatting makes it easier for the reader to understand and for the figure to reproduce well when publishing. To create simple, effective figures, follow these points. Figure 1 below demonstrates the required formatting.

- Introduce the figure in the text that precedes it, using whole numbers to identify each figure as it appears in the paper. The word ‘Figure’ is capitalized.
  
  Example
  
  Figure 2 shows participants’ average recall scores for novel and retested items.

- Use a 12 point sans serif font for any words or numbers that appear in the figure. Examples of sans serif fonts are Calibri, Tahoma, and Arial.

- Label both axes, including the unit(s) of measurement, and provide a legend if applicable.

- Place the figure label in *italics* below the figure, then place a period after the figure label, followed by the figure caption in plain text. Use full sentences with punctuation for the figure description.

- The range of values on the y-axis should match the total possible range of the variable that was tested (e.g., if a test was graded out of 100 points, the axis should range from 0 to 100).
  
  - If there are no upper and lower limits for a variable, such as for an IQ score, the y-axis should extend from -3 to +3 standard deviations from the mean.

- Use grayscale and patterns to distinguish among figure elements; do not use colour.

- There should be clear lines along the x- and y-axis; do not use box borders around the figure or parts of it.

- Add standard error bars if required by your instructor.

- Eliminate any distracting formatting, including 3D effects, gridlines, double borders, and so on.
Figure 1. Sample figure showing APA formatting requirements. The font is sans-serif, the axes are labelled, the legend clearly identifies the group labels, there is no colour, nor is there a border.

Lab Reports: The Discussion

The purpose of the discussion section is to interpret the results and to place them in context by explaining how they “fit” into the literature. The discussion presents the theoretical implications, limitations and other considerations, and overall conclusions about the results of the study.

Format. Follow these general rules:

- Begin immediately after the results section (not on a new page).
- Type the word ‘Discussion’ (bold, no quotations) centered on the page.
- Use past tense when discussing past ideas and results and present tense when presenting conclusions, interpretation, etc. of current results.

Content. As for an introduction section, there is a general flow of ideas for the discussion. In general, the discussion begins with specific details and expands to include conclusions about the general topic. This is typically presented as four sections of information:

- First, a short restatement of the purpose of the study and a summary of what was found in the results (not the stats or numbers).
- Second, an evidence-based explanation and interpretation of the results for each hypothesis test, including:
  - A comparison and contrast to the findings of other researchers (include citations).
    - It is not necessary to compare and contrast to every source mentioned in the introduction. The goal is to use relevant information from the literature to interpret the current study results.
  - A theoretical explanation of the results, by applying theoretical considerations from the
introduction to the results.

- A discussion and explanation of possible confounds, along with next steps to address these in future studies.
- Third, a discussion of possible limitations and next steps to address these in future studies, and mention of the potential generalizability of the results. General next steps, supported by valid arguments, can also be added here.
- Fourth, a discussion of the implications and/or applications of the study and the overall conclusion(s).

Lab Reports: The References

- Follow the guidelines specified in Section 3.

Lab Reports: Appendices

An appendix is appropriate for materials that are relatively brief and that are easily presented in print format (e.g., copy of an unpublished questionnaire, word lists, detailed description of a complex piece of equipment, etc.). They are not always necessary for lab reports, especially when your instructor has created and provided these materials for you. Always check whether you need to include an appendix for your papers (saves you from unnecessary printing costs).

Format. Follow these general rules:

- Begin each appendix on a new page after the list of references and any attached tables and figures.
- If there is only one appendix, label it Appendix.
- If there is more than one, use letters to identify each, in the other that they appear in the paper (e.g., Appendix A, Appendix B).
- To create an appendix, type the appendix label at the top center of the page, in bold (e.g., Appendix or Appendix A). On the next double-spaced line below the label, type the title of the appendix in bold lettering and in title case. Attach the appended materials starting on the line below the title, not on a new page.
- Do not add page numbers to the appendices. Page numbers only appear if they were part of the material that is contained within the appendix.
Appendix A

Resources

APA Style
A note of caution: These resources present the FULL APA format requirements and as such, may contain information that is not applicable to beginner-level lab reports. When in doubt, follow what is in this guide and/or what the instructor has required.

- Basics of APA Tutorial: [http://flash1r.apa.org/apastyle/basics/index.htm](http://flash1r.apa.org/apastyle/basics/index.htm)
- Using APA Format: [http://owl.english.purdue.edu/owl/resource/560/01/](http://owl.english.purdue.edu/owl/resource/560/01/)
- Tricks for APA Format in Microsoft Word: [http://info.csp.edu/Academic-Resources/WritingCenter/Instructional-Videos/](http://info.csp.edu/Academic-Resources/WritingCenter/Instructional-Videos/)

Planning to Write

- Very, Very Useful Assignment Calculator (helps plan a detailed timeline based on type of assignment and due date): [https://www.lib.umn.edu/apps/ac/](https://www.lib.umn.edu/apps/ac/)

Writing & Grammar

- Purdue Online Writing Lab (OWL): [http://owl.english.purdue.edu/owl/section/1/](http://owl.english.purdue.edu/owl/section/1/) Also: Exercises for practice: [https://owl.english.purdue.edu/exercises/](https://owl.english.purdue.edu/exercises/)
- Resources for Writers (also has some APA material): [http://info.csp.edu/Academic-Resources/WritingCenter/Resources-for-Writers/](http://info.csp.edu/Academic-Resources/WritingCenter/Resources-for-Writers/)

Recognizing and Avoiding Plagiarism

- Note Taking and Avoiding Plagiarism: [http://guides.jwcc.edu/content.php?pid=65900&sid=538553](http://guides.jwcc.edu/content.php?pid=65900&sid=538553)
- Plagiarism: How to Recognize and Avoid It: [http://www.indiana.edu/~wts/pamphlets/plagiarism.shtml](http://www.indiana.edu/~wts/pamphlets/plagiarism.shtml)
Appendix B

APA Formatting Checklist

Formatting Basics

☐ 1-inch margins on all sides
☐ Pages numbered, beginning with title page as page 1
☐ 12-point serif font throughout (except figures)
☐ Plain text, unless boldface or italics are specifically required
☐ Typed and double-spaced throughout
☐ Paragraphs are left-justified throughout
☐ Paragraphs are indented (except the Abstract)

Title Page

☐ Unique and descriptive title (about 10 – 12 words), in title case and centered about 1/3 down from top of page
☐ All author information (name, course, university, date)

Other Formatting Basics

☐ Proper levels of heading are used
☐ Numbers rule is followed (spell out if starting sentence, spell out if less than 10, digits if 10 or higher)
☐ Abbreviations are introduced
☐ Lists are formatted properly
☐ Math and stats are formatted properly

Acknowledging Sources

☐ Source material is paraphrased, with NO direct quotes
☐ All sources are cited and referenced
☐ All references in have been cited
☐ Citations follow the rules for presentation (in or out of parentheses & vs and, first vs subsequent citations, format based on number of authors is followed)
☐ Reference page is titled with the word ‘References’ top center and not bolded
☐ Reference list is alphabetized
☐ Each reference listing is formatted with a hanging indent
☐ Specific formatting rules are followed (punctuation, use of italics, etc.)

Lab Report Title Page

☐ Title conveys type of study, variables examined, population of interest (all else as above)

Lab Report Abstract

☐ Abstract begins on a new page
☐ Abstract is headed by the word ‘Abstract’ centered at the top, and not bolded
☐ Abstract text is one paragraph and is not indented
☐ Abstract is about 120 words long
☐ Abstract contains information from each section of the report
Lab Report Introduction

☐ Introduction begins on a new page, headed by the paper’s title
☐ Title is centered, not bolded, with important words capitalized
☐ The word ‘Introduction’ does NOT appear
☐ Content is focused on the purpose of the project, the review of literature, and the design and hypothesis/es of the project

Lab Report Method

☐ Method immediately follows the introduction (not purposefully on a new page)
☐ Method is headed by the word ‘Method’ which is centered and in bold type
☐ The subsection headings are left-justified and in bold type (Level 2 headings)
☐ Subsections include participants, materials, procedure (or other sections as required by instructor)
☐ Level 3 subheadings – if used – are indented, bolded, in sentence case, and end with a period

Lab Report Results

☐ Results section immediately follows the method (not purposefully on a new page)
☐ Results heading is centered and in bold type
☐ Tables and figures are introduced in the preceding text
☐ Tables are formatted properly
  ☐ Correct format for table label and title
  ☐ Horizontal lines used to denote headings and content
  ☐ No vertical lines
  ☐ Table is not split across pages
☐ Figures are formatted properly
  ☐ Correct format for figure label and caption
  ☐ Sans-serif font is used
  ☐ Y-axis reflects possible range of scores
  ☐ Both axes are labelled and legend is provided (if applicable)
  ☐ There are lines along each axis
  ☐ There are no boxed borders
  ☐ Grayscale and patterns are used (no colour)
  ☐ Figure is not split across pages
☐ All results are reported (including non-significant results)

Lab Report Discussion

☐ Discussion section immediately follows the method (not purposefully on a new page)
☐ Discussion heading is centered and in bold type
☐ Content is focused on a restatement of purpose and results, an interpretation of each result, limitations, next steps, generalizability, and conclusions

Lab Report References

☐ All as above

Lab Report Appendix (if required)

☐ Each appendix is labelled and titled in APA format
Appendix C

Annotated Sample Lab Report

The following pages provide a short sample annotated lab report to help students visualize the final product. We have illustrated common formatting features and have provided some writing tips in the notations. This report is NOT comprehensive, meaning that it does not include the full amount of theoretical content that is necessary in lab reports. Most, but not all of the APA formatting requirements are featured: therefore, always double-check your work using the full guide and checklist. Finally, the margins and spacing in the sample report appear slightly smaller than standard APA due to the added graphics for annotations.
Effects of Retesting, Note-taking, and Highlighting on Recall in Undergraduate Students

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Cognitive Processes

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August 1, 2014
The current study examined the effectiveness of various study strategies among 118 undergraduate participants, comprised of 87 females and 31 males with a mean age of 19.52 years (SD = 1.54). Participants studied two text passages by highlighting one and taking notes on the other. They completed two tests; one immediately after studying and another one week later. The second test included repeated test items and new test items. The results indicated a strong testing effect with significantly more correct responses for repeated items than for new test items. These results suggest that students should integrate repeated testing into their studying.
Effects of Retesting, Note-taking, and Highlighting on Recall in Undergraduate Students

Students are often faced with the challenging task of studying for several midterms or exams at once, while also juggling class schedules, assignments, or work schedules. It is therefore important for students to maximize their study time and to employ strategies that will promote a high rate of recall. The purpose of the current study was to examine three study strategies: retesting, note-taking, and highlighting.

Roediger and Karpicke (2006) performed one of the first studies examining the effects of retesting on recall. They explained that students and educators typically viewed test-taking as a method of assessment and not as a possible study strategy. They argued that tests could assume a formative role as well as an evaluative one, explaining that taking multiple tests on material could promote better recall, a phenomenon called the testing effect. Roediger and Karpicke (2006) suggested that the experience of attempting to answer test questions enables a student to practice recalling information and that this practice could lead to enhanced recall on a subsequent test, because the practice strengthens the memory trace for the material.

Roediger and Karpicke (2006) sought to recreate the testing effect found in previous experiments and to eliminate a possible confound in previous research. They explained that in past experiments, participants were typically divided into two groups: one that studied as usual and one that was tested and then retested. This created what Roediger and Karpicke (2006) called the “exposure” confound because participants who studied and took a pretest were exposed to the test material twice before the final test. They argued that perhaps the testing effect was simply due to this added exposure. Roediger and Karpicke (2006) asked their participants to read and study two prose passages by rereading (Study-Study condition) or by testing themselves after studying (Study-Test condition), thus controlling exposure. In a series of experiments, they also
manipulated the length of study time, the number of repeated study sessions, and measured recall at various time intervals. Overall, Roediger and Karpicke (2006) found no differences in recall performance when participants were tested within five minutes of studying but they did find differences in recall after two days and after one week. On these later tests, passages studied through retesting were recalled better, even if no feedback was given regarding performance on earlier tests. Therefore, Roediger and Karpicke (2006) found support for the testing effect and eliminated exposure as a possible confound, suggesting that practice in recalling information enhanced overall learning. They suggested that this occurs because it allows students to practice the skill of test-taking and information retrieval and that educators should incorporate repeated testing into their class schedules.

Einstein, Mullet, and Harrison (2012) suggested that students tend to use rereading as their predominant study strategy, possibly because they are not aware of the benefits of other methods, such as testing themselves as they study. Einstein et al. (2012) suggested that students might also overestimate their ability to recall information simply due to their familiarity with the material from rereading. Furthermore, they suggested that students may not realize that the struggle to recall information through testing is an effective way to improve memory. Therefore, they sought demonstrate the strategy to students and to encourage them to use retesting as they prepare for midterms and exams by replicating Roediger and Karpicke’s (2006) study in an applied classroom setting.

Einstein et al.’s (2012) study followed the procedures established by Roediger and Karpicke (2006). Students completed the traditional experimental process as part of a laboratory project for the course and learned about the testing effect as they worked on their projects. At the end of
the semester, the students also anonymously rated the laboratory project and whether they were more likely to use retesting as a study strategy as a result. The overall results of Einstein et al.’s (2012) study demonstrated the testing effect: students recalled more information for passages using a study-test strategy than when using a study-restudy strategy. Participants also indicated that although they were initially unaware of the testing effect, they intended to use it more often in the future. Overall, Einstein et al. (2012) concluded that the testing effect methodology is applicable in classroom settings.

While the testing effect has received much scrutiny over the past several years, students also commonly employ other methods of studying, such as taking notes from or highlighting information in their textbooks. As such, it is important to examine the effectiveness of some of these alternate strategies. Researchers examining study strategies often base their methods on Craik and Lockhart’s (1972) classic ‘depth of processing’ study that was designed to test their proposal that the process of storing and retrieving involved more than the simple transfer of information. They argued that memory operated more like a processor and that information processed more deeply, such as by considering the meaning of a word (semantic encoding) would benefit recall more than information processed more shallowly, such as by considering the features of the letters in a word (structural encoding). Craik and Lockhart (1972) presented a list of words to their participants; some were encoded semantically, some phonetically, and some visually to encourage different depths of processing. The results supported Craik and Lockhart’s (1972) hypothesis, suggesting that information processed more deeply encourages a stronger and richer memory trace that facilitates later recall.

Depth of processing theory is now widely accepted in the field of memory; however, very few studies have examined the testing effect from a depth of processing viewpoint. The present
study was designed to examine both the testing effect and the differences between note-taking (deep processing) and highlighting (shallow processing) on recall in a classroom setting. Following the general method outlined by Roediger and Karpicke (2006), participants studied by note-taking or highlighting and were pretested on half of the studied material. They were given a surprise test again one week later. Based on depth of processing theory, it was expected that overall recall at both testing times would be better for material studied by taking notes than for material that was highlighted. It was also expected that a testing effect would emerge, with recall for pretested material better than recall for novel material after a one week delay.

Method

Participants

One hundred and eighteen students from a pool of 124 students enrolled in an undergraduate psychology class at a small Liberal Arts university participated as part of a class project. The participants’ mean age was 19.52 years (SD = 1.04) and most (60.23%) were in their second year of studies. There were 31 males and 86 females and the majority of the participants were Caucasian (88.41%). Sixty participants were in the note-taking condition and 58 were in the highlighting condition. Incentives were not provided and participation was voluntary.

Materials

The two passages used by Einstein et al. (2012) were used in this study. These passages were originally taken from an English as a second language test and discuss one of two topics: sea otters and the sun. Each passage is approximately 350 words long. Einstein et al. (2012) also developed 12 short answer questions for each passage; these questions and the corresponding answer keys were used in the present study. A copy of these materials is included in Appendix A.
A short demographic questionnaire asking about participants’ age, gender, year of study, and ethnicity was developed and included in a study and pretest booklet that contained the reading passages and instructions, a distraction task (a general hidden figures test), and the first short answer test that was comprised of six items from each 12-item test. There were four versions of this booklet so as to counterbalance the order of passages (sea otter or the sun) and study format (highlight or take notes). A follow-up testing booklet was designed for the final recall test. This booklet included six previously tested and six novel questions for each study passage. Two versions of this booklet were created to counterbalance the order of the topic of the tests. Sample booklets are included in Appendix B.

**Procedure**

Participation was in a group setting, following a within-subject repeated measures design. Participants provided consent, then received the study and pretest booklet, with the various booklets assigned at random. They were given seven minutes to study the first passage according to the instructions for that passage and then did the same for the second passage. They then completed the demographics questionnaire and were given six minutes to complete the hidden figures test. Finally, participants answered the 12 pretest questions. Participants were not given feedback on the results of this pretest. One week later, participants returned to complete the final short answer test and were debriefed.

**Results**

Participants’ free recall answers were scored as either correct or incorrect according to the marking key developed by Einstein et al. (2012). This resulted in six scores for each participant: 1) a pretest score for the highlighted passage, out of 6 points; 2) a pretest score for the note-taking passage, out of 6 points; 3) a score for the final test on the highlighted passage.
for novel items, out of 6 points; 4) a score for the final test on the note-taking passage for novel items, out of 6 points; 5) a total score on the final test for retested items, out of 12 points; and 6) a total score on the final test for novel items, out of 12 points.

The possible difference between highlighting and note-taking on the immediate test was examined by a dependent t-test. No significant differences were found between test scores for highlighting ($M = 4.51, SD = 1.42$) and for note-taking ($M = 4.67, SD = 1.21$), $t(115) = -1.21, p = .230$. In addition, the possible difference between highlighting and note-taking after a one-week delay was examined by a dependent t-test. No significant differences were found between test scores on novel items for highlighting ($M = 2.15, SD = 1.23$) and for note-taking ($M = 2.04, SD = 1.42$), $t(110) = 0.68, p = .501$. Together, these results indicate a lack of support for the depth of processing hypothesis.

The third analysis examined the testing effect hypothesis by comparing the scores on retested items to scores on novel items one week after studying. A dependent t-test revealed a significant difference between test scores for new items and repeated items, $t(110) = 14.97, p < .001$, with higher scores for repeated items, as shown in Figure 1. This indicates support for the testing effect hypothesis.

Discussion

The current study sought to examine two common study strategies, highlighting and note-taking, combined with the less-known strategy of repeat testing. Participants studied passages by highlighting or note-taking and were tested twice on some of the material. The results indicated no difference in recall performance between highlighting and note-taking, either immediately after studying or after a one week delay. A testing effect was found, such that on a final test, questions that participants had answered previously were answered correctly more often than
novel questions, regardless of original study method. In addition, this testing effect occurred even though participants had not been given feedback on their pretest performance.

**Figure 1.** Average recall scores on the final test of the two study passages. Retested items included six items from each passage that was tested one week prior. Novel items included six items from each passage that had not been seen previously.

The current findings mirror those of Roediger and Karpicke (2006) who found a testing effect after a two-day and one week-delay and Einstein et al. (2012), who also examined the testing effect as a laboratory demonstration. The current study specifically asked students to highlight or to take notes and the testing effect still emerged, adding to the findings by Roediger and Karpicke (2006), who did not manipulate the type of studying used by their participants. This indicates that retesting is a robust and effective study strategy that can be used in many situations and with various study techniques.

Contrary to depth-of-processing theory (Craik & Lockhart, 1972), note-taking while studying the passages did not result in higher recall performance over highlighting. Given that
Craik and Lockhart’s (1972) depth of processing theory is widely supported by the literature, this indicates that the current study might not have adequately manipulated this variable. For example, it is possible that participants were not motivated to create detailed notes or to take notes in their own words as they studied, knowing that the test was for experimental purposes only and held no course credit value. In this case, the note-taking strategy may have been shallow due a simple transcription of words onto a piece of paper. In the future, researchers examining differences in study method and the testing effect in an applied setting may wish to enhance the depth manipulation by giving an incentive such as course credit, which would increase the likelihood that students would put maximum effort into the task.

The current findings lend support to the growing body of research on the testing effect, suggesting that the effect can be found in various learning situations. However, our findings are limited in that only free recall questions were examined. It is possible that the testing effect might not apply to a recognition task, such as for multiple choice questions. Future studies may wish to examine both free recall and recognition tests to see whether the testing effect emerges in both.

A second limitation is the nature of the task itself. While this study was designed and conducted in a lab setting and mimicked a class setting, students do not typically learn materials in only a few minutes, followed by an immediate test. In addition, the materials chosen for the study were not related to the course content. Therefore, as also noted by Einstein et al. (2012), future researchers may want to apply this general design using real course-related materials that apply to actual grades in a course, following a typical lecture and midterm timeframe. Finally, the current results may not generalize to the population due to the non-random nature of the sample of participants. Future studies should re-examine this with a more appropriate sample for
increased generalizability.

Overall, the current study found evidence that the testing effect is a robust phenomenon that may be applied in a real-life class setting. It also found no overall differences between note-taking and highlighting as study strategies. Taken as a whole, this suggests that students wishing to learn information for their courses should study using their preferred method and that they should test themselves as they study in order to maximize the benefits of their study sessions. This may help them to learn and recall the material in the short term and also until – and after – the final exam.

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