PSYC 11 Final paper

Jeremy R. Manning

Spring, 2022

Overview

The most common "product" of scientific studies is a research article (also called a scientific paper, or a manuscript). Research articles are how scientists share their findings with the broader community. For this reason, "doing science" is nearly synonymous with "writing research articles."

As the culminating assignment in this course, you'll be writing a research article about your final project. In doing so, you will draw on many of the skills you practiced in the lab exercises during the first part of this course. Each group will write one paper.

Learning objectives

This assignment is intended to help you:

- Draw connections across the content from different parts of this course
- Practice describing every aspect of a scientific study
- Practice effectively communicating through writing
- Practice thinking about study design, data collection, analysis, and interpretation
- Practice working with peers on a complex project under a deadline
- Practice time management and project management skills

Writing a research article

The basic elements of a research article are described in this lecture. Brief descriptions of each element are also provided below. Although there is no formal length requirement for this assignment, your paper will likely end up being roughly 10–15 pages, excluding a title page, figures, and the bibliography. That said, your primary focus should be on the paper's *content*, not on its *length*. If you can say everything you need to say in fewer than 10 pages, that's great! Or if you need longer than 15 pages, that's OK too. The suggested lengths below assume 1 inch margins, a 12-point standard serif font (e.g. Petrona, Times New Roman, Cambria, Palatino Linotype, etc.), and standard (default) character spacing. Each section (aside from the title) should start with a section heading (e.g. "Abstract", "Introduction", etc.). The Methods and/or Results sections may also be further sub-divided using sub-section headings (e.g. "Participants", "Experimental Design",

etc.). Generally the Abstract, Introduction, and Discussion sections do not include sub-section headings.

Title

The first page of your paper should comprise a title page containing the following information:

- Your paper's title. The title should (usually in 1–2 lines of text):
  - Indicate what your project is about
  - Suggest or describe the project's "take home" message
  - Help to "advertise" your paper by making it sound interesting
- A list of the paper's authors (i.e., all of the group members)

Abstract

The abstract of your paper provides a quick summary of (a) your research question, (b) how you studied your research question, and (c) what you found. Abstracts are typically fairly short (roughly 250–500 words, written as a single paragraph). Whereas the main content of your paper might use some jargon or dig into some of the technical aspects of your project, the abstract should be written at a high level for a broad audience.

Introduction

The goals of the Introduction section are to:

- Motivate your project
- Describe your main research question (and why it's interesting!)
- Summarize what is already known about your question or topic, including citations to key papers
- Set up your approach (e.g., foreshadow what's to come in the Methods section)
- Briefly foreshadow what you found (e.g., what you'll be describing in the Results section)

To help you organize your thoughts about the Introduction section, it may be helpful to draw on your reflections of the Pitch Session Lab. In particular, which strategies were effective for getting other people excited about different research projects? How might you implement analogs of those ideas in written form?

Most Introduction sections are roughly 2–3 pages: half a page for introducing the question, about a page and a half describing what is already known about the question, and half a page briefly foreshadowing the approach and findings. However, each project differs, so this breakdown won't necessarily work for every project or framing. Use your best judgement; it's always preferable to write well and clearly than to follow a particular prescribed format.

Methods

The purpose of the Methods section is to describe what you did, in whatever level of detail you think is needed to enable someone else to replicate your study. In considering what level of detail is "necessary," you may find it useful to draw on your reflections of the Picture Drawing Lab.

Your Methods section will likely comprise the following sub-sections:

- **Participants.** First, who did you test? For example, how did you advertise or recruit participants? What were the demographic breakdowns (along whatever dimensions you measured) of your participants? Next, how did you motivate your participants to do your study? Did you compensate them for their time? Teach them something interesting? Usually this sub-section is relatively short (roughly one half page).
- **Experiment.** Describe your experiment and how you implemented it (to the extent that the implementation details are relevant). It may be helpful to include one or more figures showing a timeline, flow chart, or screenshots of the key elements of your experiment. This sub-section will vary in length depending on the complexity of your experimental design, but generally it takes about a page or two of text to describe the relevant aspects of a complex experiment in sufficient detail.
- **Analyses.** If you carried out any complex analyses (e.g., preparing or preprocessing your data, non-standard statistical tests, models, etc.), you should describe them here. This sub-section will vary in length substantially depending on how you approached your analyses. If your analyses were limited to standard statistical tests (e.g., t-tests, correlations, etc.), you may not even *need* a sub-section to describe your analytic approaches. On the other hand, if you carried out an extensive preprocessing procedure (e.g., where you "cleaned up" the data or excluded certain participants), or if you implemented one or more complicated models, this sub-section might require several pages to sufficiently unpack the relevant details. For particularly complicated procedures, figures may be useful.

Results

The Results section is the "core" of your research paper– it's your primary way of communicating, in detail, what you found. To plan out your Results section, you may find it useful to reflect on the Data Sleuthing Lab.

Your Results section will likely be roughly 3–5 pages. Your job is to tell a "story" about your project. You should start with an overview paragraph (roughly half a page) reminding the reader about your question and approach. Next, take the reader through each of your findings in turn. For each finding, include any relevant figures (and associated captions), statistical results, interpretations, and implications.

An important aspect of turning a list of results into a cohesive story is to help your reader understand the underlying logic of your approach. For example, how did your question lead you to your first set of analyses? What did those initial analyses show, and how did that lead you to your next set of analyses? Each set of results might open up new questions or new avenues for subsequent analyses.

In designing your project's story, you can take substantial "poetic license". Even if your "true"

approach was to "brainstorm a bunch of interesting-seeming analyses we could run on our dataset," you can still tell your story in a way that suggests you had a plan all along. Although you need to report what you did and found openly and honestly, your internal rationale (i.e., your thinking while you were actually doing the project) is *not* always necessary to communicate accurately. In other words, you must communicate what you *did* (and *found*) accurately, but the underlying "why" can be adjusted post hoc to create a more cohesive story. For particularly complex Results sections, it may be useful to split your narrative into sub-sections (each with an overview paragraph, one or more figures, and associated text telling that part of the story). If you take this approach, you should also include a sentence or two at the end of each sub-section that helps to lead into the next sub-section.

Analogous to illustrations in a children's book (or a textbook), figures should supplement your narrative. Your figures should have labeled axes and legends, along with any other descriptions needed to enable the reader to fully understand what is being shown.

📜 Discussion

The Discussion section helps to situate your work within the context of the broader literature. In writing your Discussion section, you may find it useful to reflect on the Literature Review Lab.

Discussion sections are generally around 2–3 pages. You should start by summarizing your main question, your approach, and major findings. Generally this can be done in 1–2 paragraphs (roughly half a page). Next, you should consider different "themes" that show up in the relevant literature, or that you took away from your project. For example, does your project help to clarify a question in the literature? Or did reflecting on the literature (or on your results) uncover important insights or limitations of your study? How should readers interpret or synthesize your findings, and what should they take away from your project?

As in the Results section, your goal should be to tell a "story" whose logic follows a clear narrative path. Each theme might be discussed in 1–2 paragraphs, each with citations of the relevant papers. You should also include transition sentences (or paragraphs) to make it clear how the different ideas you're discussing relate to each other. The Discussion section typically concludes with some comments about potential future directions and/or higher-level questions (beyond the scope of your project or question) to help connect your work with other areas of scientific inquiry.

📜 Bibliography

You should include a list of any papers you cite. Typically, in-text citations follow one of two formats:

- **Author(s) and year.** (Examples: Manning, 2022; Fitzpatrick & Manning, 2022; Manning et al., 2022) For papers with a single author, list the author's last name and the publication year. For papers with two authors, list the authors' last names (separated by "&" or "and") and the publication year. For papers with three or more authors, list the first author's last name, followed by "et al." and then the publication year.
- **Numbered citations.** (Examples: [1], (1), [1], [1–3], (1, 4, 5)) Each referenced paper gets assigned a number (either in order of appearance in the text, or alphabetically by first name). Rather

than spelling out authors and/or years, each paper is referred to in the main text only by its number (e.g., in square brackets, parentheses, superscript text, etc.). This requires numbering the papers in bibliography so that the in-text numbers may be matched to specific papers.

However you decide to format your references, it should be clear what specific paper you are referring to with each citation (to enable your reader to find the paper and read it themselves, if desired). Formatting consistency across references can also improve readability.

Group contributions statement

In addition to your final paper, each student should write up a brief synopsis of each group members' contributions to the project. This can take several forms (including a combination of either of the formats below, or a format inspired by or loosely related to either of the formats below):

- **A CRediT (Contributor Roles Taxonomy) statement.** CRediT statements are a formal way of recognizing each collaborator's contributions to a scientific paper. The linked-to description outlines a variety of tasks that are frequently part of scientific projects, along with an example statement in the suggested format.
- **Descriptions of group members' roles.** You could also write a bulleted list or series of paragraphs describing the role each group member played in the project.

Although the group contributions statement will not (itself) be graded, the group contributions statement provides an opportunity to bring to my attention any aspects of your project, group dynamics, group member contributions, etc. that might merit special consideration. For example, if one of your group members went "above and beyond" what was expected of them, or stepped in to cover a task that was "dropped" by another group member, that may be useful for me to know about. In general I use the group contribution statements to award additional credit to students who put in an outsized effort on the final project. Exceptional circumstances notwithstanding, group contribution statements are *not* used to "take away" credit or lower anyone's grade.

Submitting your paper

Each group should submit a PDF of their final paper on Canvas. All group members will receive the same grade on the paper; only one submission should be made per group.

In addition to the PDF of your group's final paper (to be submitted by a single student, nominated by your group), each student should also submit a separate group contributions statement (as a DOCX file or PDF).

Concluding remarks

Congratulations! By this point in the course, you have conceptualized, implemented, and written up a complete scientific study– no small feat! I hope that the skills you've practiced in this course will serve you well in your future pursuits. If you decide to stay in science, perhaps you'll end up directly applying some of the course material when you write up your studies. But even if you

never again write a scientific paper, the toolbox you've amassed may be used for a broad range of applications:

- **Pitching and introducing.** Convincing others that your ideas and plans are worth following is central to many roles, whether you're a scientist applying for funding or running a collaborative study; a consultant proposing an idea to a client; or a writer selling a book idea to a publisher. In each of these scenarios, and others like them, you'll need to describe your idea clearly and succinctly, and figure out a "hook" that can get other people interested.
- **Explaining.** In addition to communicating scientific methods and results, effective explaining is critical in myriad circumstances, whether you are teaching, managing, or delegating. You'll want to sort out which details are critical versus tangential, and describe the key instructions or conceptual content in a way that your intended audience can understand and follow to produce your desired outcome.
- **Situating.** Impactful ideas cannot exist solely in a vacuum. Helping people to understand why your idea is interesting often entails "discussing" how the idea fits in with the other ideas that came before. You can leverage the ways that others have thought about the question or problem to highlight key benefits or differences of your new idea, or to better understand the benefits and drawbacks of ideas that are communicated to *you*.

Ultimately, good science is primarily about empathy and trusting your instincts. To focus your efforts, empathize by always keeping your intended audience (and their background knowledge, preferences, goals, beliefs, etc.) in mind. And leverage your intuitions and "gut feelings" when you are evaluating your own (and others') ideas. If something seems particularly compelling, or particularly suspect, follow that feeling and use it to gain a deeper understanding.

So: now you're a real psychological scientist. Go unlock the mysteries of the mind and change the world! Oh– and enjoy your break too!