Supplemental Material S3. Research lab manual template.
This research lab manual templeate provides examples of the key components used in our lab manuals to centralize information and introduce undergraduates to successful lab practices. The template is designed to be adaptable across different labs.

COMMUNICATION DISORDERS PROGRAM

Research Lab Manual

Contact Information

Table of Contents

What is Research?

> "Scientists can be as dogmatic as anyone else – but their dogma is always wilting in the hot glare of new research. In science, it's not a sin to change your mind when the evidence demands it. For some people, the tribe is more important than the evidence; for the best scientists, the truth is more important than the tribe." [1]

Research is the diligent, systematic investigation of posed questions. The findings of these investigations may reaffirm commonly held wisdom, reach new conclusions and/or lead to new questions. Judicious use of ethical research methodology supports new discoveries via systematic collection, analysis, and reporting of data findings.

Why is Research Important?

Research discoveries are important because they can support or refute commonly held public beliefs and provide evidence for an observed phenomenon. Research endeavors often lead to more questions. Research can identify evidence for solutions to problems and research methodology to help evaluate the effectiveness of the solutions identified. These aspects of research are vital for evidence-based clinical training programs.

Research Philosophy

As inferred in the initial quote from National Geographic, research endeavors require an open, honest acknowledgment when the evidence obtained does not always support your hypothesis. Ethical research conducted with integrity and honesty provides the evidence to advance our understanding of human physiology. Research-related skills learned over time with guidance dovetail well with clinical work. My clinical experiences inform my research questions and my research pursuits help make me a better clinician.

Why am I interested in research?

Participation in research contributes to the development of knowledge. It is important to explore why you are interested in research - what are your motives for initiation of a project or experience in a research laboratory? Take some time to think about what you hope to learn about and set some goals/plans!

Important First Meetings

Meet your Team!

While this manual provides textual guidance for the start of your research endeavor, the richest support you will receive is from your professors, mentors, and colleagues. Your relationships with the researchers lab are important! Creating a positive, rich work environment that builds up fellow colleagues is a priority!

"I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel." –Maya Angelou

Getting started: Take the initiative and set up an appointment with your mentor.

An initial "research interest" meeting is likely to consist of research topic brainstorming while getting to know each other. If regular research meetings are scheduled to follow-up on the initial meeting, always arrive prepared!

Graduate Research Assistants (GRAs): GRAs are responsible for the engagement, support, and investigative efforts in the laboratory. The GRA will guide you in the lab, provide research advice, and may serve as a mentor for aspects of your project. You are encouraged to email and schedule appointments with the GRA, they are helpful resource as you.

Using University Resources

Universities provides exceptional resources aimed to support educational endeavors, including research! Listed are examples of university-supported resources that are beneficial and likely necessary to use:

- **Librarian Services**

You will be asked to complete some training in the library to become familiar with conducting literature searches. Get to know your resource librarians, many are assigned to specific content areas. Your librarian can provide you instructions for journal searches, a detailed understating of multiple research search engines, and citation management. Your initial meeting with your librarian may include a discussion of research topic, selection of key words to investigate, and an introduction to Library Resources and research journal engines.

Meeting with your librarian is encouraged throughout the entire project timeline.

- **Collaborative Institutional Training Initiative (CITI) Training**

Research ethics training is required for all students. CITI training consists of multiple modules that provide information and corresponding quizzes related to compliance and research ethics. The specific facets of your project will determine which modules are necessary for you to complete. To assure you complete all applicable modules, check with your mentor or GRA.
CITI Program Page.

- **Citation Management**

Citation management allows for efficient inclusion of citations in your research scholarship. There are several citation management software tools available (ex. EndNote, Zotero, Mendeley etc, Check with your mentor to learn which system is being used in your lab.

- **Writing Center**

Writing centers offers one-on-one consultations with undergraduate and graduate peer tutors to aid you in the writing process. This resource is available for an array of writing assignments, courses, and styles. When making an appointment, be sure to clarify that your writing goals relate to scientific research

Lab Equipment Familiarity

After posing a research question(s) and developing the methods for the research question, learning the appropriate lab equipment will further prepare you for upcoming data collection (if your specified project calls for this). Coordinate with your mentor and GRA about times that you can be trained to use the technology and equipment in the lab that will be used to collect your data.

Practice makes Perfect = Trial and Error

What is the best way to practice use of the equipment?

While reading the manual and visually observing the technology will be extremely helpful, actual trial and error of the procedures is crucial. First, read the directions of the equipment. Then, if possible, observe another trained individual as they use the technology. After observing, practice the techniques on classmates and/or yourself. Running through the steps multiple times will reduce errors when collecting data on participants.

What to know about IRB's!

The Institutional Review Board (IRB) is a committee responsible for review and approval of projects that plan to conduct research involving human participants. When starting a project, you need to submit an IRB before collecting data on any human participants. This should happen early in your research process, after project aims are set and methods are refined, to allow time for revisions and approval.

Funding Guidance & Opportunities

- **Undergraduate Research Scholarships & Fellowships**, may be offered to support undergraduate student research. These program requires submission of a proposal and various assignments throughout the completion of the project at hand. Types of fellowships vary by timeframe: year-long, two-semester, one-semester, and summer fellowships. All fellowship opportunities require a detailed application. Funding is provided, specific to the type of scholarship or fellowship offered.

- Each year, American Speech-Language-Hearing Association (ASHA) offers an array of scholarships. Grants, scholarships, and fellowships are often intended for professionals, PhD students, and/or graduate students. Some support may be provided for undergraduate researchers. Familiarity with any ASHA opportunities (proposals, grands, awards, scholarships) is advised! ASHA Student Opportunities

Manuscript Preparation

Writing a manuscript includes multiple revisions, typically over an extended amount of time. Prior to writing a manuscript, recall and use any previous articles you have read when determining a project aim. These will likely show strong examples of the format and flow of a manuscript. You will be assigned reading a several journal articles to learn about your topic of interest and scientific writing. It takes a little while to become familiar with this writing style. Don't feel intimidated to ask many questions. There will be may be many technical words that you are unfamiliar with and you may not feel comfortable with making sense of the statistics. That's ok. Don't give up. We will spend time talking through the articles assigned and you will become better with practice. Remember that you are learning how to read, understand, and conduct research experiments. You should have questions and all questions are to help you learn. It's ok to not know or understand something. Being curious to learn more is the only requirement.

You may choose to write a little or a lot. We will work together to find what fits your goals and ambitions to craft the project which may lead to a manuscript

submission. Your mentor will be very involved in helping and guiding you through the writing process. You don't have to do it alone. Below you will find an outline that can be used to draft your paper. You and your mentor will be discussing each section in regularly scheduled meetings.

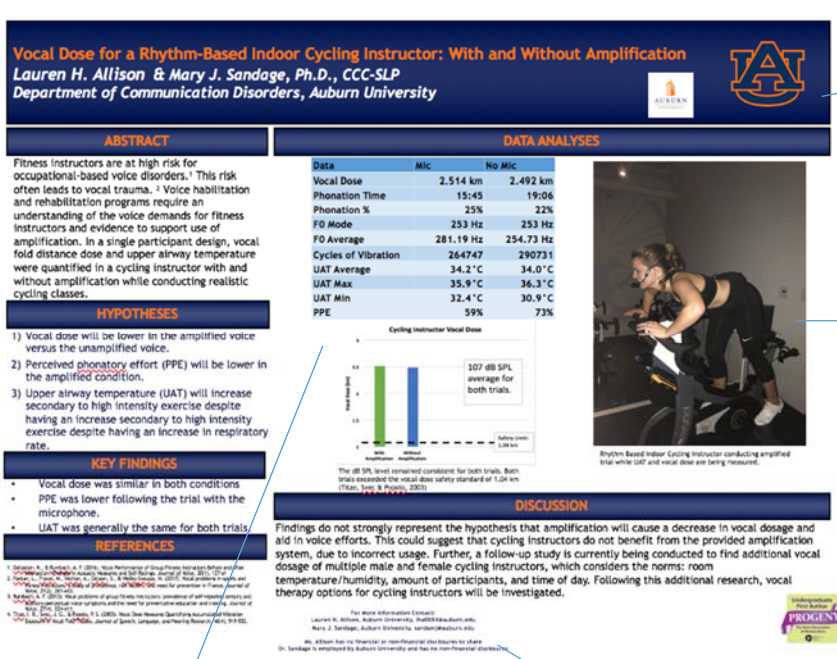
Below is a table that describes the general sections within a manuscript journal.

	What to include:
Introduction	- Introduce topic - Address question, nature of the problem, and purpose. - State rationale, hypothesis, and purpose. - This needs to "**make it** (your subject) **matter**." - Avoid wordiness.
Materials and Methods	- Describe the study design and rationale for participant inclusion/exclusion. - Identify, define, and describe the measurement parameters. - Provide enough details so that the project could be replicated.
Results	- Present data results. - Tables and Figures often incorporated here! Record results in the same manner they are presented in methods. - Do not include any interpretations of data (yet).
Discussion	- Explore and explain meaning of results. - Strengths and limitations of this study - Future directions and suggest new questions
Conclusion	- Concise summary of findings and related assumptions. - Provide any last recommendations or comments.
References	- List of resources used in the creation of your project. - Follow guidelines specific to the journal you plan to submit. - Insert references into EndNote (or another software program).

Poster Preparation

Many conferences host poster presentations during convention weekends. ASHA (a National Convention) and Speech and Hearing Association of Alabama (a State Convention) are two examples of organizations that host annual conferences with refereed poster presentation opportunities. A poster provides a visually pleasing image with key components of the project (listed below):

Abstract, Hypotheses, Data Results & Analyses, Discussion, Key Findings, References



Title

University Logo

Images

Numbering & Bullets

References

Awards

Tables & Figures: tables often provide detailed numerical data. Figures often reveal results in a visual manner. Both should have captions that explain the image in full, while remaining concise.

Contact Information & Disclosure: At the bottom of the poster, contact information

Poster Presentation

How to print a poster:

Discuss with your mentor the guidelines for printing the poster. When printing a poster, make sure to look up the specific measurements that are appropriate for your convention.

Also, some researchers present their poster digitally, often through a power point presentation. This would require coordination, approval, and provided technology from the convention.

Many conventions offer paper poster presentation opportunities to accepted abstracts, submitted by the researcher. At the convention poster presentations, the researcher can present their project to colleagues. Observers often pose questions to the researcher and engage in conversation. Be prepared to explain your project in about 2 minutes or less, allowing opportunity for organic conversation with potential observers.

Oral Seminar Presentation

An oral presentation is seminar-like. Researchers present a prepared presentation, often using audiovisual equipment to a room of observers. At the conclusion of the oral presentation, the lecturer/researcher often allows for questions.

Looking Ahead: Thesis Talk

What is a Thesis? → A thesis is a research paper written by a candidate for a college degree that provides results of original research.

University Options → For many universities, there is an option to complete a thesis. This research experience is designed to help you consider future research opportunities as a graduate student. You may consider completing a thesis in a Masters program or a dissertation as a Ph.D. student. Many students consider these options after completing an undergraduate research experience.

References

1. Joel, A. (2015, March 1). Why Do Many Reasonable People Doubt Science? Retrievedn.d.,from https://www.nationalgeographic.com/magazine/2015/03/science-doubters-climate-change-vaccinations-gmos/

2. Allison, L.H. & Sandage, M.J. (2019). Vocal Dose for Rhythm-Based Indoor Cycling Instructors: With and Without Amplification. American Speech-Language-Hearing Association (ASHA) Convention, Orlando, Florida, November.