Thoughts on Graduate Student Research
04. Writing

Steven R. Fassnacht, PhD, PEng

ESS – Watershed Science, Colorado State University

Goals of Thesis Writing

- Present the story
  - What are the opportunities?
  - What are the main points
    - Just because you spend a lot of time on it does not mean it deserves a lot of text
- Develop Research Questions, Objectives or Hypotheses
  - Use these to guide your writing throughout
  - Keep the same order throughout

General Concepts

- Be concise and succinct
  - Need to use specific words
- Be consistent
  - Use the same words to describe a specific concept, terms, etc.
    - May read boring, but using different words confuses the reader
    - Plan out what these words are and use them throughout
- Write
  - Start early, keep writing
  - Writing is the most difficult part for most science-minded people

Be Careful with the Voice

- Active voice can be better than passive voice, although most scientific writing is done in the passive voice. But it makes for dull writing! https://www.youtube.com/watch?v=TZd7rDVNi58

- In a sentence written in the **active voice, the subject of sentence performs the action**.
  - *Beautiful giraffes roam the savannah.*

- In a sentence written in the passive voice the subject receives the action.
  - *The savannah is roamed by beautiful giraffes.*

Be Careful with Awkward Writing

- Often, you can just say what was found.

- *It has been shown that there is variability in environmental lapse rate temporally* (citation).

  versus

- *The environmental lapse rate varies temporally* (citation).

- Avoid the former. Be succinct.

Referring to Work from Others

- Cite any ideas that are from others
- Use quotes and italicize when add text directly from others
  - Try to avoid this and try to reword/rewrite what they say to put into context of your work
  - Uncited direct (or indirect) referencing is plagiarism

Telling the Reader about Past Work

- Usually don't need to set up the story.
  - *Smith et al. (2015) studied snowpack variability in the Canadian Rockies. They examined data from a variety of sources, and found that snow varies over various scales.*

- Just tell us the main points.
  - *Snow varies over different scales (Smith et al., 2015).*

- If the "*variety of sources*" is relevant then be specific. It would be most relevant if you are using similar or the same dataset, or scales of data

Specific word examples 1

- These come in part from working in (submitting papers to) other (sub-)disciplines, such as meteorology. For some of these there is not actually a consensus of what word should be used, and there is an international difference. Specifically Europeans uses one set of words, and North Americans use another.

- *YES, there are too many words on this and the following slides. BUT, these are meant to be read without a verbal narrative*

Specific word examples 2

1. A variable changes over space and time while a parameter usually only changes over space. For example, temperature is a variable with canopy density is a parameter. Canopy density can change over time due to forest disturbance, but this is much slower than the diurnal fluctuations in temperature. A parameter such as leaf area index (LAI) changes can changes seasonally, such as leaves falling off deciduous trees, but change is slow and values are often consistent, e.g., winter LAI tends to be the same year to year.

2. Hydrological models have input data that "drive" or "force" the model. These are usually meteorological time series of data. The minimum data are typically temperature and precipitation at a specific time step (monthly, daily, hourly, sub-hourly, depending on the requirements). The output data are usually streamflow. Models also have "state" or internal variables, such as snowpack (e.g., SWE and depth) and soil (e.g., soil moisture and temperature) properties

Specific word examples 3

3. A variety of terms is used for model fitting and testing. Most people use the word "calibration" to get a model to fit, or the parameterization of a model. However, for testing, people use "validation," "verification," or "evaluation," often interchangeably. Validation implies that we know the actual answer. This is often not the case, but assumed. For example,

4. Be careful with the word "forecast." Usually the word "estimate" or "compute" is meant. Forecast mean to provide an estimation for an unknown future, i.e., it hasn't occurred yet. "Predict" implies looking into a crystal ball.

Specific word examples 3

5. The word "around" is usually used in a spatial context while "about" usually used in a temporal context. "Where" is spatial and "when" is temporal; "smaller" and "larger" are spatial, while "slower" and "faster" are temporal (especially in the context of rates; e.g., use "slower melt" instead of "smaller melt rate"). Consistency in the words used is even more important than the specific word choice. Similarly, a "pattern" is spatial while a "trend" is over time and usually implies change over a time series, such as the Theil-Sen slope and Mann-Kendall significance test.

6. "Elevation" is height of the ground while "altitude" is height above the ground, i.e., in the air. Europeans often use altitude when they mean elevation.

7. Europeans often use "height of snow" with the variable HS. Others use "snow depth" and the variable d_s. The latter is recommended. Snow depth is measured from the ground up.

Look at the Details and the Big Picture