Methodology Section for Research Papers

Parts of a Research Paper
- Abstract
- Introduction
- Literature Review
- Methodology
- Findings/Results
- Discussion
- Conclusion

The methodology section of your paper describes *how* your research was conducted. This information allows readers to check whether your approach is accurate and dependable. A good methodology can help increase the reader's trust in your findings. First, we will define and differentiate quantitative and qualitative research. Then, for each of these types of research, we will look at the kinds of information that a methodology should provide. This handout has annotated examples of both quantitative and qualitative methodologies.

What are Quantitative and Qualitative Research?

Quantitative research involves collecting numerical data and conducting mathematical analyses to observe trends, make predictions, run experiments, and test hypotheses. Qualitative research involves collecting non-numerical data and identifying patterns in language, theme, and structure, among other features, to understand human experiences. Instruments for qualitative research include questionnaires, interviews, and observations.

What Information Should You Include in the Methodology?

The goal of your methodology is to increase the credibility of your research by making your process transparent and reproducible. Your methodology should begin by describing your research question and the type of data you used in answering it. You want to indicate why this type of data is appropriate, relevant, and important to the question being asked.

You will then explain your process of data collection. This is the place to state the tools and materials that were used to collect data, the process and criteria you used to sample subjects, and the size of your sample. If your research was quantitative, you will specify how your data was measured. If your research was qualitative, you will describe how data was recorded and how you observed and/or participated in the study. You want to provide enough detail for readers to be able to replicate your procedure. If you used existing data sets instead of collecting new data, you can elaborate on where you found the data sets, how the set was originally produced, and what criteria you used to select the data. Remember to explain why you made these decisions.

After describing data collection, you will elaborate on data analysis. This includes how you prepared the data for analysis and what tools you used to analyze it. If your research was quantitative, you will outline the mathematical calculations you performed. You will also explain why your calculations were appropriate for the data and the research question in hand. If your research was qualitative, you will describe your process of interpreting, labeling, and analyzing

data. When working with personal or sensitive data, you should describe the steps you took to protect the privacy of your sources.

Finally, you will justify the approach you took. You should show that your approach was appropriate to answering your research question. If your approach is unconventional, you should explain why your approach was more effective than other methods. This is the place to mention any difficulties or challenges you encountered in your approach and to explain how you addressed these issues.

Sample Quantitative Methodology with Annotations

Provides relevant and detailed information regarding the environmental conditions of the experiment

Cites sources as needed

Acknowledges limitations of the chosen approach, while also showing that this choice was appropriate

Provides sufficient detail, including measurements wherever possible, so that the reader is able to replicate the experiment

Study site. This study was conducted within an intact tabonuco (*Dacryodes excelsa*)-dominated forest at *ca* 400 m elevation near El Verde Field Station in the Luquillo Experimental Forest (LEF), Puerto Rico (18°10'N, 65°30'W). The site is classified as a subtropical wet forest, with average temperatures ranging between 21°C in January and 25°C in August (Waide & Reagan 1996). Annual precipitation averages 3700 mm and varies seasonally, with 200 to 250 mm/mo during January–April (dry season) and 350 mm/mo for the remainder of the year (McDowell & Estrada-Pinto 1988). Precipitation exceeds evapotranspiration in all months. Soils are Ultisols belonging to the Los Guineos series, which are well drained, acidic clays and silty clay loams (Waide & Reagan 1996).

Literbag preparation. Although litterbags may not accurately depict true rates of litter decomposition due to the artificial drying of the leaves (Taylor 1998), exclusion of large soil fauna (Stewart & Davies 1989, González & Seastedt 2001), and microclimatic alterations imposed on the decaying material (Heal *et al*. 1997), the technique is a useful tool for experimental comparison of litter decay (Swift *et al*. 1979, Heal *et al*. 1997). . . . Upon collection, leaves were air-dried for 48 hours and stored until use. Litter of each type was thoroughly mixed and litterbags (10 x 10 cm, 1 mm fiberglass mesh) were then filled, so that each contained 2.5 ± 0.1 g of leaf litter from only one of each species and treatment (green or senesced). . . . Bags were placed on the forest floor in early November 2001 and five replicates of each species and treatment combination were collected at each of four sampling dates: 14, 28, 56, and 112 days. Upon collection, litterbags were oven-dried for seven days at 50°C. Bags were then dismantled, leaf litter was separated from soil, roots, and other debris, and the remaining leaf

material was weighed to determine the fraction of leaf mass remaining.

Nutrient analysis. Four subsamples for each species and treatment were collected from the bulk litter during litterbag construction and analyzed for total C, N, and fiber using methods described by Madritch and Hunter (2002). Briefly, samples were dried at 65°C for three days, ground into a fine powder, and then stored at 80°C prior to analyses. Carbon and nitrogen were measured using a Carlo Erba NA 1500 CHN Analyzer® (Carlo Erba Instrumentazione, Milan, Italy). Dry mass percentages of cellulose, hemicellulose, and lignin were determined using sequential neutral detergent/acid digestion in an Ankom Fiber Analyzer® (ANKOM, Fairport, New York).

Data analysis. The decomposition of leaf litter is commonly described by a negative exponential function of the form: $X_t/X_0 = e^{-kt}$, where X_0 is the initial mass of litter, X_t is the mass of litter at time t, and k is the decay rate constant (Olson 1963, Swift *et al.* 1979). The decay rate constant k thus provides a single, functionally relevant parameter for describing decomposition. This simple model, however, has been shown to inadequately depict early stages of mass loss in some studies, thus prompting modifications to the model (Gallardo & Merino 1993, Sullivan *et al.* 1999). In this study, rapid initial mass losses of over 20 percent in the first two weeks resulted in a poor fit of this traditional decay model since the model requires the *y*-intercept to pass through zero. To redress this problem, we allowed an intercept term y_{int} in the model that serves as an indicator of the initial mass loss or leaching losses (Sullivan *et al.* 1999). This resulted in a model of the form: $\ln(X_t/X_0) = -k't + y_{int}$, where X_t is the mass remaining at time t, X_0 is the original mass of the substrate, and k' is a decay rate constant describing a post-leaching phase of decomposition.

Multiple linear regression models using indicator variables for treatment (green vs. senescent) were applied separately for each species to test for differences in slope (k') and y_{int} between green and senescent litters. N, C, fiber, and other litter quality indices were analyzed for differences between green and senescent leaves across all species using analysis of variance and within-species using two-sample *t*-tests. Litter quality indices were also tested

against the decay rates k' using simple linear regression to determine which indices best correlated with decay rates across all species and treatments. All statistical analyses were conducted using S-Plus statistical software (MathSoft 2000).

Source: Fonte and Schowalter, "Decomposition of Greenfall vs. Senescent Foliage in a Tropical Forest Ecosystem in Puerto Rico," *bioTROPICA*, 36(4) 2004.

Sample Qualitative Methodology with Annotations

Draws connection to research question

Specifies criteria for data sample

Provides sufficient detail for the reader to replicate the study

Provides rationale for research decisions

To find out how Twitter users imagine their audience, we asked them directly. We posted questions to our own followers (many of whom retweeted our question to their followers) and sent @reply questions to a sample of users whose tweets appear in the public timeline, every person in the 300 most-followed accounts (249 total), and a subset of users with 1000–15,000 followers. While all the Twitter accounts we reference are public, we anonymized all of our informants except the highly-followed users. Our questions included: 'Who do you imagine reading your tweets?' and 'Who do you tweet to?' Later, we asked: 'What makes an individual seem "authentic" on Twitter? (Or what does it mean to be authentic?)' and 'What won't you tweet about? What subjects are inappropriate for Twitter?' Our goal in approaching different types of users was not to get a representative sample of Twitter users but to elicit potentially diverse perspectives.

Acknowledges and discusses obstacles encountered during research

Given the issues mentioned above, we are unable to assess how many people saw our tweets. We received 226 responses from 181 Twitter users through direct messages or @replies to our queries. The responses we received revealed many different perspectives on audience. While we can neither quantify audience management techniques nor account for all potential perspectives, the responses we received provide valuable insight into some core differences in conceptualizing audience. Future empirical work might examine the prevalence of these strategies and their relationship to follower counts, demographics, or genres of content.

Source: Marwick and Boyd, "I tweet honestly, I tweet Passionately: Twitter Users, Context Collapse, and the Imagined Audience," *New Media & Society, 13(1)* 2011.

Activity: Learn About Methodologies in Your Field

Navigate to Google Scholar or your library database. Or visit the SJSU ScholarWorks page (scholarworks.sjsu.edu), click "Collections," select a college, select a department, and then click to view "Master's Theses and Graduate Research." Find some articles, both quantitative and qualitative if possible, on a high interest topic for your chosen field.

Compare the methodologies in these articles to the two samples we looked at above. What is similar? What is different? What patterns seem most common? How long are the sections?

Reference

University of Southern California. *Organizing Your Research Paper Methodology. USC*

Libraries, 2021, July 27, https://libguides.usc.edu/writingguide/methodology.