

Writing the Methods Section

The 'Methods', or 'Materials and Methods', section is usually a short section in a research paper. It enables readers to:

- Understand what you did, what methods, equipment and/or reagents you used and where you got them;
- Precisely reproduce your experiment or study;
- Judge whether your results and conclusions are valid.

The Methods section needs to be tightly written and follow a logical structure (described below).

Terminological distinctions

The following terms are often used in a Methods section. They are sometimes conflated, but they have different meanings.

Methodology

This is the broad framework that supports the rationale for, or purpose of, a study. The methodological framework is the lens through which you *interpret* your results. Constructivist, positivist, empiricist, interpretivist, critical realist, phenomenological, or ethnographic are just some of the methodological frameworks commonly adopted. A brief description of the Methodology may be included in the Methods section, or it may be incorporated into the background to the study in the Introduction. It may also be a section of its own (e.g., the Methodology is often called 'Theoretical Framework' or 'Conceptual Framework' or even 'Research Philosophy').

Methods

These are the specific ways in which you *collected* your data, and the circumstances under which this occurred. It might include the *context* of the study—i.e., the study conditions—and how evidence was gathered. This includes, for example, how the specific measurements or samples were taken, or how data from human/animal interactions were recorded. Methods means both: a) the research *tools* and/or the *reagents* used and/or b) the research *approach* taken:

- *Tools*: focus groups, case studies, online data collection strategies, interviews, statistical measurement techniques, and so on. Tools used can vary in type, so it is important to describe them. For example, interviews can be structured or semi-structured; surveys can be multiple choice or open-ended written responses.
- *Approaches*: grounded research, action research, experimental research (e.g., control/experimental groups or pre-test, post-test), qualitative, quantitative, or mixed methods, etc.).

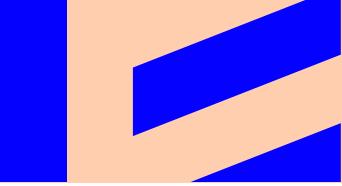
These are all described in the Methods section. (NB: Confusingly, the term 'Methodology' is sometimes used to *include* the Methods.)

Materials

These constitute *what* was studied, for example participants, animals, equipment, tissue preparations, actual materials, reagents and where they were obtained. This section is sometimes incorporated in the Methods section, and sometimes it is its own section.



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Procedure

This describes the *process* and *processes* used to undertake the study. It is a series of steps in chronological sequence: e.g., '*this was done, then this was administered ...*'. Details in this section must be precise so readers can reproduce the study exactly as you did it. As with the Materials section, this is sometimes incorporated in the Methods section, but sometimes it has its own section, especially if a study is complex with many variables.

In summary:

- **Methodology:** The broad framework used to interpret a study
- **Methods:** *How* you collected your data (the context studied, tools used, and approaches taken)
- **Materials:** *What* was used in your study and where it was obtained
- **Procedure:** The *processes* undertaken during the study.

What is the right term?

What is the right term: '*I use several methods?*' or '*I use several methodologies?*'

The answer is: it depends on the emphasis. If you are referring to the research tool or approach used to collect data, then you mean 'methods'; if you are emphasising the broad approach behind your research that explains your choice of methods, you mean 'methodologies'. (Note: The literature sometimes uses the two terms interchangeably.)

How to write the Methods section

As the Methods section is the most structured in a scientific paper, it is often the simplest to write. Many researchers therefore start on the Methods section when writing a scientific paper as it helps organise the task ahead.

This section should be set out in a logical fashion, moving from *general* to *specific* information, i.e., from the methodological justification for the Methods; to *how* you did the study, i.e., the Methods themselves; to the specific details of *what* was studied, i.e., the Materials; and finally, the *process* that was used, i.e., the Procedure.

1. Outline the broad **Methodology** used or assumed (if applicable)
2. Outline the specific **Methods** used
3. Describe the specific **Materials** used in the study, i.e., how they were selected and prepared for the study
4. Describe the **Procedure**, i.e., the research protocol, how measurements were made, and how calculations were performed, e.g., outline the steps taken for statistical analysis of the data.

Describing the Method

The following stages are recommended for the Methods section:

Methods (simple present or simple past tense)

Overview (present or past tense)

- '*The choice of sampling method for this experiment **requires** great care...*'
- '*Company employees **are** crucial for the success of the ...*'



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- 'A bilingual and monolingual group **were compared**. ...'
- 'Total phosphorus and total nitrogen **were measured** ...'

Description of parts/samples/tools/approaches used in the experiment (simple past tense)

- 'An Agilent Model 8453 UV-visible Spectroscopy System set at 495 nanometres **was used** to ...'
- 'A 1.45-gram sample **was taken** from the distal region of the liver of male Sprague Dawley rats between 17 and 24 weeks of age ...'
- 'Female participants between the ages of 25 and 42 years of age and without any past medical or family history of cardiovascular disease **were selected** from a pool of ...'
- 'A standard protocol **was followed** in selecting...'

Spatial/functional organisation of the experiment and any restrictions (simple past tense)

- 'The surveys **were conducted** under strict conditions ... Firstly the ... was ... then the ... was...'
- 'Only bilingual students less than 30 years of age who were either born in France or had lived in France for at least 2 years within 5 years prior to the commencement date **were** of interest for the purposes of this study ...'

Sampling technique [if applicable] (simple past tense)

- 'The bilingual subjects **were selected** from the cohort of Mexican participants.'
- 'An inter-rater reliability coefficient **was used** to ...'

This can be followed by the Materials and Procedure sections as follows (typically with no break or additional heading).

Materials (past tense)

Description of materials used (simple past tense)

- 'Antibiotic levels in milk **were** analysed using a Perkin Elmer QSight® triple quad LC/MS/MS 400 Series...'
- 'Human Cytochrome P450, 1A1 Isozyme Microsomes, with P450 Reductase, recombinant, expressed in baculovirus infected insect cells (BTI-TN-5B1-4), Enzyme Commission Number 1.6.2.4 (BRENDA, IUBMB) **was** obtained from Sigma-Aldrich, St. Louis MI, USA (SKU C3735-1VL)
- 'The model used **consisted** of a series of glass plates which were ...'

Description of how they were used

- 'The XYZ survey **was** used to collect data on ... This **was** administered using ...'
- 'The model **was** engineered to extract ... / the plates **were** used to ...'
- '5 micron tissue slices **were** subject to 100 lumens of ultra violet light at 280 nanometres for 30 seconds. The light source **was** 20 millimetres from the samples ...'

Procedure* (NB: In some reports this comprises a separate section to Methods)

- 'The participants **were** first given a 400-millilitre glass of water at 4° C to drink ... They were **then asked** to ...'
- 'The experimental group **was** instructed that the auditory test would be five-minutes in duration. Then they were asked to ...'



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*Choose whether to use active or passive voice to describe procedures:

- Use the passive voice if no human agent needs to be mentioned ('*The monitor is placed in a suitable location and turned on...*')
- Use active voice if it is important to mention the human agent ('*The team presented the survey to all employees...*'). Use passive if this is not important: *The survey was presented to all employees ...*'

Related helpsheets

- Writing the Discussion section
- Writing in the Third Person
- Incorporating Evidence
- Editing your Writing



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