

## **A Guide to Writing Scientific Essays**

These are general points that any good scientific essay should follow.

1. Structure: essays should make an argument: your essay should have a point and reach a conclusion, even if tentative, and you should try to convince the reader that your point is correct. This is the most important single point in writing a good essay. It will help you make it well organized, and well-written. Clarity of thought and argument provide the necessary basis for a clear writing style. Thus, just like making a legal case in the courtroom, you follow a logical progression, using data or evidence to support each step of your argument, until you reach a logical conclusion.

What counts as a good argument, or a solid conclusion? There is room for considerable creativity here, depending on the topic. It is easier to say what does not count as a good conclusion. For example, you should never just review a study or studies, and conclude that "more work is necessary". More work is always necessary, and YOUR work in this essay is to reach a more substantive conclusion than that. A recapitulation of some experiments with no substantive conclusions does not constitute a good essay, however accurate.

State the point of the essay in the introduction, using the first person (I argue, I believe, etc.). For example: "I will argue here that the frustration/aggression hypothesis is based on an oversimplified and inadequate psychological model, and is thus unable to explain most cases of prejudice that have been analyzed".

2. It is key to back up each crucial point that you make with data. Don't just cite the study, but briefly describe its key result(s) in a sentence or two, and explain, explicitly, why this supports your point. Any statements of nonobvious fact (e.g. "monkeys can follow gaze", or "dopamine is necessary for motor function") should be followed by a reference (even if only to a textbook).

Each piece of data should be cited at the appropriate place in the argument (and not repeated excessively in other less appropriate places). Avoid unnecessary data. How many of a species live where, what it eats, etc. are typically NOT relevant. Specific statistical values, like means or p values, are almost never appropriately cited in a review. Also, don't describe all the details of any experiment, only those that are relevant to the question you are addressing.

On the other hand, ALWAYS cite relevant data. If something is relevant to your point, you must cite it (even if it goes against your argument!). Finally, don't say "This treatment appeared to have an effect" - either there was a statistically significant effect (in which case you say "there was a significant effect of x on y) or it didn't ("there was no effect of x ")

3. Proof: Note that the logic of scientific discovery is that of generating a list of possibilities (postulating hypotheses) and then doing experiments to test them. We proceed by rejecting false hypotheses, rather than proving true ones. If we've rejected all of the plausible hypotheses but one, we consider the one left standing to be the best one, so far, but we don't consider it proven until a large amount of data converges on that as the only remaining possibility, from many labs and with many different techniques. So it is very unusual for a single empirical study to "prove" a particular hypothesis. It may be consistent with that hypothesis, but doesn't prove it.

So in general, we say "this finding rejects the hypothesis that x", or "this finding is consistent with the hypothesis that y". Scientists tend to avoid the word "proof" except where the logical case is really water-tight.

Similarly, a bad or methodologically flawed experiment can't prove (or disprove) anything (except the ineptness of the scientists who performed it).

4. Being critical means carefully examining the factual basis for a statement. Just criticizing a study (e.g. for only looking at one species, using a particular methodology, or having too few data points) does not demonstrate a critical attitude. Part of science is separating the crucial from the incidental factors, and criticizing incidentals is worse than saying nothing at all. Being overcritical about irrelevant issues is as bad as (maybe worse) than being uncritical.

So for example, using a technique that is not perfect, or has only a few conditions, or using a single test species, etc., are not valid targets of strong criticism. They may be points to be brought up in considering the *implications* of a study, but they are not "flaws". Flaws include critical things left uncontrolled, poorly-described methods, incorrect statistics or hypotheses overlooked that suggest the results presented do not show what the scientists claim they show. Thinking of alternative hypotheses that can explain the observed data in a different way is one of the most creative aspects of psychological research, and can be challenging and fun.

5. Be concise. Avoid such tropes as "it is believed that" or "scientists believe". Or (perhaps worse) "the general consensus seems to be..." (Science is not a popularity contest!) Say instead, "Herman (1996) {claimed (particularly if you don't agree)/showed (particularly if you do)/suggested (if it is a hypothesis)} that x". If it is you making the argument, just say "I suggest" (don't say "this paper suggests").

Keep sentence structure simple and clear (avoid run-on sentences). Finally, avoid colloquial or informal expressions "a lot of", "to try and see what is best", or hyperbole ("this fabulous and amazing study").

6. Do not use technical terms not known to a general psychologist without definition and explication. Terms like "metarepresentation", "pedunculopontine", "second-order representation", "phoneme" or "intentionality" have technical uses that need to be concisely summarized.

7. Latin names of species are italicized. The genus is always capitalized and the species never is (*Homo sapiens*, *Canis familiaris*). If the species is unknown it is written *Naja sp.*, (singular) and if you want to discuss multiple species of the same genus you can write *Naja spp.* (plural). These rules are the same for all living things.

On the other hand common names of animals are typically not capitalized in modern literature (we say rhesus macaques, not Rhesus Macaques). The exception is when a place name is involved (Alaskan brown bears, not alaskan brown bears).

8. References: You must cite all work that you rely on to in making your argument. More detail on this is given in the section on Plagiarism below. All references should be given in full at the end of the essay (as in the example reference list at the end of this section). In the text, these should be referred to using the names of the authors

and the date of publication. For example: Stein and Walsh (1997); Correll, Park, Judd and Wittenbrink (2002). If there are more than two authors, then this may be abbreviated if you need to refer to it again (so this example becomes Correll et al (1978). If there are six or more authors, you should use 'et al' even for the first citation.

Note there are two formats that can be used for referencing, shown here:

"Stein and Walsh (1997) review the evidence for differences in the magnocellular processing stream ..."

"There is evidence that processing in the magnocellular stream can differ in dyslexia (Stein and Walsh, 1997)"

Don't cite something you haven't read yourself directly. Instead say: "(Sherif (1966), as cited in Hogg et al)". Then give the reference to Hogg et al, *not* to Sherif (1966), in the reference list.

9. A few common mistakes with scientific terms/words/abbreviations:

- A. The abbreviation for *et alia* (which means "and others" in Latin) is et al. So you write (Jones et al., 1978). Do this *only* if there are two or more co-authors in addition to the primary author (so Jones and Smith 1978 is never Jones et al 1978)
- B. One stimulus, two stimuli. "A stimuli" is not a correct grammatical construction.
- C. "Data" are plural. "The data are consistent with...". The singular term, "datum" is rarely used - instead we discuss a single "data point"
- D. "Ganglion is" singular, "ganglia are" plural (thus "the basal ganglia are"). Same with criterion (sing) and criteria (plural) or phenomenon (sing) vs phenomena (pl).
- E. Hyperbolic terms like "huge", "amazing", "vast" , and "incredible" and punctuation like "!" very rarely have a place in scientific writing.
- F. The "work" of some scientists generally refers to their life's work or some subset of it, and thus more than a single paper. If you want to discuss one paper, call it a "study".
- G. Replication: a study is an "attempt at replication" if they 1) use the same methods and "a replication" if they 2) get the same results. If they don't get the same results it is a "failure to replicate". If they don't use the same methods (in broad outline) it is neither an attempt to replicate, nor a failure to replicate - its just a different study.

10. Finally many students seem to have problems with contractions and possessives. Singular possessives are formed by adding -'s (a single animal's food). The possessive of a regular plural (with -s) is formed by adding the apostrophe after the s: "all the animals' cages". But irregular plurals (like person/people) just take the -'s: "The People's Party"

## **REMEMBER:**

**Make an argument, and reach a conclusion.** State the argument in the introductory paragraph. The rest of the essay is an attempt to convince the reader that your argument is sensible, logical, and conforms to the facts. The most

important thing is to argue some point: don't just say what they are but say what the advantages and disadvantages of each are.

**Example References:**

**Journal Article:** Fitch, W. T., & Hauser, M. D. (2004). Computational constraints on syntactic processing in a nonhuman primate. *Science*, 303, 377-380.

**Book:** Byrne, R. W. (1995). *The Thinking Ape: Evolutionary Origins of Intelligence*. Oxford: Oxford University Press.

**Book Chapter:** Fitch, W. T. (2005). Computation and Cognition: Four distinctions and their implications. In A. Cutler (Ed.), *Twenty-First Century Psycholinguistics: Four Cornerstones* (pp. 381-400). Mahwah, New Jersey: Lawrence Erlbaum.