Statistics Writing

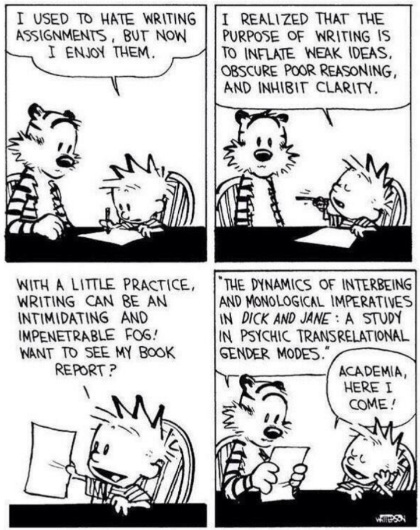
How to write more gooder

Samuel Robinson, Ph.D.

Nov 3, 2023

Outline

- Types of scientific writing



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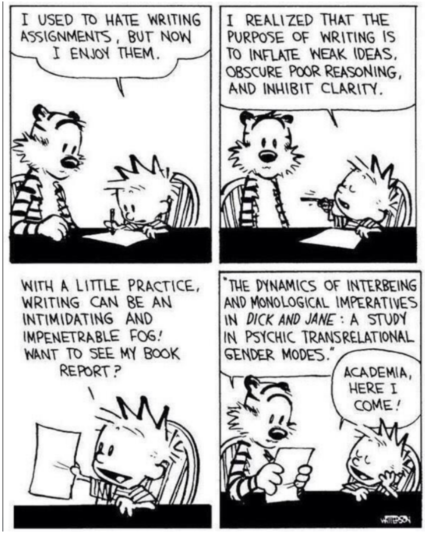

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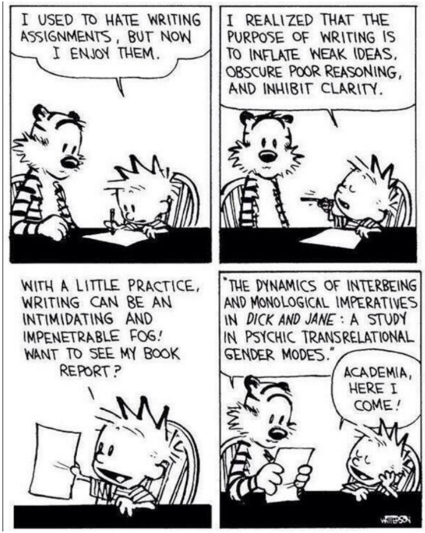

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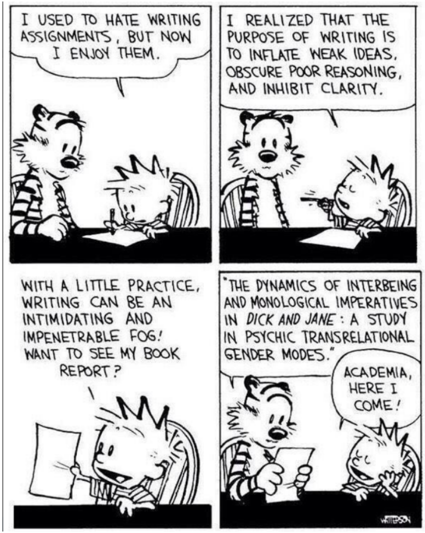

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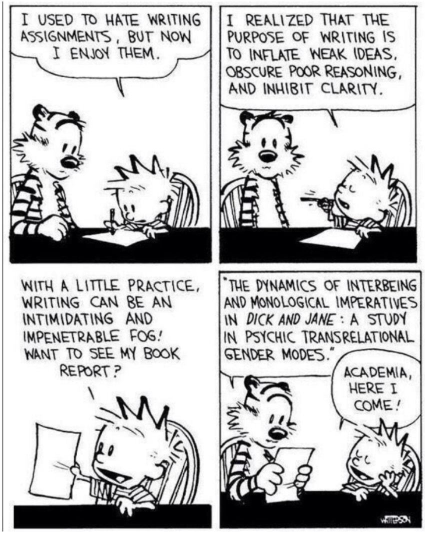

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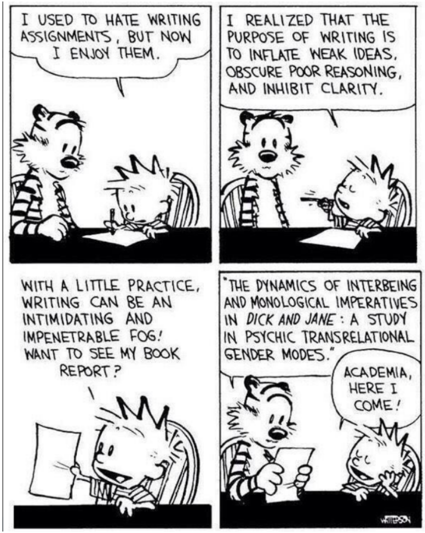

Part 1: Types of scientific writing

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- You've finished fitting your models, and the results make sense to you, but...
- How do I translate all these numbers into "real" English?
- Where do I put all these numbers in the paper?
- Do I need figures and tables?

Answer: “It depends”

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- Do these numbers help my audience to understand what I found?
- Would figures or tables help to prove my point more concisely or easily?
- How do these numbers relate to the rest of the literature?

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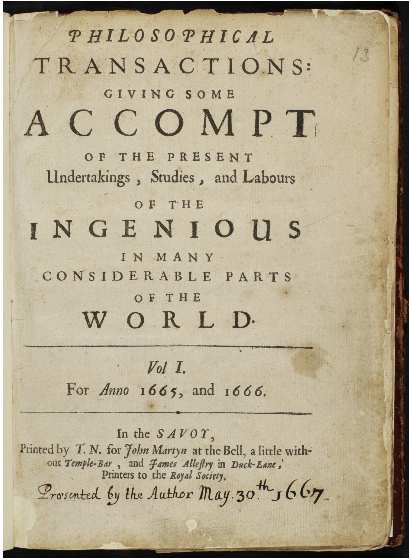
    - Biology began slightly later (1700s-1800s), as offshoots of medicine and natural history
- "Natural philosophers" (scientists) would write letters to each other about what they were up to

A bit of history (cont.)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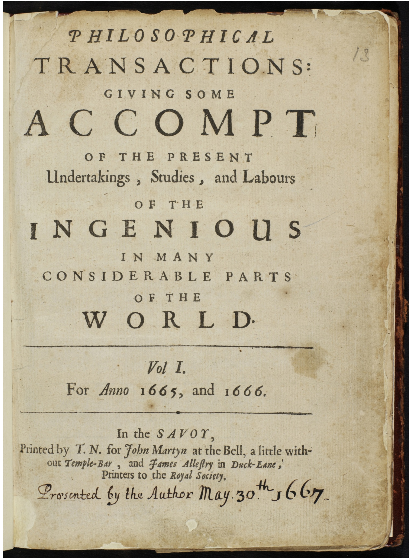

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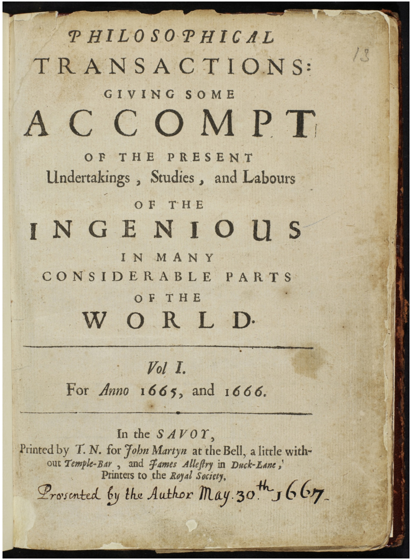
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- Early science writing is *extremely* varied, and is much different from modern science writing

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- More recent push for *replicability*, with data and code being stored in online repositories

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“[Fiske is] seeing her professional world collapsing... her work and the work of her friends and colleagues is being questioned in a way that no one could’ve imagined ten years ago. It’s scary, and it’s gotta be a lot easier for her to blame some unnamed”terrorists” than to confront the gaps in her own understanding of research methods.” - Andrew Gelman

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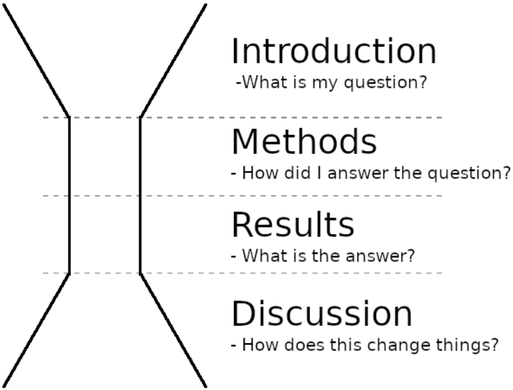
IMRaD Paper Structure



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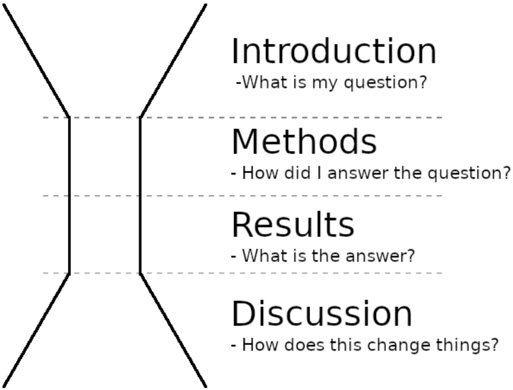

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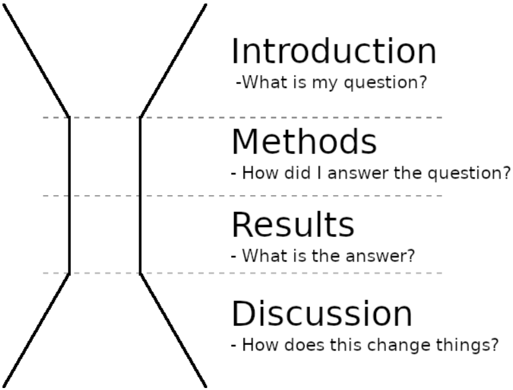

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- Generally, statistics are discussed in the *Methods* and *Results* sections only

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- I recommend highlighting, underlining, or annotating the paper for later reference

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  - Prediction: "... we should see more bat foraging activity in forests"

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  - `lm(batCounts ~ forest + unicorns)`

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- **So what?** What new things have we learned? How might this affect theory or practice? Should non-bat people pay attention to this paper?

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2. Use them to illustrate what your models show and move the rest into a supplemental or appendix.

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   - Formal proposals include a timeline and a budget, as well as a list of personnel

Part 2: Writing about statistics

Models as evidence for arguments

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Show the *bare minimum* number of statistics needed to convince people. If it's not relevant to your story, move it somewhere else.

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    - Model structure and performance checks (residual plots, etc.) should *also* convince the reader that this is believable

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[1] Inductive reasoning

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[1] Inductive reasoning

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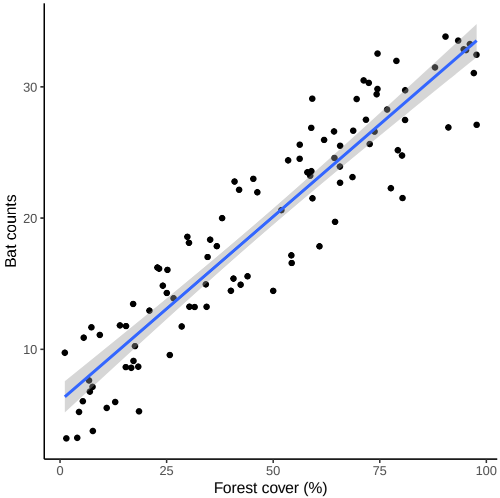

What might the underlying physical process be here?

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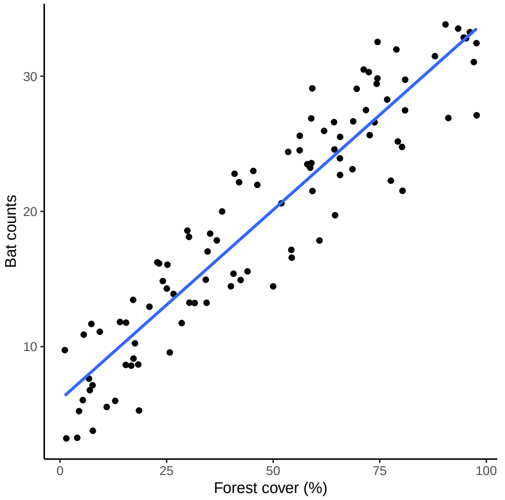

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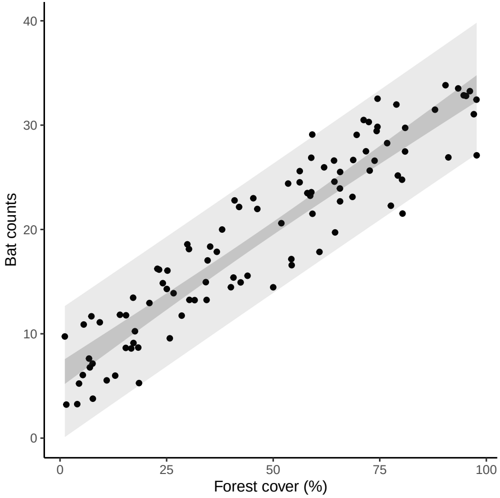


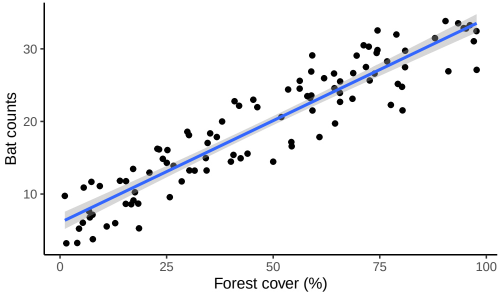
Example write-up

Say we fit a model of bat counts that looks like this

```
##
## Call:
## lm(formula = batAbund ~ forest + unicorns, data = d1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6.5932 -2.2268  0.1891  2.7222  6.4240
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 5.153103   0.811636   6.349 6.97e-09 ***
## forest      0.280178   0.010959  25.567  < 2e-16 ***
## unicorns    0.005906   0.003505   1.685   0.0952 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.079 on 97 degrees of freedom
## Multiple R-squared:  0.8721, Adjusted R-squared:  0.8695
## F-statistic: 330.7 on 2 and 97 DF,  p-value: < 2.2e-16
```

Methods:
"I collected data from 100 sites around Calgary, and recorded…"
"I used a linear model to estimate the effect of forest cover and unicorns on bat abundance. Models were fit using `lm()` in R and were checked for…"

Results:
"My model identified a strong, positive effect of forest cover, with each additional 10% of forest cover adding an additional 3 bats (Figure 1, $p < 0.0001$), while the effect of unicorns was weak ($p = 0.19$). The model also explained $\sim$ 88% of the variance in bat abundance, further highlighting the importance of forest cover to bats…"



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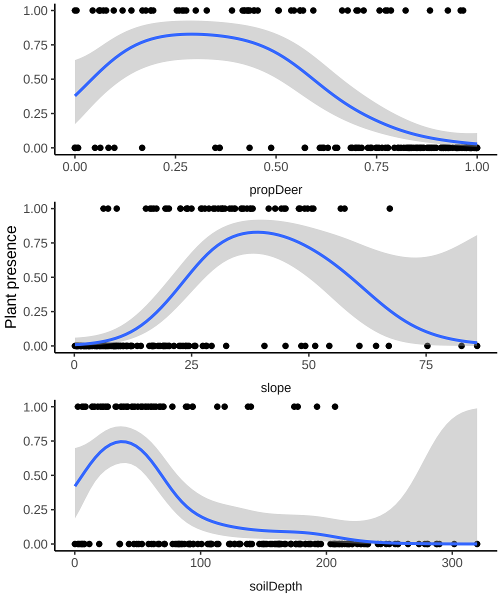

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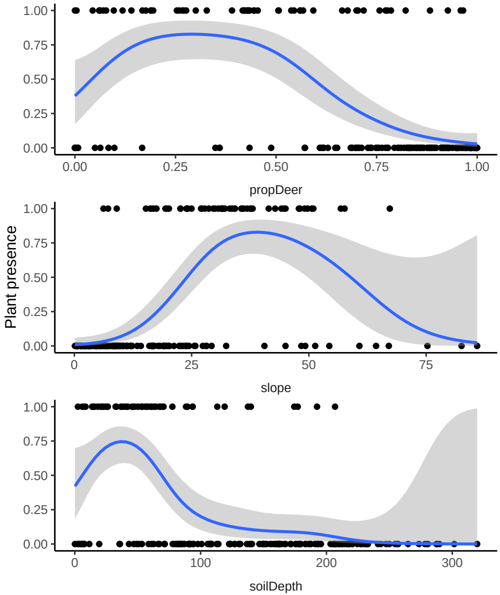

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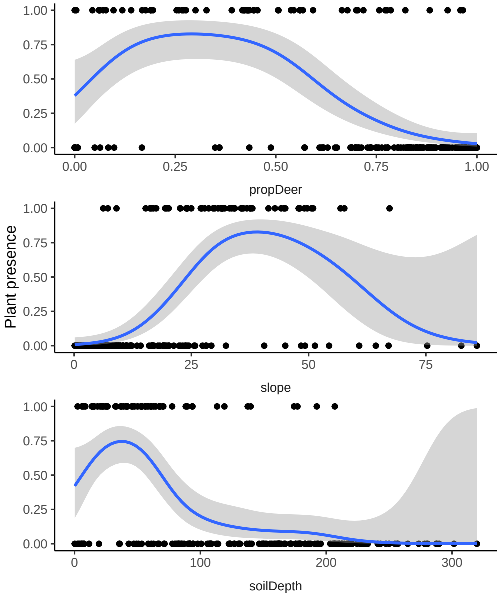

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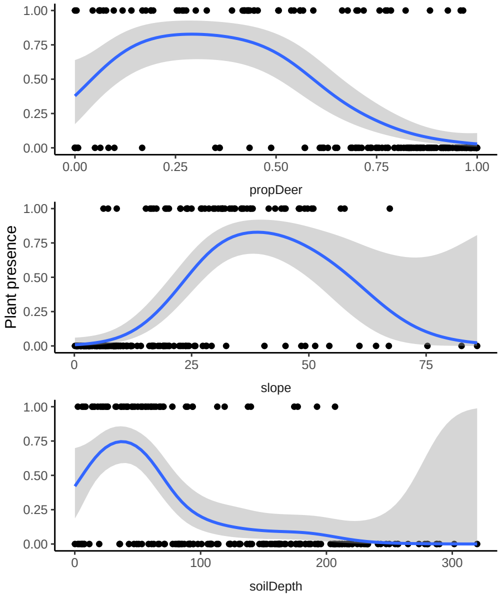
- Explain the model results, and make an accompanying "Figure 1" to go with the results



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Part 3: Peer review

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  - Keep an eye out for predatory or "papermill" journals! Some sets of open-access journals (MDPI) have a *suspiciously fast* peer review process

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    - A *cover letter* helps convince the editor they should give your paper a chance

Peer Review Process

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WILEY

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    - They may temper the claims from *bad or rude peer reviewers*, or may remove them entirely!

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- Think about what could improve the paper, and provide a suggested way forward where possible! (e.g. "I suggest moving this paragraph to here…")

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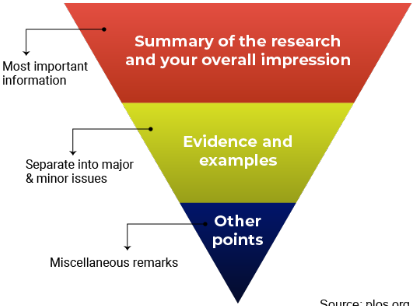

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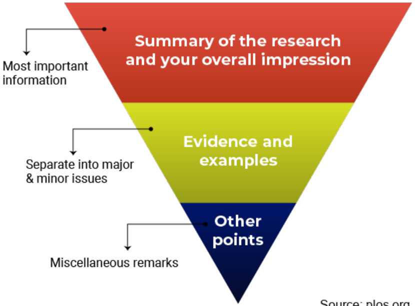

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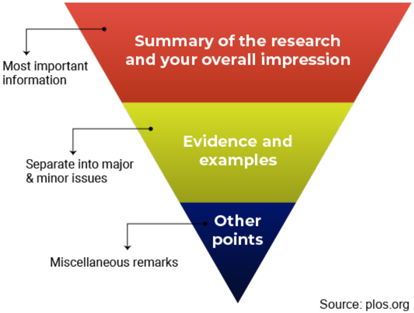

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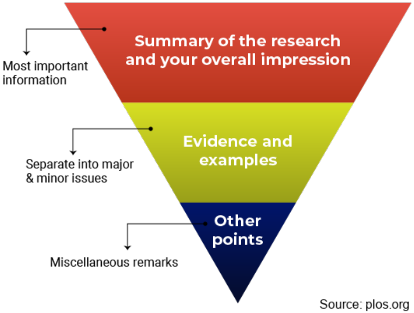

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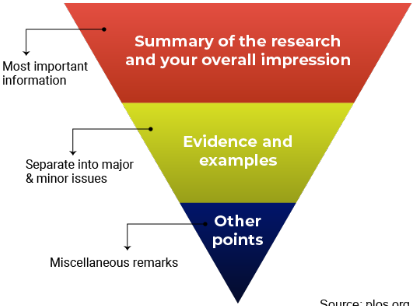

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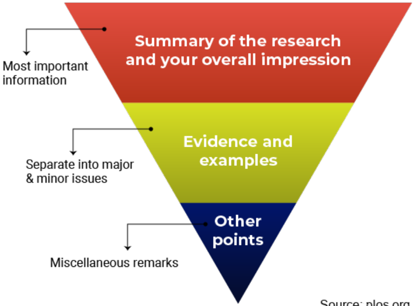

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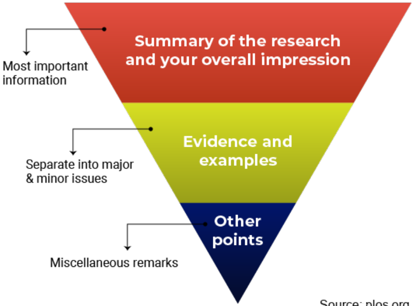

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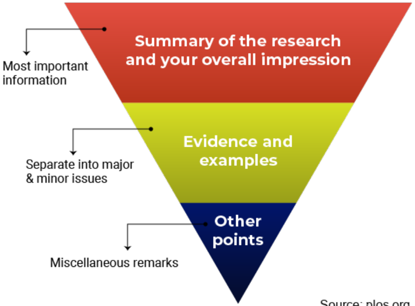

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There are many other appproaches to doing peer review: see here, here, or here)

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