Notes for research design and paper writing

Part I: A “5C” law
Part II: Paper structure and components

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Part I: A “5C” law

- C1: Critical
Critical

- What is a **PhD**?
  - Publish papers? Research projects? Experiments? or
  - “Permanent Head Damage”?

- My answer: PhD is “a **critical** way of thinking”.

- **Critical**: see a thing clearly and truly in order to judge it fairly;
- **Critical thinking** involves determining the meaning and significance of what is observed or expressed, or, concerning a given inference or argument, determining whether there is adequate justification to accept the conclusion as true. (Wiki)

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3 approaches for research design

- App 1: **New** method for **old** problem
- App 2: **Old** method for **new** problem
- App 3: **New** method for **new** problem

- Clearly, research needs something “**NEW**”.
- However: “**NEW**” should not the merely reason to do research!
- Resources are limited, so the exploration for **NEW** things should be adequately justified.
Ask yourself before doing any research

- **App 1: New method for old problem**
  - Why the old problem needs revisiting by new method?
  - Why the new method may probably work for the old problem.

- **App 2: Old method for new problem**
  - Why the new problem is worth researching?
  - Why the old method may fit for the new problem?

- **App 3: New method for new problem**
  - Why the new problem is worth researching?
  - Why the new problem calls for new method?

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To be **critical**

- **Present background problem**
  - Why the background problem is important? Social, economic, environmental, health impacts? or to understand the universal? or to prepare for future needs?

- **Define research problem**
  - Why the research problem helps understand or solve the background problem?

- **Review existing research**
  - Review is not for “review” itself. Review is for “justifying the current research”.
  - Why the research problem calls for more research efforts? Lack of research? Existing research not enough? Why the current research is important?
To be critical

- Set up research hypothesis / objective
  - Why the research hypothesis / objective is reasonable, rational, and reachable?

- Design research strategy / methodology
  - Design experiments, data collection and analysis method? Why the methodology is appropriate to test the research hypothesis

- Discussion and conclusion on results
  - How the results support or refute the research hypothesis? Justify and rationalize the results? Why can be concluded? What is the limitation of this research? And future needs?

Part I: A “5C” law

- C1: Critical
- C2: Consistent
Consistent

- **Newton:** “If I have been able to see further, it was only because I stood on the shoulders of giants.”

- Consistent: possessing firmness or coherence.
- To be consistent is a basic quality of a researcher!
- Consistent attitude and standpoint to specific problems in your publications.

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To be **consistent**

- **Consistency in research design**
  - App 1: New method for old problem, App 2: Old method for new method, both contain “OLD”. Generally, “OLD” or “Existing” is the starting point of innovation.
  - App 3: New method for new problem. Very few research belongs to this category. In most cases: “New” is generated from the “Old”. No absolute “new”.

- **Consistency in theoretical derivation**
  - Theoretical evolution, coherence in model components, experiment design, variable definition, analytical framework, references, etc.

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To be consistent

- **Consistency in presentation**
  - **Term usage:** use consistent terms in a paper or presentation. i.e. Crash vs. Accident; Accident prediction models vs. safety performance function
  - **Abbreviation:** define abbreviations in the first appearing place and use it consistently afterwards.
  - **References:** use consistent format for reference list and citations in text in accordance with Journal requirements.
  - All other places, e.g. spacing, heading, font, etc.

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**Part I: A “5C” law**

- C1: Critical
- C2: Consistent
- C3: Concise
Concise

- Research is an activity of creating new knowledge. Conciseness can help deliver research products and the dissemination to peers and general public.
- Publishing is costly. Save paper! Also save time of readers.
- A principle for “to be concise”: delete or ignore any materials irrelevant for evaluation of research hypothesis or accomplishment of research objective.

To be concise

- Intrinsic conciseness
  - Conciseness in logic thinking, to be sharp
  - e.g. good literature review needs excellent summary and filtering for essence of existing studies only relevant to current research.
  - e.g. experimental design: to fulfill research objective, only those steps useful for testing hypothesis should be included. Do not be distracted.
To be concise

- **Extrinsic conciseness**
  - Presenting only the materials supporting the conclusion. *not result deliberate selection, just do not be redundant* (including limitation or exceptional observations).
  - Reference selection: the *key references only*, not as many as possible.
  - Do not repeat the whole research process: *get straight to what you found out*.
  - Do not be wordy in presentation. *To be sharp in writing*. Use concise and simple sentence as possible as you can.
  - Do not over-elaborate (to explain the obvious – to explain things that every intelligent reader will know or ought to understand).
  - Short paper is preferred. *The longer, the more to be criticized* (increased exposure!).

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**Part I: A “5C” law**

- **C1: Critical**
- **C2: Consistent**
- **C3: Concise**
- **C4: Clear**
Clear

- Research paper is not fiction. Do not hide anything as long as you have chance to make it clearer.

- To be clear is helpful for manuscript to be more readable, acceptable, and deliverable.

To be clear

- Go straight to the research problem. Clearly define and present research problem and research hypothesis/objective in clear places. Do not let readers guess.

- Present everything, including introduction, literature review, data, results, discussion and conclusion in clear structures and formats with clear mind.

- Use clear sentence structure in paragraph: one paragraph one central sentence, central sentence appearing first or last.

- Use clear words in sentences: important words first.

- Use tables, charts or numbering to make comparable observations or parallel arguments clear.
Part I: A “5C” law

- C1: Critical
- C2: Consistent
- C3: Concise
- C4: Clear
- C5: Complete

Complete

- No matter how long or how short a paper is, it should be stand-alone.
- There should not be “to be continued”. Any paper should fully accomplish the objective within the specific scope set up before.
- Thus, there is a need to rationally set up the objective and scope. Do not aim at an elephant, and yield an ant.
- Given that any paper accomplishes its objective, the level of a paper can be judged by the level of objective.
Two puzzles for “To be Complete”

- Limitation and future study
  - Limitation is the limitation of “objective and scope”, not the limitation of “accomplishing the objective and scope”.
  - In other words, “limitation” should outrange the objective and scope of current study.

- Accompanying papers
  - Each paper in accomplishing papers has its own objective and scope, which should be fully accomplished by itself.
  - “Accompanying” means accompanying objectives, e.g. method vs. results. Not accompanying parts to fulfill a specific objective.

Part I: A “5C” law

- C1: Critical
- C2: Consistent
- C3: Concise
- C4: Clear
- C5: Complete

Review your research design and manuscript by these 5 Cs prior to submission or presentation.

Finally, two bonus “C”s regarding research spirit
**Bonus C1: Candid**

- Research is a way to create knowledge. It is sacred, so do not cheat, to be frank.
- The research circle is small. Reputation is the most treasured for a researcher.
- Do not hide the problem underlining your research.
  - Before: seriously identify it and solve it.
  - After: explain clearly the limitation.

**Bonus C2**

**Crazy!!!**

Like it and then do it.
Never give up!