Thesis Writing Workshops for Graduate Research Students

Workshop 2

Principles of Academic Writing
(Science/Applied Science Stream)

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Objectives:

- To consider strategies for writing a thesis that has a logical structure and communicates effectively
- To consider paragraph structure
- To demonstrate the essential components of an Introduction

*(Please bring 3 paragraphs of your own writing to this workshop.)*
Acknowledgements

Thanks to Writer’s Liberation Front members Jennifer Davis for finding the key reference used in this workshop, and to Helena Clayton for passing it on to me.
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>9.00 – 9.30</td>
<td>Freewriting: What is good writing?</td>
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<td>or 2.00 – 2.30</td>
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<td>9.30 – 10.15</td>
<td>How to write well</td>
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<td>10.15 – 10.30</td>
<td>Break</td>
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<td>10.30 – 10.45</td>
<td>Figures and Tables</td>
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<td>10.45 – 11.15</td>
<td>Structuring Introductions</td>
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<td>11.15 – 11.30</td>
<td>Drafting, revising and editing</td>
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<td>11.30 – 11.45</td>
<td>Evaluation and close</td>
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Generative writing exercise (5 minutes)
What is good writing in your discipline?
Features of good scientific/academic writing

• precise, clear, brief in that order of importance;
• effective structure, with all sections containing appropriate information;
• simple, clear language;
• short, correctly structured sentences and paragraphs;
• correct spelling and grammar;
• simple, clear illustrations;
• easy to read and understand;
• Interesting.
How to write well

Key reference:

“It does not matter how pleased an author might be to have converted all the right data into sentences and paragraphs; it matters only whether a large majority of the reading audience accurately perceives what the author had in mind.” (p. 550)

“If the reader is to grasp what the writer means, the writer must understand what the reader needs.” (p. 550)

What does the reader need?
(adapted from R. Lawe-Davies, 2001)

- Readers actively seek a basis for prediction
- Readers make predictions that relate to topic and organisation of text
- Reader predictions are based on words that are read (from the top)
- Topic predictions may be fulfilled by word repetition, predictable word groups
- Items that fulfil reader predictions need to be in a noticeable position; at the front of the text unit
- Readers expect to continue predicting until the final section
- Readers become confused when predictions are not fulfilled
- Unpredicted/unpredictable topics increase reader difficulty

Therefore well written work is structured so that readers are guided in what will follow, and their expectations are actually fulfilled.
Important structural principles to make your writing accessible and clear, without minimizing the complexity of ideas conveyed:

1. every unit of discourse (clause, sentence, paragraph, section) should serve a single function or make a single point
2. use transition words and discourse markers to guide the reader as to the writer’s intent
3. follow the subject as soon as possible with its verb
4. place in the stress position* the “new information” you want to emphasize to the reader
5. place the person or thing whose “story” a sentence is telling at the beginning of the sentence, in the topic position
6. place appropriate “old information” (material already stated in the discourse) in the topic position for linkage backward and contextualization forward.
7. choose a verb that articulates the action of every clause or sentence
8. in general, provide context for your reader before asking that reader to consider anything new
9. in general, try to ensure that the relative emphases of the substance coincide with the relative expectations for emphasis raised by the structure

* the stress position is usually located at the end of a sentence. It is “the moment of syntactic closure. A reader has reached the …stress position when there is nothing left in the clause or sentence but the material presently being read.” (p. 552)
Transition words and discourse markers:
In the following extract, each paragraph has a specific role in developing the author's argument. This is signalled within the first few words of each paragraph.

What particular words are used to indicate the purpose of each paragraph? How is the argument structured?

The scientific method has amply demonstrated its validity and power in the areas of inquiry, and for the purposes, for which it has been designed. Witness the spectacular advance of science over the past three hundred years, the large measure of agreement among reputable scientists, and the technological achievements of applied science, every one of which is a pragmatic demonstration of the scientist’s understanding of natural processes.

Science also invites, and supports, more embracing philosophical accounts of nature of the physical world, and no responsible interpretation of reality as a whole can ignore, or contradict, careful philosophical generalizations based upon well-established scientific conclusions. The position I would defend is therefore committed to affirmative reliance on scientific evidence and to the full incorporation, at any point in history, of accepted scientifically supported interpretations of nature.

Science, however, in the stricter sense of the term, is not all-inclusive; it addresses itself to a specific type of inquiry into a specific area of reality for a specific purpose. Pure science concerns itself solely with temporal events, both “physical” and “psycho-physical.” It studies these to discover and formulate recurrences and uniformities, commonly called “laws of nature”; and it does so partly to satisfy man’s native curiosity, partly to facilitate his control of nature for greater human welfare. But, as Professor Stace admits, it is by its very nature unqualified to deal with values; “it can teach us the best means for achieving our ends, it can never tell us what ends to pursue.” This fact is enormously important, for it means that science, in its strict sense, simply has nothing to say about God or goodness or beauty.

Hence the “imaginative picture of the world” which science, in and of itself, supports is of course a picture of a valueless, meaningless universe. How could it be otherwise? But this doesn’t prove that there are no values and no God in the universe; it merely proves that science can’t possibly discover these values and this Deity if they do exist.

Furthermore, no scientific conclusions, at any point in history, are final, definitive, or certain. They are necessarily hypothetical and tentative. It follows that philosophical extrapolations of science are equally tentative and hypothetical. For example, late-nineteenth-century science supported the philosophical doctrine of strict mechanistic determinism; some qualified philosophers today are not sure that the most recent scientific thinking justifies any such philosophical conclusion. In any case, the farther science advances, the less disposed are first-rate scientists to believe that they fathomed the mysteries even of the world of nature, let alone the whole of reality. Their attitude is humble and cautious, not dogmatic and assured.

If my analysis is correct thus far, it follows that science cannot properly deny that there may be meaning and purpose, or even a God, in the universe, though it cannot itself make any such assertions. Responsible belief in God and in a cosmic purpose is possible, however, only if affirmative evidence can be adduced for its support. Without such evidence, moral and religious belief would have to be wholly blind, and I would condemn blind faith as heartily as does Professor Stace. What kind of evidence, then, would be relevant and coercive? On what kind of experience can an enlightened belief in God and cosmic meaning be based?
Consider also the first 3 paragraphs of Matthew Simpson’s outstanding PhD Thesis entitled *An Analysis of Unconfined Ground Water Flow Characteristics near a Seepage-Face Boundary* for effective use of discourse markers

**Paragraph 1:**
Ground water flow occurs under conditions that are usually classified as being either confined or unconfined. Confined ground water flow is… Conversely, unconfined flow… (The structure is clearly signposted by the discourse markers “either - or” and “conversely”, and repetition, in correct order, of the terms “confined” and “unconfined”)

**Because….then** it is imperative that unconfined flow processes can be quantified… (An argument of cause and effect is signposted)

**Paragraph 2:**
The …quantification of unconfined flow processes… (Repetition of key words indicates continuity to previous paragraph)

The justification for ignoring the vertical processes is that the horizontal length scale of a typical unconfined aquifer is much larger than the vertical, i.e. \( L >> H \) in Figure 1-1. Therefore… (An argument is signposted, and the reader is referred to a Figure that makes the point visually. The consequence of that argument is also signposted.)

**Paragraph 3:**
Several analysts have expressed reservation about horizontal flow modelling strategies; for example… Although these reservations have been voiced, other researchers have shown that… Therefore, (A point is made and an illustration signposted. The words “although” and “other” indicate that controversy is being discussed. The word “therefore” signposts an outcome of the controversy or a conclusion.)
Some difficult passages and modifications that make them more comprehensible

Example 1:

“The smallest of the URF’s (URFA6L), a 207-nucleotide (nt) reading frame overlapping out of phase the NH$_2$-terminal portion of the adenosinetriphosphatase (ATPase) subunit 6 gene has been identified as the animal equivalent of the recently discovered yeast H$^+$-ATPase subunit 8 gene. The functional significance of the other URF’s has been, on the contrary, elusive. Recently, however, immunoprecipitation experiments with antibodies to purified, rotenone-sensitive NADH-ubiquinone oxido-reductase (hereafter referred to as respiratory chain NADH dehydrogenase or Complex I) from bovine heart, as well as enzyme fractionation studies have indicated that six human URF’s (that is, URF1, URF2, URF3, URF4, URL4L, and URF5, hereafter referred to as ND1, ND2, ND3, ND4, ND4L and ND5) encode subunits of Complex I. This is a large complex that also contains many subunits synthesized in the cytoplasm.” (p. 551)

(URF = uninterrupted reading frame or a segment of DNA that could encode a protein)

Example 1 modified by placing the subject and its verb closer together in each sentence and making better use of the stress position:

“The smallest of the URF’s, URFA6L, has been identified as the animal equivalent of the recently discovered yeast H$^+$-ATPase subunit 8 gene; but the functional significance of other URF’s has been more elusive. Recently however, several human URF’s have been shown to encode subunits of rotenone-sensitive NADH-ubiquinone oxido-reductase. This is a large complex that also contains many subunits synthesized in the cytoplasm; it will be referred to hereafter as respiratory chain NADH dehydrogenase or Complex I. Six subunits of Complex I were shown by enzyme fractionation studies and immunoprecipitation experiments to be encoded by six human URF’s (URF1, URF2, URF3, URF4, URL4L, and URF5); these URF’s will be referred to subsequently as ND1, ND2, ND3, ND4, ND4L and ND5.” (p. 553)
Example 2:
“Large earthquakes along a given fault segment do not occur at random intervals because it takes time to accumulate the strain energy for the rupture. The rates at which tectonic plates move and accumulate strain at their boundaries are approximately uniform. Therefore, in first approximation, one may expect that large ruptures of the same fault segment will occur at approximately constant time intervals. If subsequent mainshocks have different amounts of slip across the fault, then the recurrence time may vary, and the basic idea of periodic mainshocks must be modified. For great plate boundary ruptures the length and slip often vary by a factor of 2. Along the southern segment of the San Andreas fault the recurrence interval is 145 years with variations of several decades. The smaller the standard deviation of the average recurrence interval, the more specific could be the long term prediction of a future mainshock.”

Example 2 modified by placing the subject of the 3rd and 4th sentences in the topic position (see italicised text). Transition words (in parenthesis) are also added to indicate the points that are being made.

“Large earthquakes along a given fault segment do not occur at random intervals because it takes time to accumulate the strain energy for the rupture. The rates at which tectonic plates move and accumulate strain at their boundaries are roughly uniform. Therefore, nearly constant time intervals (at first approximation) would be expected between large ruptures of the same fault segment. (However ?), the recurrence time may vary; the basic idea of periodic mainshocks may need to be modified if subsequent mainshocks have different amounts of slip across the fault. (Indeed ?), the length and slip of great plate boundary ruptures often vary by a factor of 2. (For example ?), the recurrence interval along the southern segment of the San Andreas fault is 145 years with variations of several decades. The smaller the standard deviation of the average recurrence interval, the more specific could be the long term prediction of a future mainshock.”
Example 3:
Transcription of the 5S RNA genes in the egg extract is TFIIIA-dependent. This is surprising, because the concentration of TFIIIA is the same as in the oocyte nuclear extract. The other transcription factors and RNA polymerase III are presumed to be in excess over available TFIIIA, because tRNA genes are transcribed in the egg extract. The addition of egg extract to the oocyte nuclear extract has two effects on transcription efficiency. First, there is a general inhibition of transcription that can be alleviated in part by supplementation with high concentrations of RNA polymerase III. Second, egg extract destabilizes transcription complexes formed with oocyte but not somatic 5S RNA genes.

Example 3 modified by adding verbs that articulate the action being described:
In the egg extract, the availability of TFIIIA limits transcription of the 5S RNA genes. This is surprising because the same concentration of TFIIIA does not limit transcription in the oocyte nuclear extract. In the egg extract, transcription is not limited by RNA polymerase or other factors because transcription of tRNA genes indicates that these factors are in excess over available TFIIIA. When added to the nuclear extract, the egg extract affected the efficiency of transcription in two ways. First, it inhibited transcription generally; this inhibition could be alleviated in part by supplementing the mixture with high concentration of RNA polymerase III. Second, the egg extract destabilized transcription complexes formed by oocyte but not by somatic 5S genes.
Exercise:
Evaluate a paragraph of your own writing against the list of structural principles listed on p. 8 of these notes. Note where changes need to be made.
Another way to look at improving the accessibility of your writing:

**Paragraph Structure**

Good, focussed writing is underpinned by a clear paragraph structure:

“Paragraphs in expository writing are characterised by their increasing specificity. That is, they move from the general to the specific, thus, increasingly refining the reader’s understanding of an idea. Well organised paragraphs in academic writing should contain a topic sentence, explanatory sentences, and examples.”

(Puhl, L. and Day, B. (1992) *Writing at University* ECU p. 7)

**A clear topic sentence is essential to a good paragraph.** Topic sentences tell the reader what your paragraph is about, and help prepare them for what you will then say.

**6 steps to writing good academic paragraphs**

1. Select a **topic** for your paragraph and a key **question** that your paragraph will answer (eg the topic may be “features of good academic paragraphs” and a key question might be “what are the features?”)

2. Decide on the **answer** to your question. You may need to do some mind mapping or even free writing to sort out your thoughts first.

3. Use your own words to write a sentence that is a simple and direct answer to the key question e.g. “Good academic paragraphs contain a clear topic sentence, cohesive support, convincing argumentation, and good expression.”

4. Write a cohesive set of supporting sentences. They should be well ordered and contain appropriate transition signals (see A3 handout)

5. Make your answer as **convincing** as possible through effective argumentation. ie use evidence (research data, statistics, expert opinion) and logic. Explain, exemplify and justify your answer.

6. Check your paragraph for good expression, grammar, spelling punctuation, capitalisation and referencing.
**Exercise:**
Consider the following version of an Introduction to a scientific paper.

**Version 1:**
Various Eulerian link-node models have been developed for the simulation of transport for water quality modelling. For example, Tim et al (2003), Jin et al (1998), Lung and Larson (1995), Gu and Dong (1998) used WASP5 for water quality modelling in rivers and lakes. Barnell et al (2004) and Melching et al (1994) used QUAL2E for river water quality modelling. However, the Eulerian models contain an undesirably large amount of numerical diffusion in the advection simulation (refs) and are found unsatisfactory for transport and water quality modelling. Also, due to the limitations in time steps, Eulerian models may not be suitable for long term simulations of large river systems. In the Lagrangian frame, as the control volumes are moved with the mean flow velocity, numerical diffusion associated with advection is totally eliminated and accurate modelling of transport and water quality may be achieved. Further, a Lagrangian model allows a large time step so that a long term simulation may be achieved.

Can you list the points the author is making?
What is he arguing?
How might you restructure this to make his arguments clearer to the reader?
Restructured paragraph:
**Exercise:**
Evaluate up to three paragraphs of your own writing. Can you identify a topic sentence? Is it located early in the paragraph? Note where changes need to be made.
**Figures and Tables:**

“...readers make many of their most important interpretive decisions about the substance...based on clues they receive from its structure.” (Gopen and Swan p. 550)

An investigator tracks the temperature of a liquid over a period of time, takes measurements at 3 minute intervals and records the temperature. These data can be presented in a number of ways. Which do you prefer and why? Does it depend on what the experiment was about?

1. The temperature was recorded at the start of the experiment, and then at 3, 6, 9, 12 and 15 minutes after the experiment began. The recorded temperatures were 25, 27, 29, 31, 32 and 32 degrees respectively.

2. Table 1: The change in temperature of a liquid over a 15 minute period.

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<tr>
<th>Temperature (°C)</th>
<th>Time (mins)</th>
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<tr>
<td>27</td>
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Note: “Because we read from left to right, we prefer the context on the left, where it can more effectively familiarize the reader. We prefer the new, important information on the right, since its job is to intrigue the reader” Gopen and Swan p. 550
Temperature of liquid as a function of time

Temperature (°C)

Time (mins)

Temperature of liquid as a function of time
Structuring Introductions – 3 Essential Moves

1. Establish a research territory by 
   showing that the research area is important, problematic or relevant in some way 
   and introducing previous work in the area

   “How students perceive their learning environments has long been 
   accepted as having a significant influence on the quality of the 
   students’ learning outcomes (e.g. Doyle, 1997; Fraser, 1989; 
   Ramsden, 1992; Walberg, 1971). Over the past quarter century an 
   extensive empirical base…has been developed…The ultimate aim of 
   most of this research has been to…”

   (Opening sentences in the Introduction of the following paper: 
   Clarke, J Tertiary Students’ Perceptions of their Learning 
   Environments: A New Procedure and Some Outcomes)

2. Establish a context in which your research makes sense by 
   defining a problem or question that needs to be answered

   e.g. “Although (past work described in the preceding paragraph) is 
   psychometrically sound, (it has) a number of potential limitations. First, there is 
   always a concern that….. Second, the instruments (used in measurement) focus 
   on just one type of learning environment…… Third (these instruments) …. may 
   deny the complexity of classroom life. And fourth, the instruments do not 
   investigate why…”

   (Clarke, J Tertiary Students’ Perceptions of their Learning Environments: A New 
   Procedure and Some Outcomes)

3. State what you will do in relation to the problem or question by 
   o outlining the objectives of your research, what do you propose as the 
     solution to the problem identified above
   o indicating the structure and scope of the paper

   e.g.
   “This paper reports on the use of the Perceptions of Learning Environments 
   Questionnaire which uses a semi-structured …format to gather student 
   perceptions…This seeks to address the limitations of existing instruments 
   outlined above. The outcomes of the data collection reported here are used to 
   produce student views of good and bad teaching which are then evaluated in 
   terms of contemporary ideas about effective teaching.”

   (Clarke, J Tertiary Students’ Perceptions of their Learning Environments: A New 
   Procedure and Some Outcomes)
Exercise:
Rewrite the following excerpts so they are precise, clear and brief.

1. In recent discussions and conclusions on the analysis of fuzzy logic sets it has been shown by Paynter (2000), Delaune (2004) and Fisher (2007) that it is possible to use this approach when one is dealing with highly variable data derived from the studies of plant and animal communities.

(example taken from Prof. Alistar Robertson’s presentation on Writing a Research Grant Application

2. The level of demand on the commitment and ability of communities to ‘undertake coordinated and targeted action’ in Natural Resource Management (Commonwealth of Australia, 2000 p.5) has increased over the last two decades. There has been some recognition of the need to develop community ‘capacity’ to meet these new challenges (Commonwealth of Australia, 2004), yet there is little evidence of consideration of the notions of communities that can be derived from a rich, if fluctuating history of community research (Agrawal and Gibson, 1999).
Some useful references:


- Flesch, R.F. (1962) *The Art of Readable Writing* (available from the Humanities and Social Science Library, 808.042 Art)


- How to recognise plagiarism  
  [http://www.indiana.edu/~istd/sitemap.html](http://www.indiana.edu/~istd/sitemap.html)


- Murphy, E (1985) *You Can Write* Longman

- *The Style Manual for authors, editors and printers* (2002)  
  John Wiley and Sons, Australia Ltd. (Prepared for the Commonwealth Department of Finance and Administration)

Various Eulerian link-node models have been developed for the simulation of transport for water quality modelling. For example, Tim et al (2003), Jin et al (1998), Lung and Larson (1995), Gu and Dong (1998) used WASP5 for water quality modelling in rivers and lakes. Barnell et al (2004) and Melching et al (1994) used QUAL2E for river water quality modelling. However, Eulerian models have two major limitations. First, these models contain an undesirably large amount of numerical diffusion in the advection simulation (refs) and are found unsatisfactory (you could be more specific here e.g. “which makes them insufficiently accurate”) for transport and water quality modelling. Second, time-step limitations mean that Eulerian models may not be suitable for long term simulations of large river systems.

The Lagrangian frame has the potential to overcome these limitations. First, since control volumes are moved with the mean flow velocity, numerical diffusion associated with advection is totally eliminated and accurate modelling of transport and water quality may be achieved. Second, a Lagrangian model allows a large time-step, thereby allowing for a long-term simulation. (Now make your point about an economic solution).

An alternative to the excerpts that required simplification:

1. Fuzzy logic sets can be used to analyse highly variable data on biota (Paynter 2000, Delaune 2004, Fisher 2007).

2. There has been an increased demand for the last two decades, for communities to be committed to and to ‘undertake coordinated and targeted action’ in Natural Resource Management (refs). Although it has been recognised that community ‘capacity’ needs to be developed to meet these new challenges, there is little evidence that the notions of community that can be derived from the rich, if fluctuating history of community research (refs), have been considered. (by whom?)