SCIENTIFIC WRITING: CONCEPTS & TIPS (PART 1)

UCLA Graduate Writing Center

Scientific Writing Workshop Overview

Part 1:

- Structure
  - Drafting Process
  - Introduction, Discussion, Abstract
  - Transitions
- Style
  - Active vs. Passive Voice, 1^{st} vs. 3^{rd} Person
  - Clarity of Language, Flow
  - Editing Example

Part 2:

Submission Process for a Journal Article (Brief Overview)

Structure

Traditional format:

Abstract

Introduction

Methods

Results

Discussion

Within IMRaD sections the structure is not set.

Tips:

- Look at journal articles for models of how subsections are organized (similar studies)

Drafting Process

It is often easier (and more efficient) to write the middle before the beginning and end.

You might write in this order:

- Methods
- Figures, Results
- Introduction
- Discussion
- Abstract

Or this:

- Figures, Results
- Methods
- Discussion
- Introduction
- Abstract

Structure

Introduction: start broad then narrow down

Move 1 — Big picture context

Move 2 — What's known in lit
What's unknown

Move 3 — Your specific research Qs

Structure

Intro: Creating a Research Space (Swales)

Move 1: Establishing a Research Territory
Introduce and review items of previous research in the area

Move 2: Creating an Niche
Indicate a gap in the previous research

Move 3: Occupying the Niche
State the nature of the present research
Possible: significance, hypotheses, main findings, paper structure

Structure

Common Introduction Structures:

- Move 1
- Move 2
- Move 3

Or

- 1st paragraph: Moves 1, 2, 3
- Later paragraphs: Elaborations of 3 moves

Structure

- Introduction Examples (Handout: Richland & Burchinal)

- Do the authors go from broad to narrow?
  - Establish a research territory (Move 1)?
  - Create a research niche (Move 2)?
  - Occupy that niche (Move 3)?

Structure

Move 1
Big
Picture

Innovation and adaptive thinking are hallmarks of 21st-century learning and essential for a modern workforce (National Research Council, 2012). Nonetheless, little is known about the cognitive mechanisms underlying children's development of the capacity to engage in these complex forms of reasoning. We used longitudinal data to suggest an integrated resolution to debates about the factors underlying children's acquisition of analogical thinking, one type of complex reasoning. Analogical reasoning is a core part of human innovation (Markman & Wood, 2009), creativity (Dunbar, 1997; Sternberg, 1988), and adaptive general intelligence (Cattell, 1971; Gentner, 2010). It is defined as the ability to draw relationships between disparate or dissimilar phenomena (Gentner, 1983). Thinking relationally is fundamental to analytical and inductive reasoning and may distinguish human thought from the thinking of humanity's closest animal relatives (Gentner, 2010; Penn, Holyoak, & Povinelli, 2008).

Move 2
Gap in lit

Move 3
Specific
goals of
this study

State & justify
your
approach/area
of interest
(Move 1, with
more details)

Richland & Burchinal, 2013

Structure

Tips for Writing the Discussion

- Comparing the introduction and the discussion
- Comparing the results and the discussion

Abstract

- Why this project?
- Topic of article
- Methodology
- Findings
- Conclusions
- Implications/recommendations

Transitions

Good transitions maintain the logical flow of Ideas from paragraph to paragraph, and from section to section.

- Don’t over-rely on headings
- Think carefully about when the reader needs definitions, information, and connections
- Lead your reader to your interpretations and conclusions
- You don’t want the reader to say, “I wish I had that information earlier or I didn’t make that connection.”

Bad Example – No transition between sections

II. DEVICE AND CIRCUIT ARCHITECTURE

A. MTJ Stack

An MTJ is composed of two layers of a ferromagnetic material (a fixed layer and a free layer) separated by an extremely thin nonconductive tunneling (MgO, Al_20_3, etc.) barrier (Fig. l). The MTJ resistance depends on the relative orientation of the magnetization directions of the two ferromagnetic layers due to spin-dependent tunneling involved in the electron transport between the majority and minority spin states. If the spin orientations are parallel, applying a voltage across the MTJ is more likely to cause electrons to tunnel through the thin barrier without being strongly scattered, resulting in high current flow and low resistance (R_p). In contrast, the resistance is high (R_{AP}) if the spin orientations are antiparallel. The resistance change is measured by a TMR ratio, which is defined as $\Delta R/R = (R_{AP} - R_p)/ R_p$. With the MgO oxide barrier, the TMR ratio could reach 500% at room temperature and 1010% at 5 K [6]. Most practical devices have TMR ratios between 50% and 150%. The write operation can be done by flipping the magnetization direction of the free layer (the fixed layer cannot be changed) with a spin-polarized current (Fig. 1). The current density through the STT needs to be higher than the critical current density J_c to flip the magnetization direction [14]. Reverse current direction results in the reverse magnetization direction of the free layer and, consequently, different resistance (Fig. 1). The read operation is done by measuring the spin-dependent tunneling current (resistance change) between the magnetic layers. This device is scalable because the absolute writing current scales with the junction size assuming that J_c is independent on the MTJ size [6].

B. DyCML Style

DyCML circuits combine the advantages of metal-oxide-semiconductor current-mode logic circuits with those of dynamic logic families to achieve high performance at a low voltage swing and low power dissipation [15]. Fig. 2 shows the general structure of the DyCML logic. A function F is implemented using two pull-down networks that implement F and F' . Either F or F' wilI turn on to evaluate the logic output. During the precharge phase (CLK = 0), both outputs are precharged to " 1," and the capacitance transistor CL is fully discharged. During the evaluation phase (CLK = 1), the pull-down network with low resistance will discharge its

Ren et al., IEEE Trans. Electron Devices, 2010

Bad Example – No transition between sections

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The reader has no idea how Section B and Section A (or how the concepts “MTJ stacks” and “DyCML style”) are related! (No transition between sections.)

Ren et al., IEEE Trans. Electron Devices, 2010

Bad Example – Improved

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MTJs can be used in two logic styles: DyCML and LIM-MTJ. Before presenting our results, we will briefly describe each logic style.

Ren et al., IEEE Trans. Electron Devices, 2010

Good Example

the cascaded sample capacitors. helps to make the monolithic high-pass filter more robust. The limitation of this architecture is the finite polarization headroom, which will be discussed in more detail later.

B. Micropower Chopper-Stabilized Amplifier

The design of the chopper amplifier targets low-noise and low-supply operation along with current-steering demodulation. Chopping signal currents is achieved by modifying a folded-cascade amplifier. This implementation requires few modifications to the basic design, and high-power examples of chopper cascade architectures were previously studied in [21] for operational amplifiers.

The classical architecture requires only two additional sets of CMOS switches to chopper stabilize the amplifier. The architecture is shown in Fig. 9; the bias networks are not shown to simplify the diagram. The first switch set is placed at the sources of the bias transistors M12/M13, which demodulates the desired ac signal as well as upmodulating the front-end offsets. The second switch set is embedded within the self-biased cascade mirror to up-modulate the errors from M8/M9. The source degeneration of M6/M7 and bias network M12/M13 attenuates their offsets and excess input-referred noise. With this switch architecture, the output of the transconductance stage is at baseband. Which allows for the integrator to both compensate the feedback loop and filter up-modulated offsets and noise.

An additional advantage of the folded-cascode amplifier is that currents can be better partitioned to improve noise performance. In this design. we allocated 300 nA to flow through each input pair, 50 nA to flow through each leg of the folded cascade. 50 nA for the output stage, and 50 nA for bias generation and distribution. To suppress the noise contribution from M3 and M4 at the chopper frequency, they were scaled to be relatively large, and

Repeating Key Terms

Transition Words

C. Amplifier Front-End Biasing

The biasing design of the summing node VA at the input of the chopper amplifier is a balance between noise and settling considerations. Although the signal characteristics are purely ac at this node, the amplifier must have the proper dc biasing to ensure the appropriate amplification and de modulation of the signals. In particular. the de bias network's impedance must be sufficiently large to minimize noise, while still being small enough to keep the input held at the bias in the presence of typical leakages and common-mode perturbations.

To balance these performance constraints. the input stage was biased with "long-FET" (W/L<<1) transistors to a value of roughly 7.5 GΩ [9]. As illustrated in Fig. 10, a bias current was passed through a reference FET M1. biased in subthreshold. The gate voltage was then mirrored to a long-length FET M2. Assuming symmetric drift currents. the net small-signal impedance of M2 to the reference voltage is modeled as

$$R_{eq} \approx \frac{W1}{L1} \cdot \frac{L2}{W2} \cdot \frac{kT}{kqI_{bias}}$$

where k, is the subthreshold slope factor of approximately 0.7. This model demonstrates that synthesizing a resistor of the order of 7.5 GΩ is feasible using on-chip FETs biased with 5 nA of current. Unlike diode biasing with nonlinear settling time constants, this approach settles out with a defined time constant of $R_{eq} * C_{in}$ or roughly 125 ms in our implementation.

The noise for the bias circuit is modeled by shot noise in the equilibrium drift currents through M2. This model predicts the equivalent noise current as

$$I_n^2 = \frac{4kT}{R_{eq}} \cdot \left[\frac{A^2}{H\%}\right]$$

that, when referred back to the input through the input capacitors impedance at the chop frequency, yields a net noise

$$e_n = \sqrt{\frac{4kT}{R_{eq}}} \cdot \left(\frac{1}{2\pi C_{in} F_{chop}}\right) \cdot \left[\frac{V}{Hz}\right]$$

of roughly 25 nV/rtHz.

Pointing Words

Denison et al., JSSC 2007

Style

Passive vs. Active

First vs. Third

I vs. We

Style: Voice

Active Voice:

We **investigated** the [role] of protein kinase A in three separate lines of breast cancer.

Passive Voice:

The [***role***] of protein kinase A **was investigated** in three separate lines of breast cancer.

Style

When possible, use active voice.

However, don't force it.

Sometimes passive voice is more appropriate.

Style: Voice

Reasons to use passive:

1. **When you don’t know the “actor” or “doer.” (Or the doer is not important)**

[***Scientists***] **were taught** to use passive voice.

Style: Voice

Reasons to use passive:

2. **To emphasize the object of the sentence action.**

[***Protein A***] **is phosphorylated** in pancreatic cancer cells. (Passive)

An unknown protein **phosphorylates** [Protein A] in pancreatic cancer cells. (Active)

Style: Voice vs. Person

The terms “voice” and “person” are distinct aspects of grammar.

Style: Voice vs. Person

These both use active voice:

We **discovered** that retrieval enhances memory. (First person plural)

Retrieval **enhances** memory. (Third person singular)

Style: Voice vs. Person

These both use passive voice:

[***Protein A***] **was investigated**.
(Third person singular)

[***Protein A***] **was investigated** by <u>our lab</u>
(Same verb construction, but in addition,
a first person plural possessive pronoun is used in the phrase.)

Style: Person

Frequently used in STEM:

First Person

Plural vs. Singular

Style: Person

First-Person Singular: ***I*** **discovered** that the [function] of Protein A is to transcribe Gene B.

First-Person Plural: ***We*** **discovered** that the [function] of Protein A is to transcribe Gene B.

Style: Person and Voice

First-Person Plural/ Active Voice: ***We*** **hypothesize** that…

Third-Person S./ Passive Voice: [***It***] **is hypothesized** that…

Third-Person S./ Active Voice: The ***hypothesis* states**…

Style

Clear, simple, direct language.

Style

Overly specialized terminology utilized by a particular subset of the population that is difficult for others to comprehend

Style

~~Overly specialized terminology utilized by a particular subset of the population that is difficult for others to comprehend~~

Jargon.

Style: Avoiding Jargon

Example 1: (technical jargon to the point of being unclear)

> Focal Adhesion Kinase (FAK) is a non-receptor tyrosine kinase localized to matrix adhesions and becomes activated following engagement of β1 and αv integrins. Upon autophosphorylation at Tyr397, FAK combines with Src or another Src Family Kinase (SFK)... It is therefore unsurprising that upregulation of FAK has been found in many human malignancies…

Style: Avoiding Jargon

Example 1: (revised and clearer to a broader audience)

Many human cancers arise when cells lose their ability to sense the extracellular environment and they can no longer properly regulate key cellular processes such as proliferation, differentiation, and apoptosis…We have shown that FAK is overexpressed in human breast cancer and that specific deletion in the mouse mammary gland impairs tumor initiation, progression, and metastasis.

Style

Writing with the reader in mind…

Tips and Example from:

Gopen, G. D. and J. A. Swan. (1990) The Science of Scientific Writing. *American Scientist.*

Style: Reader Expectation

- Put information where the reader expects to find it
  - Within article sections
  - Within paragraphs
  - Within sentences

- By working to meet reader’s expectations, writers can identify logical gaps

Style: Functional Units

- Readers expect each unit of discourse (section, paragraph, sentence) to serve a single function.
- When a unit serves more than one function, readers can become confused.

Style: Subject and Verb

- Readers expect the action of a sentence to be in its verb.
- Readers interpret information between the subject and verb of a sentence as a kind of interruption, especially if a lot of words separate the subject and verb.
- To help the reader process information more easily, follow a subject with its verb as soon as possible.

Style: Topic Position

- Topic position is at the beginning of a sentence or unit. (It can be the grammatical subject, but it can also be a prominent noun phrase at the beginning of a unit that has another function.)

- Topic information tends to:
  - Link back to information that has already been discussed
  - Provide context for upcoming information
  - Contain the information that is already known or familiar to the reader (ideally)
  - Be the subject/topic of the story or discussion at hand

Style: Stress Position

- Stress positions are at the ends of clauses, sentences, sections.
- Reader expects closure – assign emphasis to points in these positions.
- Have to figure out what you want the reader to take away from each unit.

Style: Information Flow

- Old information → New information
- Place old information in topic positions (context)
- Place new information in stress positions (emphasis)

- Once new information has been introduced in a stress position in one sentence, it will likely become contextual information ("old information") used in the topic positions of subsequent sentences. Following this pattern helps the reader process information and reduces logical gaps in the sequence of the text.

Editing: Sentence Level

Revising by the sentence level, determine if:

1. The backward-linking old information appears in the topic position.

2. The new, emphasis-worthy information appears in the stress position.

3. The person, thing or concept whose story it is appears in the topic position.

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1. The backward-linking old information appears in the topic position.

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Revisions

- Compare Intro with Discussion
- Compare Results with Discussion

- Backwards Outlining

- Circular (iterative) process!

Editing Example

Example 2:

"Currently, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-term volume stable adipose tissue in vivo is limited by suboptimal properties of their biomaterial carriers including insufficient biocompatibility and rapid scaffold degradation rates."

Editing Example

“Currently, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-term volume stable adipose tissue in vivo is limited by suboptimal properties of their biomaterial carriers including insufficient biocompatibility and rapid scaffold degradation rates.”

Editing Example

Implied

"~~Currently~~, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-term volume stable adipose tissue in vivo is limited by suboptimal properties of their biomaterial carriers including insufficient biocompatibility and rapid scaffold degradation rates."

Editing Example

Implied

"Currently, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-term

Redundant

volume stable adipose tissue in vivo is limited by suboptimal properties of their biomaterial carriers including insufficient biocompatibility and rapid scaffold degradation rates."

Editing Example

Implied

"Currently, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-term volume stable adipose tissue in vivo is limited by suboptimal properties of their biomaterial carriers including insufficient biocompatibility and rapid scaffold degradation rates."

Redundant

Context

Editing Example

Implied

"Currently, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-

Redundant Context

term volume stable adipose tissue in vivo is limited by

Jargon

suboptimal properties of their biomaterial carriers including insufficient biocompatibility and rapid scaffold degradation rates."

Editing Example

Implied

"~~Currently~~, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-term ~~volume stable~~ adipose tissue ~~in vivo~~ is limited by ~~suboptimal~~ properties of their biomaterial ~~carriers~~ including insufficient biocompatibility and rapid scaffold degradation rates."

Redundant

Context

Jargon

Implied

Editing Example

"~~Currently~~, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-term ~~volume stable~~ adipose tissue ~~in vivo~~ is limited by ~~suboptimal~~ properties of their biomaterial ~~carriers~~ including ~~insufficient~~ biocompatibility and rapid scaffold degradation rates."

Implied

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Implied

"Currently, however, the efficacy of exogenously delivered stem cell populations to support the generation of long-

Redundant Context

term volume stable adipose tissue in vivo is limited by

Jargon Implied

suboptimal properties of their biomaterial carriers

Redundant

including insufficient biocompatibility and rapid scaffold

Redundant

degradation rates."

Editing Example

“However, the efficacy of exogenously delivered stem cell populations to support the generation of long-term adipose tissue is limited by properties of their biomaterial**s**, including biocompatibility and rapid scaffold degradation.”

Editing Example

Better! Let’s keep going.

Editing Example

"However, the efficacy of exogenously delivered stem cell populations to support the generation of long-term adipose tissue is limited by properties of their biomaterials, including biocompatibility and rapid scaffold degradation."

(Note: "efficacy" is object of action but grammatical subject of sentence.)

Editing Example

“However, the efficacy of exogenously delivered stem cell populations to support the generation of long-term adipose tissue **is limited** by properties of their biomaterials, including biocompatibility and rapid scaffold degradation.”

(Note: “efficacy” is object of action but grammatical subject of sentence.)

Editing Example

"However, the efficacy of exogenously delivered stem cell populations to support the generation of long-term adipose tissue **is limited** by properties of their biomaterials, including biocompatibility and rapid scaffold degradation."

(Note: "properties" is the actor/doer of the sentence.)

Editing Example

"However, the efficacy of exogenously delivered stem cell populations to support the generation of long-term adipose tissue **is limited** by properties of their biomaterials, including biocompatibility and rapid scaffold degradation."

Redundant

Editing Example

"However, the efficacy of exogenously delivered stem cell populations [~~to support the generation of long-term adipose tissue~~] **is limited** by properties of their biomaterials, including biocompatibility and rapid scaffold degradation."

Editing Example

"However, the efficacy of exogenously delivered adipose stem cell populations ~~to support the generation of long-term adipose tissue~~ **is limited** by properties of their biomaterials, including biocompatibility and rapid scaffold degradation."

Editing Example

Jargon

"However, the efficacy of exogenously delivered adipose stem cell populations ~~to support the generation of long-term adipose tissue~~ is limited by properties of their biomaterials, including biocompatibility and rapid scaffold degradation."

Editing Example

"However, the efficacy of ~~exogenously delivered~~ adipose grafts stem cell ~~populations~~ [~~o support the generation of long-term adipose~~] ~~tissue~~ **is limited** by properties of their biomaterials, including biocompatibility and rapid scaffold degradation."

Editing Example

“However, the efficacy of adipose stem cell grafts **is** **limited** by properties of their biomaterials, including biocompatibility and rapid scaffold degradation.”

Editing Example

"However, the efficacy of adipose stem cell grafts **is**

Passive Voice

limited by properties of their biomaterials, including

biocompatibility and rapid scaffold degradation."

Editing Example

“However, properties of biomaterials, including biocompatibility and rapid scaffold degradation, **limit** the efficacy of adipose stem-cell grafts.

Editing Example

“However, properties of biomaterials, including

stability

biocompatibility and ~~rapid scaffold degradation~~ **limit**

the efficacy of adipose stem-cell grafts.

Editing Example

"However, properties of biomaterials, including

stability

biocompatibility and ~~rapid scaffold degradation~~, **limit**

stem-cell derived adipose tissue

the efficacy of ~~adipose stem-cell~~ grafts.

Editing Example

it's actually these two specific properties...

"However, properties of biomaterials, including

stability

biocompatibility and ~~rapid scaffold degradation~~, **limit**

stem-cell derived adipose tissue

the efficacy of ~~adipose stem-cell~~ grafts.

Editing Example

"The lack of stable, biocompatible biomaterials limits the efficacy of stem cell-derived adipose tissue grafts."

Editing Example

"The lack of stable, **bio**compatible **bio**materials limits the efficacy of stem cell-derived adipose tissue grafts."

Editing Example

scaffolds

"The lack of stable, **bio**compatible ~~**bio**materials~~ limits the efficacy of stem cell-derived adipose tissue grafts."

Editing Example

"The lack of stable, biocompatible scaffolds limits the efficacy of stem cell-derived adipose tissue grafts."

End of Part 1

- Please go to the next video for Part 2