How to Write More Clearly, Think More Clearly, and Learn Complex Material More Easily

Michael A. Covington
Artificial Intelligence Center
The University of Georgia
“I don’t think I’m really all that intelligent, but I have a talent for amplifying my intelligence.”

— R. D. G., 1975
Amplifying your intelligence

*How to…*

- Write more clearly
- Think more clearly
- Learn more easily

My central claim:
These are connected!
Amplifying your intelligence

How to write more clearly
(and why you should want to)
How to write more clearly

Why?

• People who write are powerful.
• In science, technology, or management, you influence people by writing things for them to read.
How to write more clearly

Why?

• Clear writing leads to clear thinking.
• You don’t know what you know until you try to express it.
• If your writing is nonsense, maybe your thoughts are nonsense too!
Misconceptions about writing

**Myth:** Writing is mainly about poetry and fiction.

**Fact:** That would be like saying exercise is mainly about ballet dancing!

Most of the writing in the world is for *information*. It’s often done by people who don’t even *like* poetry and fiction.
Myth: Writers are people who have memorized big books of grammar rules.

Fact: Grammar is not the problem. You are exposed to huge amounts of good English every day. If you know what you’re trying to say, 99% of the time you’ll say it grammatically.
Language (including grammar) is an *inborn* capability of the human brain.

The living language comes first; then people try to write grammar books in order to describe it.

You do not have to be able to name and classify the parts of your language in order to use them!
Misconceptions about writing

At most, an educated person needs help with only a few small points of grammar.

Of a 100-page grammar book, you may need 3 pages, or less.

(Get people to help you figure out which 3!)
How to write more clearly

The unselfish perspective

Good writing is partly a matter of character.

Instead of doing what’s easy for you, do what’s easy for your reader.
How to write more clearly

The unselfish perspective

I’m not giving this presentation (or writing this paper) because *I’m* important.

I’m doing it because *you’re* important.
How to write more clearly

The unselfish perspective

I’m not going to demand that you put up with my quirks (bad spelling, bad organization, sloppiness).

I’m going to package the information so that it enters your heads as easily as possible.
How to write more clearly

Writing is almost too complicated for human beings to do.

We must break up the process of writing in order to make it possible.
The writing process

Five steps:

Planning  (deciding what & how to write)
Drafting  (getting it on paper once)
Revising  (getting it on paper better)
Editing   (fixing spelling, grammar, typing)
Formatting (choosing typefaces, layout, etc.)
Planning

Ask yourself:

Why am I writing this?
Who is the audience?
What does the reader know/expect/want?
How can I organize it?
What are the format and style requirements?
If you can’t envision the audience, try using yourself as a sample.

If someone had needed to give you this information 6 months ago, how should they have done it?
Organizing a written paper is just like structured programming:

Every section has its purpose and is broken down into smaller sections each of which has its purpose.
Planning

If you can’t figure out how to organize your material, try this:

Write down ideas in random order, then sort them.
Planning

You don’t have to plan – or write – the sections in linear order.

I often write the introduction last, after I know what it will introduce!
Drafting

In the drafting step, 

*get it down on paper*

– not elegantly, not perfectly, just

*get it down on paper*

so you no longer have to

hold it all in your brain!
During drafting, do not worry about grammar, spelling, or format. Concentrate on what you want to say and how you’re going to organize it.
Drafting

Three rules for clear writing:

1. Get to the point.
2. Get to the point.
3. Get to the point.

Your reader won’t follow you down a garden path.
Drafting

To keep things clear and readable:

State the main point before you give the reasoning that leads to it.

(Unless you’re writing a detective story!)
Drafting

To keep things clear and readable:

Put the main point of each paragraph in its first sentence.

That way, people can skim your paper by reading just the first sentences of the paragraphs.

Lots of them will!
Drafting

K.I.S.S.
(Keep it simple, stupid!)

Always use the clearest, simplest language that will do the job.

NEVER try to sound formal or sophisticated.
Drafting

If your paper isn’t full of street slang, it is already formal enough.

Stuffy writing is bad writing!!!!
Drafting

What words should you never use in writing?

Words whose exact meanings you don’t know!

Never use a word unless you know EXACTLY what it means. (More about this later.)
Revising

*Now the fun begins!*

With computers, we can revise anything, any number of times, without wasting paper.

In the bad old days, it wasn’t that easy!
Revising

The goal of the revising step is to make your writing clearer and easier to read.

This is done mainly by finding better ways to put ideas into words.
Revising

When revising, pretend to be your own worst enemy.

Is there anything that can be misunderstood?

If so, change it so that it can’t!
Revising

BEFORE:  “Students may request…”

AFTER:   “Students are allowed to request…”

OR ?     “Students sometimes request…”
Revising

Make sure the main point of each paragraph is in the first sentence.

A person reading just the first sentences of the paragraphs should get a summary of your paper.
Revising

Whenever possible, **shorten your sentences** by removing needless words.

Time taken to process an $n$-word sentence is proportional to $n^3$, or more.

Cut the length in half, and you make it 8 times easier to read. (Maybe.)
Revising

An example:

“One of the best things you can do for yourself to improve your writing is to learn how to cut out words that are not necessary.”

Keep watching…
Revising

An example:

“One of the best **things you can do for yourself** to improve your writing is to learn how to cut out words that are not necessary.”

*Keep watching…*
Revising

An example:

“One of the best ways to improve your writing is to learn how to cut out words that are not necessary.”

Keep watching…
Revising

An example:

“One of the best ways to improve your writing is to learn how to cut out words that are not necessary.”

Keep watching…
Revising

An example:

“One of the best ways to improve your writing is to learn how to cut out unnecessary words.”

That’s a lot better.
Can we go further?
Revising

An example:

“One of the best ways to improve your writing is to learn how to cut out unnecessary words.”

Keep watching…
Revising

An example:

“To improve your writing, learn how to cut out unnecessary words.”

Keep watching…
Revising

An example:

“To improve your writing, learn how to cut out unnecessary words.”

Keep watching…
Revising

An example:

“To improve your writing, cut out unnecessary words.”

There! 25 words reduced to 8!
Editing

Editing is where you fix up the grammar, spelling, and punctuation.

Guess what?
Your computer doesn’t know best.
It doesn’t know what you’re trying to say!
Grammar, spelling, and punctuation are not a layer of added decoration. They help express the meaning.

If you let a computer "correct" them, you may not get what you intend.

“Spilling chequers or grate!”
Editing

What if you’re a “bad speller”?

Some exhortations…
Don’t be quick to label yourself a “bad speller.”

Remember, none of us were born knowing how to spell.

If you can spell
int main(int argc; char* argv[]);
you can learn how to spell
its and it’s!
Editing

To become a better speller…

(1) Take the time to learn the spellings in the first place.

(2) Don’t practice bad habits. Whatever you normally write will look correct to you!
To become a better speller…

(3) Recognize related words
  (govern, government…).

(4) Pronounce words carefully, or even comically, to help you remember spellings
  (significant, California – not Cal-uh-fornia!).
Editing

By the way, in case you’re wondering, the difference between *its* and *it’s*
= the difference between *his* and *he’s*.

*his* = of him  
*its* = of it

*he’s* = he is  
*it’s* = it is

This is my idea of how to teach grammar!
Formatting

With computers, we can make decisions about layout and typography long after we write the text.

And we all need some training in graphics!
Formatting

The basics:

• Keep it simple
• Keep it standard
• Avoid meaningless variation
Formatting

Keep it simple

Use familiar typefaces, no more than 2 or 3 in a document, each with a clearly defined purpose.
Formatting

Keep it simple

Use conventional roman type for text, typewriter type for computer programs, and maybe sans-serif type for headings.

Sans-serif type is also good for labels and presentations.
Formatting

Keep it simple 🙄🙄

Needless decoration distracts the reader and can look really stupid!
Never draw the reader’s eye to anything that is not the main point.
Formatting

Keep it standard

Look at well-produced material and make sure you’re following accepted practices.

Don’t leave out anything basic, such as page numbers or adequate margins!
Formatting

Keep it standard

*This is not your grandpa’s typewriter.*

Use *italics* instead of *underlining*.

Use a dash (—) instead of 2 hyphens (---).

*Follow the standard practices of the printing industry, not the limitations of the typewriter!*
Avoid meaningless variation

A basic principle of communication:

The reader will expect every change to mean something.
Avoid meaningless variation

*If you have 2 typefaces, or different margins in different places, there had better be a reason, or the reader will waste a LOT of time looking for one!*
• So much for writing more clearly.

• Now for *thinking more clearly*…
Amplifying your intelligence

How to think more clearly

• Language
• Logic
• Epistemology
Language

We all use language
(or other symbolic representations)
to do most of our thinking.

Here are some
insights from *philosophy of language*.
Earlier I said not to use words if you don’t know what they mean.

How do you know whether you know what a word means?
An answer:

You know what “dog” means if you know how to look at things and tell whether or not they are dogs.
Language

Or more generally:

You know what “dog” means if you know how, *in principle*, to tell whether things are dogs, even if you cannot perform the test yourself.
Dilbert’s boss wants “an object-oriented database” but he does not know what makes a thing a database or what makes it object-oriented.

*He doesn’t know what he’s talking about!*
Language

Our knowledge of word meanings is sometimes imprecise.

Do you know what “elm” means? …
Language

Levels of knowing the meaning of “elm”:

(1) It’s a tree.
(2) It grows in the USA and looks a lot like an oak or maple.
(3) It’s exactly so-and-so…
Language

Is it ever legitimate to use a word without knowing its exact meaning?

Maybe.
Language

Example 1:

I can tell you there are elms in New Haven, Connecticut, even though I can’t identify them myself.

I am relying on other people’s authority for the correct use of the word.
Example 2:

The clerk at Radio Shack knows they sell things called capacitors, identified by certain numbers.

He/she can sell me a 22-$\mu$F, 35-V capacitor without knowing what a capacitor really is or what the numbers mean.
Example 3:

Dilbert’s boss wants an “object-oriented database.”

(Relying on reliable authority, or just making a fool of himself? The difference is sometimes subtle!)
The important thing is that you should know whether you know what your words mean.

Do not get used to putting words together in familiar ways without understanding them!
Language

How do you know what a sentence means?

Largely, by knowing how to find out if it’s true or false.

The test may be impossible to perform, but you should have an idea what it would be.
Language

Example:
“All dogs are brown”
can be **proved true** by examining all the dogs in the world and finding them brown,
or **proved false** by finding one black dog.

If you don’t know that, you don’t know what “All dogs are brown” means.
Logic

Oops!

We’ve strayed from philosophy of language to logic.

Let’s keep going…
Some sentences, such as “Murder is wrong,” cannot be proved true or false by physical tests.

I do not think this means that they are “meaningless” or “neither true nor false,” only that they are different from sentences about physical facts.
Logic

Some sentences, such as

“There are invisible, undetectable elves all over this room,“

really are meaningless; there is no imaginable way to prove them true or false.
Logic

Some sentences that sound very deep, such as,

“Everything happens exactly the way it was fated to happen,“

may be just as meaningless as the sentence about elves.
Epistemology

Epistemology is the study of how to acquire knowledge by observing the world around you.
Epistemology

The goal is to end up believing things that are true and not believing things that are false.
Epistemology

Your epistemology has gone wrong if you **disbelieve** things that are **true**, or if you **believe** things that are **not true**.
“Scientific method”
is part (not all) of epistemology.
Epistemology

**How to form beliefs** based on evidence:

(1) Propose a belief (a hypothesis).
   (It should be something that, if true, would be worth knowing, not a waste of mental effort.)

(2) Try to confirm it.

(3) Also try to disprove it.
Epistemology

Stages:

(1) Conjecture or guess
(2) Opinion; belief supported by evidence
(3) Firm belief, thoroughly tested against evidence and still holding up

This looks like science, but is actually applicable to thinking about almost anything.
Epistemology

Really important point (from Sir Karl Popper):

A belief isn’t warranted unless you could have known if it’s not true.

That is, there should be some way that you could tell if it were false.
Popper’s principle implies:

(1) Your guesses and opinions have to be **testable**.

They have to say what will *not* happen.

Beware of vague predictions that are compatible with any outcome!
Epistemology

Popper’s principle implies:

(2) It’s your job to
    test your opinions against evidence.

You should always be looking for evidence that your current beliefs are not correct.
Epistemology

Example:

If you believe all dogs are black, you must not only look for black dogs, but also look for dogs that aren’t black.
Epistemology

Fortunetellers, quacks, and salesmen want you to only try to prove your guesses true and not try to prove them false.

Covington’s Law of Medical Research: Somebody will get well no matter what is done to them.
Epistemology

Now let me attack some widespread and fashionable epistemological mistakes from the late 20th century.
Misconception:
“It’s OK to believe anything you want, because we never really know anything; it’s all just opinions.”

Fact 1:
Our knowledge of the world is incomplete.

Fact 2:
Nonetheless, the world is objectively real.
If you step out in front of a bus, it will run over you, even if you can find people whose opinion is different.
Misconception:
“If there are good arguments on both sides of a controversy, then the question is undecidable.”

Fact:
The evidence for one side can still be a lot stronger than the evidence for the other.
Epistemology

It is important to be able to understand and present sympathetically a position that you do not agree with.

If people believe something, they probably have a reason worth knowing about even if they’re mistaken.
Epistemology

Example:

The earth is round.

But some people think it’s flat, and we should be able to explain why it looks flat.
Epistemology

Misconception:
“It is unfair to say that anything is really better than anything else.”

Fact:
Because the world is objectively real, of course some things are better than others, by any reasonable criteria.

You’re not just “showing your cultural bias” when you say so.
Epistemology

Misconception:

“You have no right to impose your beliefs on me.”

Fact:

It sounds like you’re “imposing” a belief on me!

Lots of beliefs are “imposed” on us by evidence.
Misconception:

“If something isn’t subject to physical measurement (or doesn’t fit in a preconceived system), it doesn’t exist.”

Fact:

If all knowledge depends on physical measurement, then not only do you lose truth, beauty, and love, you also lose mathematics, logic, and even epistemology!
Amplifying your intelligence

How to learn complex material more easily
How to learn…

I’ll be brief because I’ve already given you the tools.
How to learn…

1. Have goals and adjust them often.
2. Use a suitable learning strategy.
3. Insist on clear understanding.
4. Organize the knowledge for yourself.
Have goals…

You have to want to learn something and have some idea what it is.

Don’t wait passively for the teacher or textbook to take you on a ride.
Have goals…

Because you don’t start out knowing exactly what you’re going to learn, you must constantly update your goals as the material is revealed to you.

Changing your goals is OK. Not having goals is not!
Have goals...

Example:

We don’t read textbooks like novels, just to see where they go.

We read textbooks because we want them to tell us something (incl. tell us what they’re going to tell us!).
Learning strategy

When a student finds my courses unduly hard, it’s usually because of the wrong learning strategy...

• Memorizing what should be deduced
• Deducing what should be memorized
• Skipping essential background
• Demanding background that isn’t there
• Different kinds of material require different learning strategies.
A learning strategy for **history or literature**:

- Main goal is familiarization with lots of things.
- Many large trends but few rigorous logical connections.
- There is no starting point – you can start anywhere.
- Read a lot of books and “get the big picture.”
- Subjective judgment is important; careful reasoning is not.
A learning strategy for **mathematical science**:

- Main goal is clear understanding of key points.
- Important ideas are not so much *learned* as *rediscovered*, often in a flash of insight.
- It is important to trace ideas to their sources (remember who discovered them).
- You must take things in order; if you skip a chapter, or even a page of definitions, you’re lost.
Learning strategy

A learning strategy for **engineering** or **computer programming**:

- Main goal is to apply science to solve problems.
- It’s easy to experiment to find out whether your solutions work (especially with computers).
- You must learn things in order.
- No need to trace ideas to sources; any book that gives you the information will do.
- Tendency to follow authorities blindly.
A student who is only good at one subject is often someone who only has one learning strategy.
Clear understanding

Insist on clear understanding!

My C and D students are so accustomed to being confused that they don’t realize it isn’t normal.
Clear understanding

We’ve already talked about how to know whether you understand a word and whether you understand a sentence.

*Put that knowledge to use!*
Clear understanding

Learn the vocabulary,
and be precise about it.

If you don’t,
you can’t learn anything else.
Clear understanding

If something is unclear, don’t wait for it to clear up later.

Back up and get it clear.

Students who are lost have always been lost longer than they want to admit.
Clear understanding

If you guess anything, you must **test your guess** immediately.

Not just whether it might be **true**... but also whether it might be **false**.

(Remember epistemology?)
Clear understanding

Our educational system encourages unclear understanding.

If 70% is a passing grade, you can almost get by with nothing but guesses and vague familiarity.
Clear understanding

70% knowledge of American history is worthwhile, but...

70% of the multiplication table (with random gaps) is almost useless!

People accustomed to incomplete learning get terribly lost in rigorous, logical, mathematical material.
Organizing knowledge

Don’t expect the teacher or the textbook to organize the contents of your head for you.

Organize the knowledge yourself. Make your own notes. Pretend you’re writing a textbook!

That’s how I ended up writing so many books...
Organizing knowledge

Constantly check your own understanding in as many ways as you can.

Try things on the computer… check other reference books… quiz yourself… try explaining the material to others.
Organizing knowledge

Learning is a lot like writing a book.

The goal is to build a structure in your own mind, not to absorb something that somebody else gives you.

The knowledge in your mind is your own creative product! We build our own tools.
THE END