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

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"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.

Misconceptions about writing

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.

Misconceptions about writing

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?

Planning

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?**

Planning

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!

Drafting

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 <u>things you can do for yourself</u> 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 <u>ways</u> 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 <u>that are not necessary</u>."

Keep watching…

Revising

An example:

"One of the best ways to improve your writing is to learn how to cut out <u>unnecessary</u> 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, <u>learn how to</u> 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!

Editing

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...

Editing

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*!

Editing

To become a better speller…

(3) Recognize related words
(*gover<u>n</u>, gover<u>n</u>ment…*).

(4) Pronounce words carefully, or even
comically, to help you remember spellings
(*signifi<u>c</u>ant*, *Cal<u>i</u>fornia* – 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

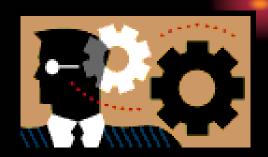Use conventional roman type for text, `typewriter type for computer programs,` and maybe sans-serif type for headings.

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 <u>underlining</u>.

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

Follow the standard practices of the printing industry, not the limitations of the typewriter!

Formatting

Avoid meaningless variation

A basic principle of communication:

The reader will expect every change to mean something.

Formatting

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.**

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?

Language

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.

Language

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.

Language

Example 2:

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

He/she can sell me a 22-μF, 35-V capacitor without knowing what a capacitor really is or what the numbers mean.

Language

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!)

Language

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…

Logic

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**.

Epistemology

"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.

Epistemology

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.

Epistemology

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.

Epistemology

If you step out in front of a bus,
it *will* run over you,
even if you can find people
whose opinion is different.

Epistemology

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.

Epistemology

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

Learning strategy

- Different kinds of material require different learning strategies.

Learning strategy

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.

Learning strategy

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.

Learning strategy

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