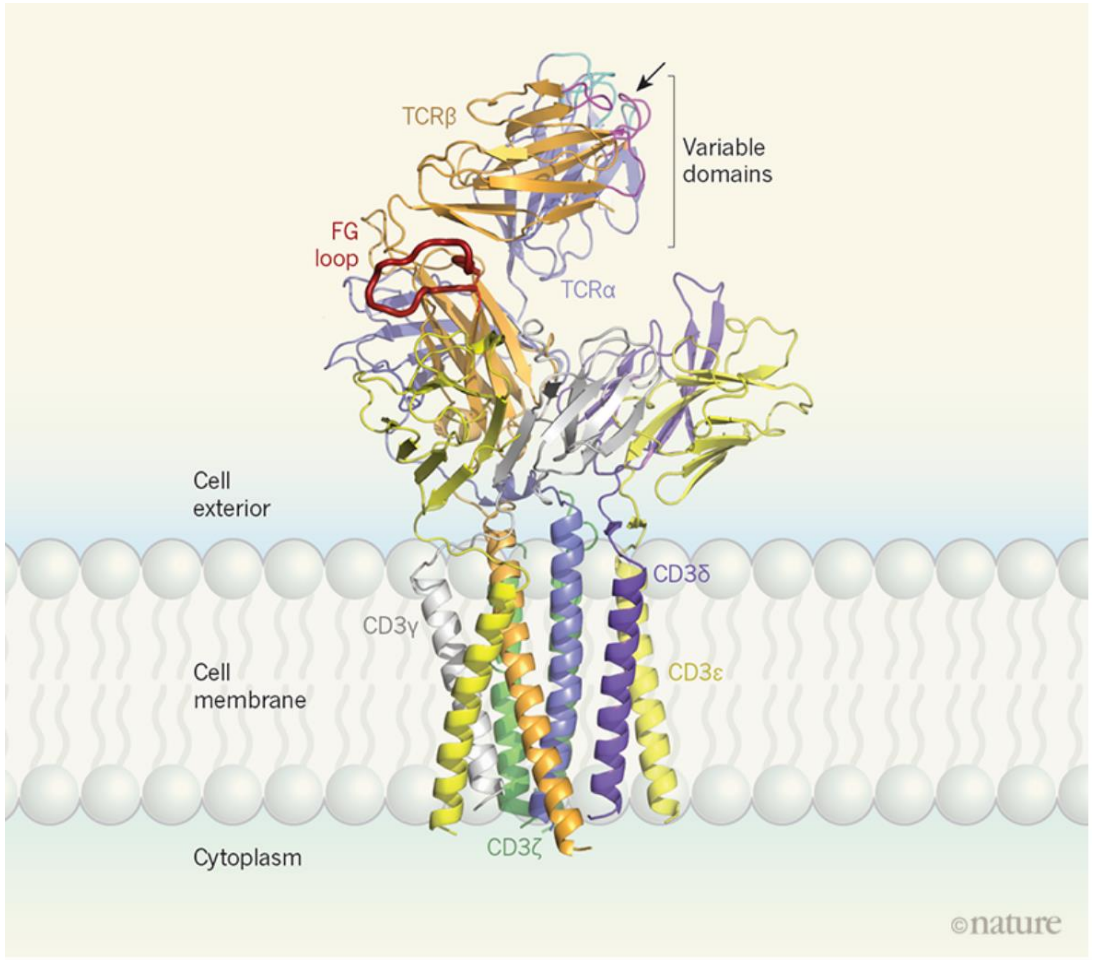
Scientific reading and writing, and creativity

Simon Davis

How to **read** a scientific paper

How to approach your reading



IMMUNOLOGY

The structure of a T-cell mechanosensor

T-cell receptors orchestrate immune-system responses against infection and cancer. A structure of an entire T-cell receptor complex clarifies its assembly and signalling, and sheds light on its dynamic ligand recognition. **SEE ARTICLE P.546**

ELLIS L. REINHERZ

technique called single-particle cryogenic electron microscopy (cryoEM). Such a high-

ELLIS L. REINHERZ

How to **read** a scientific paper

During your reading of the paper

BE CRITICAL – ask questions of it:

- what specific problem does this research address?
- is there an agenda at play?
- why is it important?
- is the method used a good one? The best one?
- are the findings supported by persuasive evidence?
- is there an alternative interpretation?
- how are the findings unique/new/unusual or supportive of other work in the field?
- what are the new questions the study uncovers?

Above all:

Does it make sense to YOU? Test it against your belief system for how Biology works

How to **write** a scientific paper

WHEN do I start?

a. When you know your conclusions and have proven them to the best of your abilities
b. **More usefully, start fairly early to establish the narrative and identify what experiments are missing ("writing is concentrated thinking")**

Don't 'over-cook' your paper…

Consider the idea that *"every paper is just a **progress report**"* – philosophy that will help fend off perfectionism that might keep your paper from ever seeing the light of day

Don't 'under-cook' it either

You don't want reviewers to tell you that you've missed an obvious control

How to **write** a scientific paper

Where should I consider sending it?

- Do need to target a journal: sets the format and the style
- Critically self-assess your results and conclusions – is the study of interest to a general or more specialist audience?
- Not all papers should go to CNS – value is ultimately judged by the citation record

Most-cited papers of all time

Lowry, O. H., Rosebrough, N. J., Farr, A. L. & Randall, R. J.	Protein measurement with the folin phenol reagent.	J. Biol. Chem.
Laemmli, U. K.	Cleavage of structural proteins during the assembly of the head of bacteriophage T4.	Nature
Bradford, M. M.	A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding.	Anal. Biochem.
Sanger. F., Nicklen, S. & Couslon, A. R.	DNA sequencing with chain-terminating inhibitors.	Proc. Natl Acad. Sci. USA
Chomczynski, P. & Sacchi, N.	Single-step method of RNA isolation by acid guanidinium thiocyanate-phenol-chloroform extraction.	Anal. Biochem.

How to **write** a scientific paper

What are the important considerations for choosing a journal?

1. Type of journal – general or specialist
2. Don't be overly concerned about impact factor
3. Reputation in the field
4. Format of the article

BUT also consider depositing on a preprint server: *bioRxiv.org*

Likely the future of biological publishing if *arXiv.org* is anything to go by

- Advantages: citable doi, early distribution/feedback, **establishes priority of discovery**, help with editors!
- Disadvantages: can compromise submission of patents; "scoop-ability"

How to **structure** a scientific paper

The Introduction: the most important part for editors

1. Provide **Context**

- orient the reader but NO UNNECESSARY INFORMATION
- works like a funnel – general to specific
- implicitly establishes the importance of your work
- *"…since the early 1990s…"*

2. Explain the **need** for your work

- provide an idea of the existing situation in your field
- state the desired situation (where the field needs to get to)
- "*but, however, or unfortunately we still don't understand…*"

3. Explain what you've **done** in the paper in response to the situation

- How you addressed this need
- *"Here, we investigated the behaviour of . . ."* PAST TENSE

4. Finish by grandly stating the **object** of the paper

- what the paper actually achieves (or tries to)
- *"This paper provides the complete framework for . . ."* PRESENT TENSE

The **writing** itself

It's all about revision…

- Writing is an iterative process
- Do not hope to write a perfect paper in one pass
- Work in several (or many) passes
- Focus on progressively smaller parts of the text

Simon's special writing tips

- Use well marked and structured paragraphs to help frame your argument
- Take care of the typos – show how careful and reliable a scientist you are
- Try to be as compact with your language as possible
- "An increase of the temperature was observed" should be "the temperature increased"
- Instead of "negatively regulates" use "inhibits"
- Be **honest**; if you didn't do something next, don't start "Next, we tested…"
- Take pride in being a good scientific writer
- ***Above all - polish, polish, polish!***

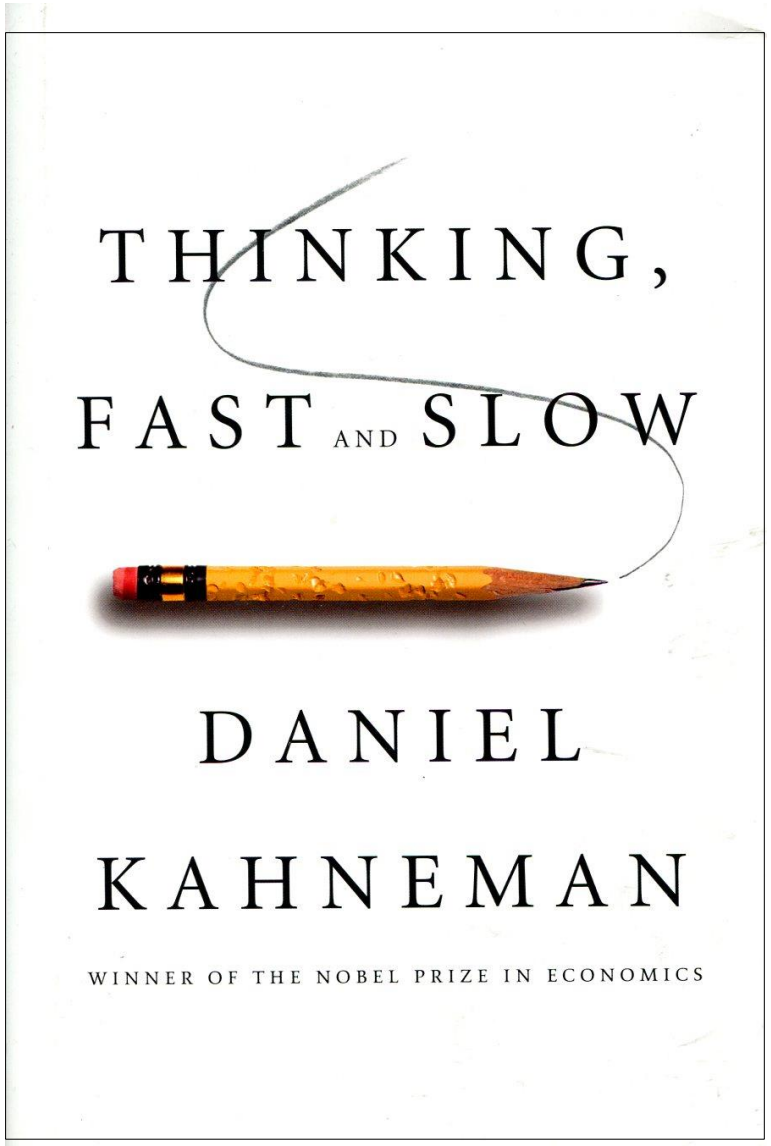
In a word: what all good writing seeks to capture…

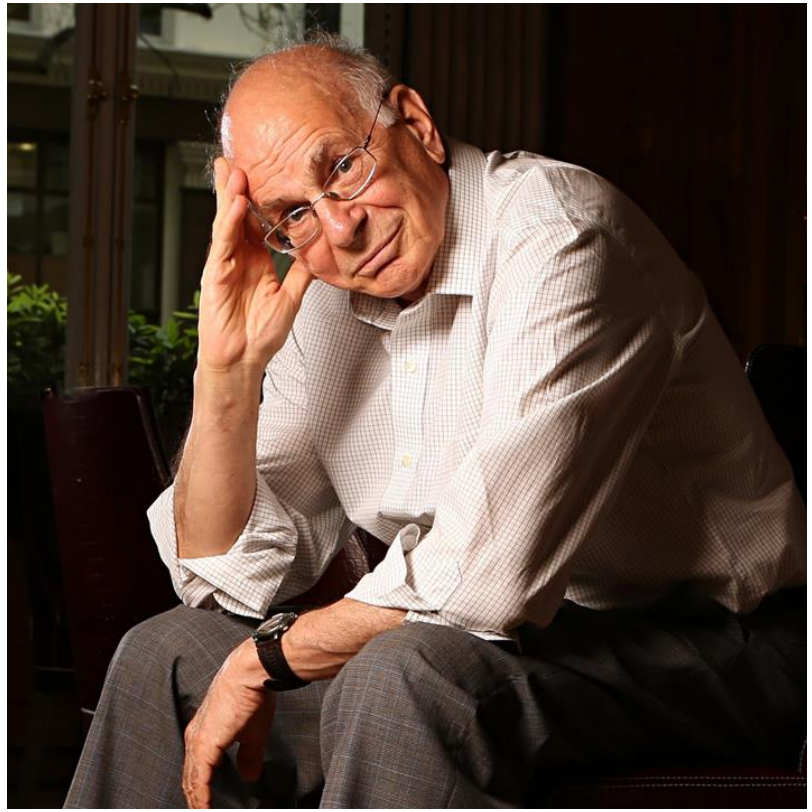
“essence”

A great resource for scientific writing (and presentations):
https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/118519859/

Creativity

Thinking, fast and slow



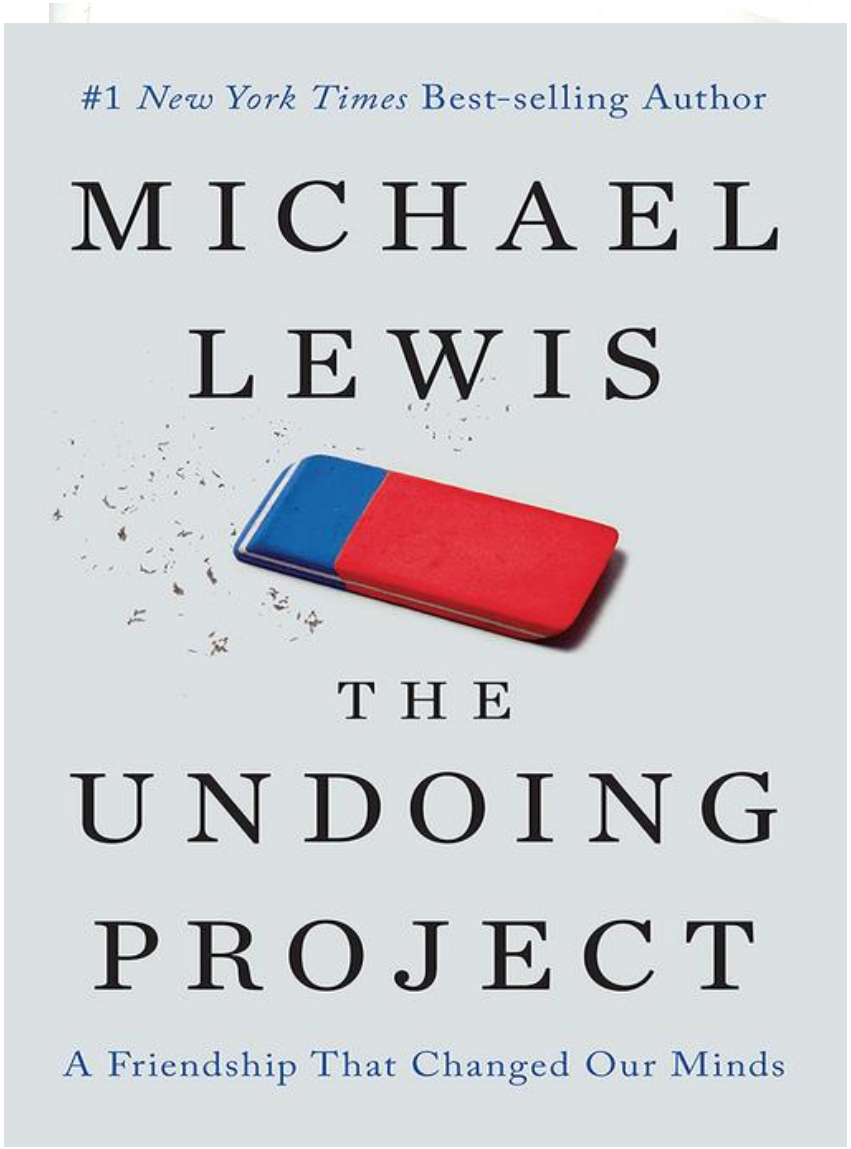


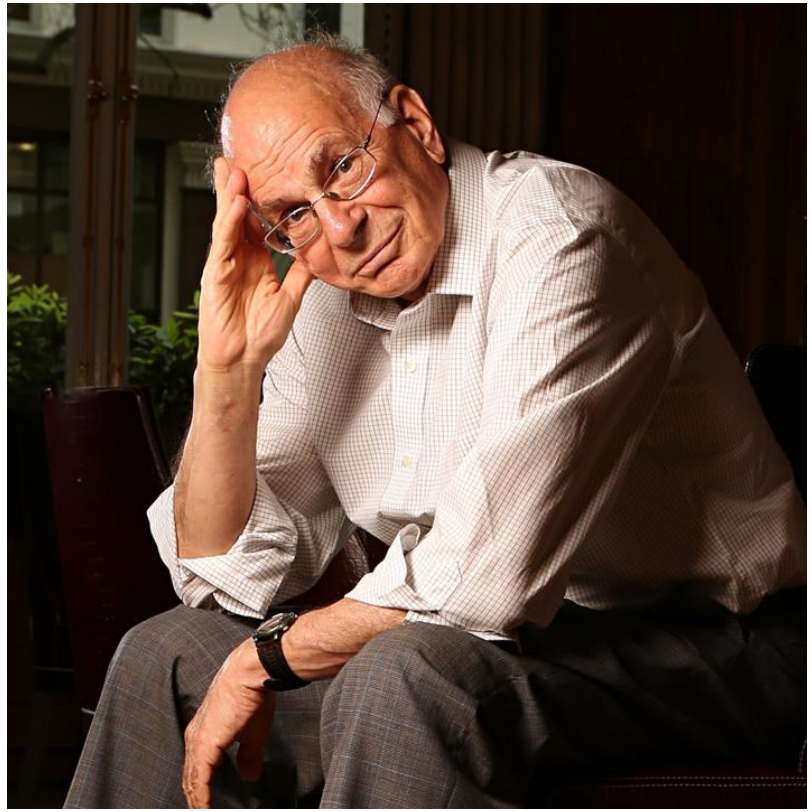
Daniel Kahneman

"How humans make decisions"

e.g. 1/2 chance of £100 vs 1/10 chance of £1000

Thinking, fast and slow





Daniel Kahneman
Nobel Prize (Economics) 2002

Two “thinking systems”

System 1

- fast
- automatic
- intuitive
- subconscious
- effortless

BIASED

e.g. allows us to drive a car whilst listening to a passenger

System 2

- slow
- deliberate
- voluntary
- effortful

LAZY

e.g. allows us to solve a quadratic equation

What about discovery?

Two types of discoveries:

a. Those solved by observation + inference *e.g.* the crystal structure of CD45

b. Those requiring the creation of a new theoretical construct
e.g. a counter-intuitive theory of receptor signaling

My (rare) experience of creative episodes

Two features

a. New idea “comes from nowhere”

b. Only when my system 2 is engaged with my work

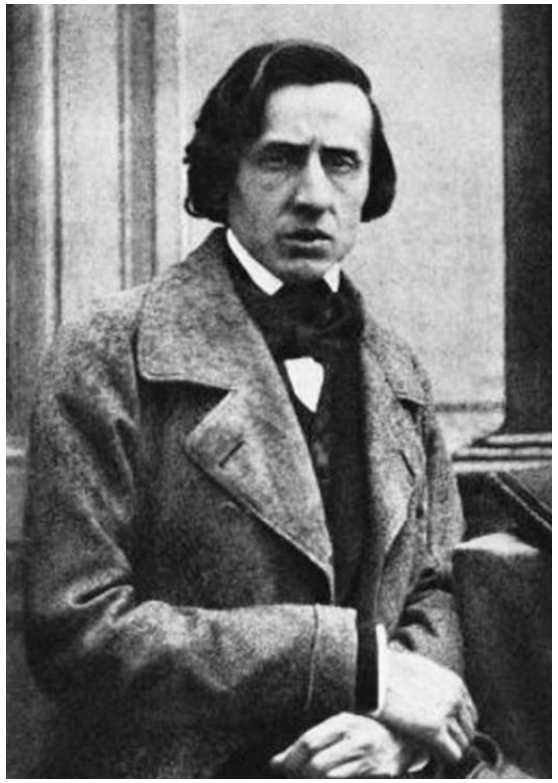
⇨ Conscious thinking opens up a portal to System 1

Time spent thinking*§

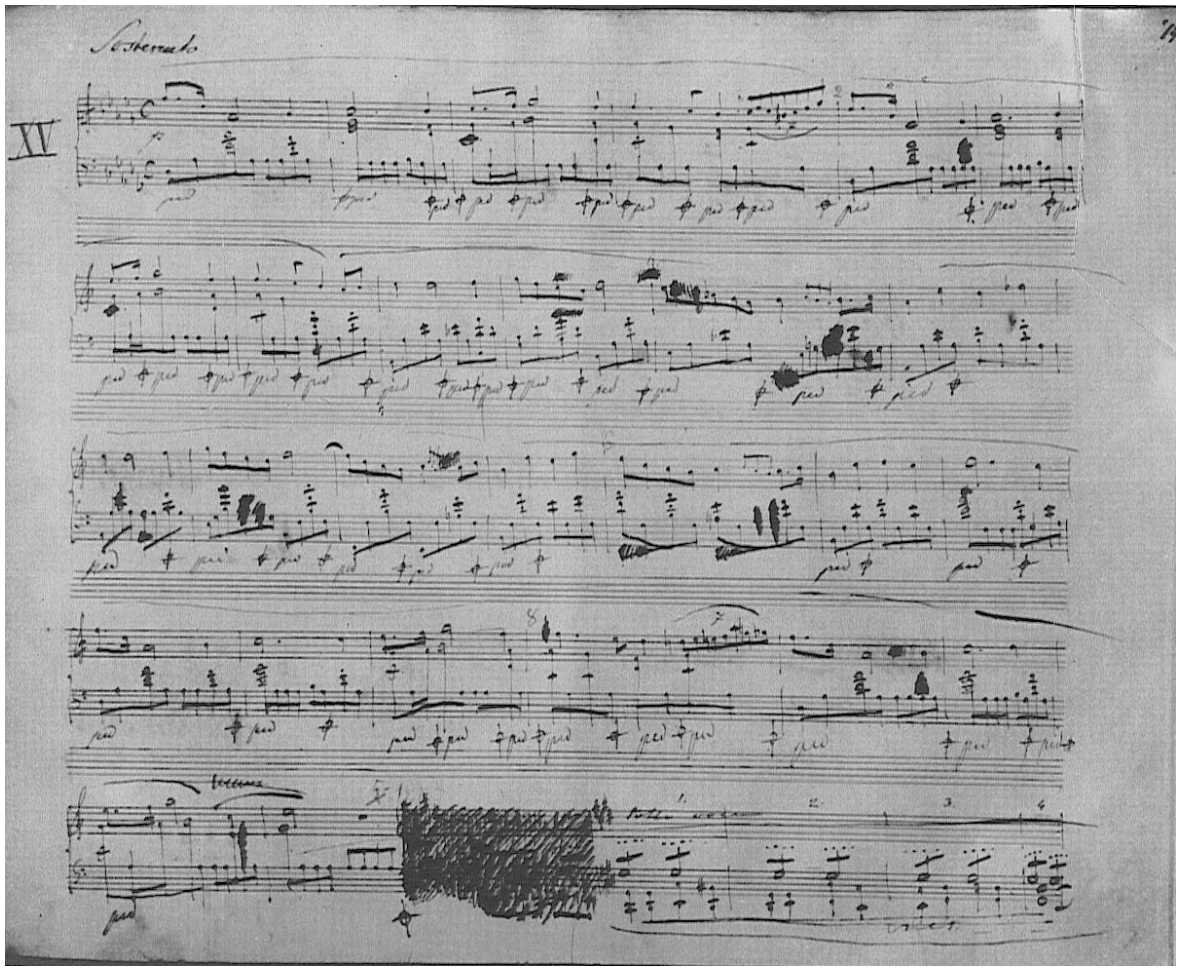
* Not alone in thinking this: Sir Isaac Newton was once asked how he discovered the law of gravity. He replied,
"By thinking about it all the time.”

§ Includes talking with (scientific) friends, reading, writing

GENIUS takes time



Frédéric Chopin



“Raindrop” Prelude Op. 28 no. 15