



Thinking Fast and Slow

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What is thinking?



Thinking going on here?





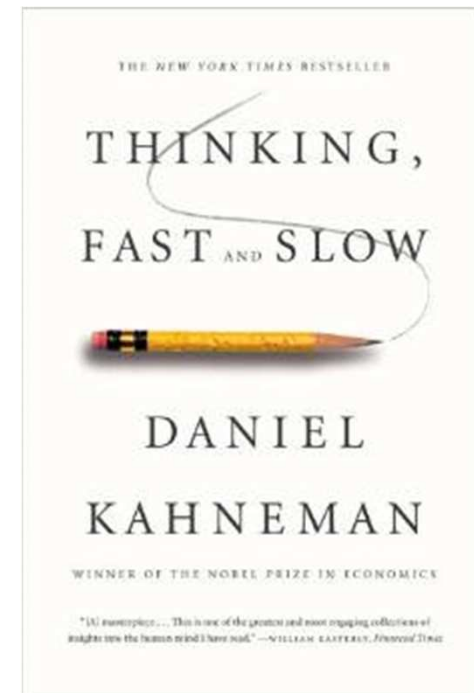
Commonalities

- **Staring, focused concentrated attention**
- **Pressure to produce, decide as quickly as possible**
- **Don't stop or take a break – that would mean you're not really working**
- **This is what passes for thinking**

Behavioral economics

Psychologist Daniel Kahneman won the Nobel Prize for “Economic Sciences” in 2002.

Kahneman & Tversky changed the way we think about thinking.





My goal: useful tips

Cognitive science is fast growing, uses controlled experiments, on-going re-testing, explosion in results

Our field is slow growing, few, if any controlled experiments (mostly anecdotes, case studies)

We should pay attention. It might help us do our work better 😊!



Which System?

System 1

Unconscious (runs 24/7)

Fast

Intuitive

Can multi-task

Remembers everything

~11 million bits/sec

95% of cognitive function

BUT inaccessible

Our gut feeling, source of insight

System 2

Conscious (on-line when awake)

Slow

Rational

Linear

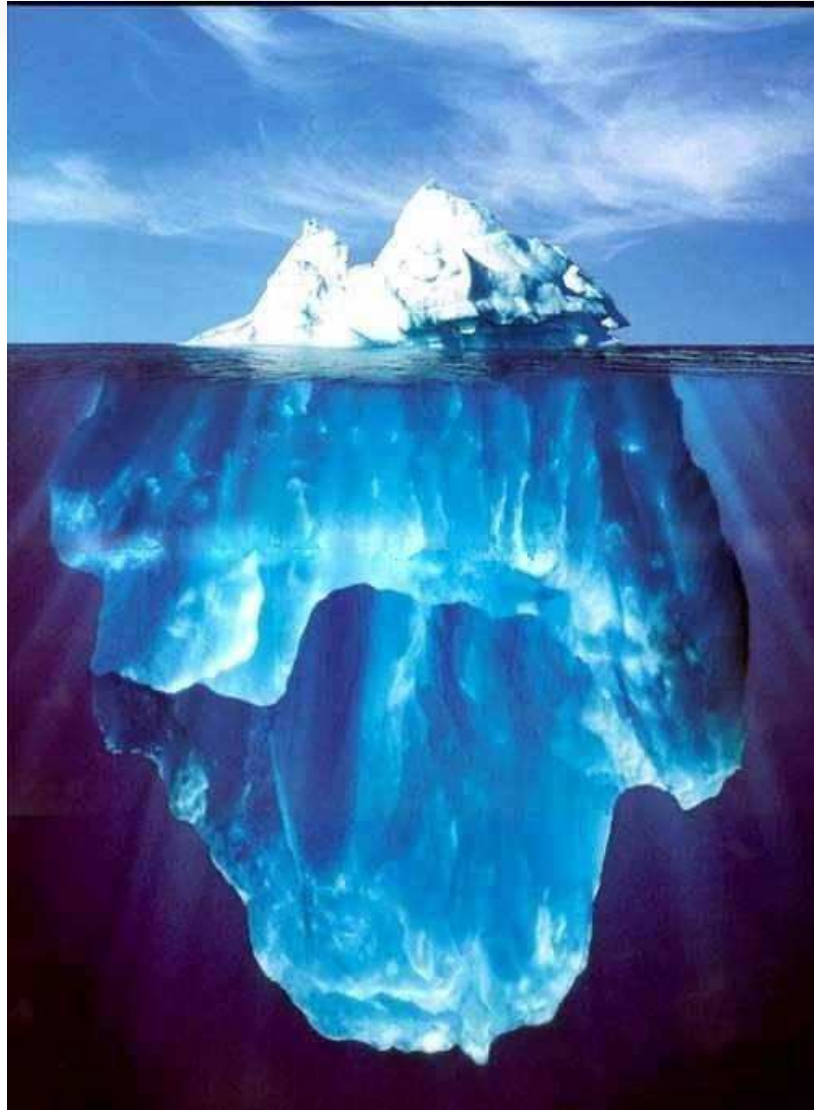
Forgetful

~40 bits/sec

5% of cognitive function

Chatters constantly while we are awake

We identify with it, believe it's in charge





More on System 1

- **Heuristics, expertise, automatic mental activities of perception and memory.**
- **Associative memory continually creates a story interpreting what is going on at any moment--your personal story where you are the hero.**



System 1 Heuristics, biases, errors

Confirmation bias: tendency to search for, interpret, favor, recall (it affects memory) information to confirm our beliefs. We seek confirmation, not information.

Cognitive dissonance: struggle to hold two disconfirming ideas at the same time.

Naïve realism: belief that we are rational and those who disagree with us only need “facts” to see our side.




Any help for cognitive bias?

- **Hardwired**
- **Difficult to overcome on a personal level**
- **So easy to see in others**



The result: severe limitations on thought

- **Excessive confidence in what we believe we know.**
- **Inability to acknowledge the extent of our ignorance and the uncertainty in the world.**
- **Overestimate how much we understand about the world and underestimate the role of chance (randomness) in events. We like “patterns” and explanations.**



I'm considered one of the worst offenders on many of these errors. I'm overconfident, when I preach against that. I make extreme predictions, when I preach against that. Some people read *Thinking, Fast And Slow* hoping it will improve their minds. I wrote it and it didn't improve my mind. Those things are deep and powerful and hard to change.

Daniel Kahneman



More on System 2

- **Allocates attention to effortful mental activities.**
- **Associated with action, choice, concentration.**
- **When fully engaged can only focus for 50 minutes (max).**



How we learn

- **New skills are acquired by System 2. With practice/experience, we can move them to System 1 as they become automatic and we become an expert.**
- **Examples: walking, driving, playing a musical instrument, engaging in a sport.**
- **When we “overthink” in a domain where we have skill we can get in the way of our expertise.**

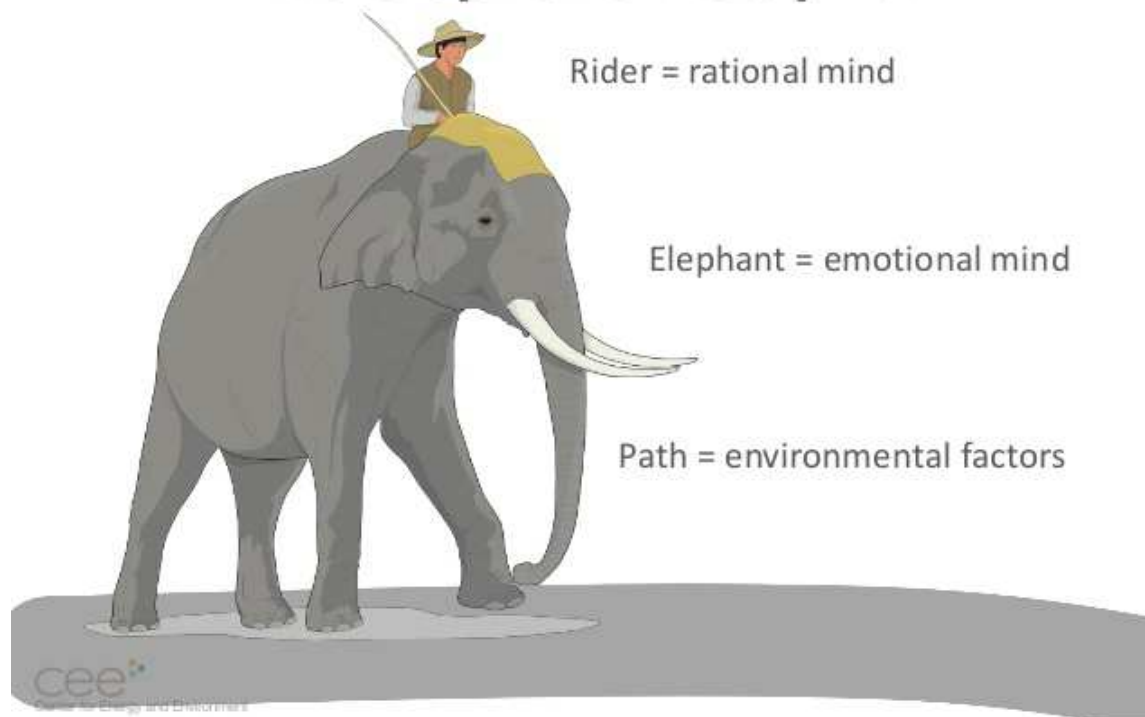


Models are not reality

- **Kahneman's model is an abstraction**
- **All models are wrong but some are useful.**
George Box, statistician
- **Kahneman made no effort to map Systems 1 & 2 to brain regions.**
- **Except for well-known areas of the brain involved in sensory and motor functions, almost every part of the brain is involved in almost everything the brain does.**

Jonathan Haidt & Heath Brothers

The elephant metaphor





System 2 takes energy

- **Conscious decision-making (System 2) takes time and energy (about 25% of your intake).**
- **Difficult cognitive reasoning or self-control causes drop in blood glucose.**
- **“Pay attention.” There is a cost to using System 2.**
- **It’s an illusion that System 2 = thinking.**
- **Don’t waste conscious effort**



Limitations of System 2

- **We have a limited pool of “mental energy.”**
- **This is why conscious multi-tasking is impossible for us**
- **This is why we make bad decisions when we are tired or hungry**
- **This is why we need to take breaks**



How it works

- **System 2 normally in a comfortable low-effort mode, using a fraction of its capacity.**
- **System 1 continuously generates suggestions: impressions, intuitions, impulses, intentions, feelings. If endorsed by System 2, impressions and intuitions become beliefs; impulses become voluntary actions.**
- **When all goes smoothly (most of the time) System 2 adopts System 1's suggestions.**
- **When System 1 has difficulty, it calls on System 2 for processing.**
- **Who's in charge?**



System 1, of course!

- **System 2 believes it runs the show, but System 1 is in charge.**
- **It's good to have System 1 in charge of stuff -- it would be bad (as David McRaney says) to hand the keys to the pancreas over to System 2 who routinely forgets your phone in restaurants.**

Cake or Fruit Salad?



BAD FOR YOU



GOOD FOR YOU

Make life simpler

You'll see I wear only gray or blue suits, [Obama] said. I'm trying to pare down decisions. I don't want to make decisions about what I'm eating or wearing. Because I have too many other decisions to make.

Fast Company 2/12/2014





Rule #1- don't do it

- **If possible—don't spend time on it!**
- **OR hand it off to System 1**
- **Professionals spend an average of 9 minutes choosing their office attire.**
OfficeTeam survey of 2015 workers in North America.
- **System 2 is a limited resource, do not waste it.**




Stories of using System 1

- Solving math problems; debugging code
- “I back away from conscious thought and turn the problem over to my unconscious mind. It will scan a broader array of patterns and find some new close fits from other information stored in my brain.”
Arthur Fry, co-creator of the Post-it Note
- The question I never asked myself: How long do I have to work on something before getting insight?



My problem-solving approach

- 1. Define problem. Say it out loud, write it down.**
- 2. Enough data?**
- 3. Invest minimal amount of time solving it (possibly adjust answers to 1 & 2) – no more than 10 min.**
- 4. If solution is not forthcoming, leave it (one or more of the following):**
 - work on another task**
 - stand up/sit down, stretch**
 - bio break**
 - longer break, e.g. exercise, meal, errand, sleep**
- 5. If no insight, repeat steps.**
- 6. System 1 is not always “right.” System 2 makes final decision.**



You may have more knowledge, data, information than you realize. It's better to go ahead with what you have than to wait for a complete understanding, which may never come and might not be necessary. Remember that System 1 is already working on it.



System 1 is creative

- **The problems you solve using System 1 are not binary solutions (should I do this or not) but can be complex, innovative approaches.**
- **Songs and novels have been written this way.**
- **Story of finding music.**



Multi-task? Sorry ☹!

System 2 cannot multi-task but must context switch as does any linear processor

Heavy multi-taskers have been shown to have no beneficial abilities and to be suckers for irrelevancy

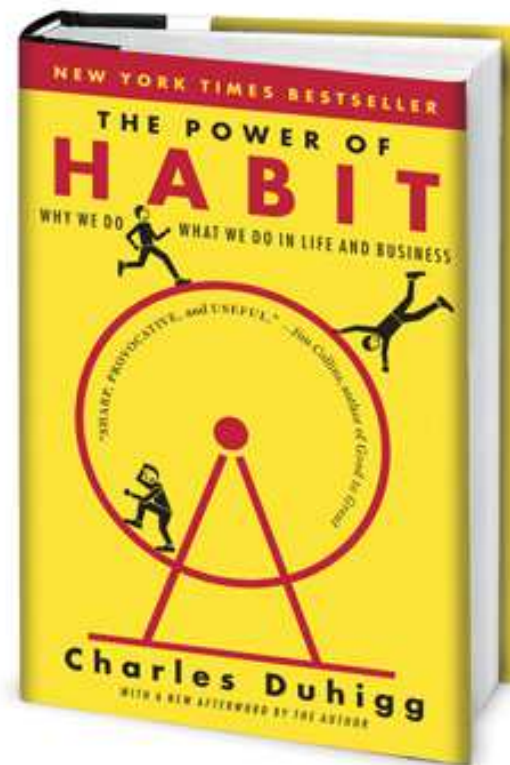
You can't compute 17×24 while making a left turn in heavy traffic. You can do several things at once, but only if they are easy and undemanding, so you can turn most of them over to System 1.



This includes habits

- **Defining a process in advance not only hands the work over to System 1, it saves wear and tear on System 2.**
- **Travel, hotel rooms, purse/briefcase**
- **Sometimes this means changing habits, a difficult endeavor.**

The best book on changing habits





When to use System 2

- **Complex tasks, e.g. income tax reports**
- **Reading. Taking notes.**
- **Practicing anything.**
- **Meetings, lectures, podcasts.**
- **Anytime you have to “pay attention.”**



Flashes of Insight

When System 2 is trying to solve a complex problem, often you need to distract it. If System 2 stops working on the problem, then System 1 (which has been working in the background) can potentially offer up results. Doing a different, unrelated activity, e.g. taking a shower, going for a walk, mind wandering, sleeping, allows System 1 to intrude. These ‘flashes of insight’ originate in System 1.




Do “Nothing”

The areas of the brain involved in (prospect) thinking about the future – insight – occurs during idle time – are the same areas of the brain involved in thinking about what others are thinking.

Right temporoparietal junction RTPJ, one of the areas that’s most different in our brains.

It takes a long time to develop ~age 5.

We need to take time off, let the mind wander, listen to others, take another point of view.



I insist on a lot of time being spent, almost every day, to just sit and think. That is very uncommon in American business. I read and think. So I do more reading and thinking, and make less impulsive decisions than most people in business.

Warren Buffett



“Let’s go for a walk.”

Steve Jobs



The Ultimatum Game

In pairs of subjects, Player A is given money (e.g. \$10) and makes an offer to Player B. If B accepts offer, both keep the money. If B rejects offer, both get nothing.

Typically, low offers (e.g. \$2) are rejected.

Research shows that if players take a 10-min break, low offers are accepted, so TAKE TEN!

Virginia Apgar, M.D. (1909-1974)

Apgar Scoring System

Indicator		0 Points	1 Point	2 Points
A	Activity (muscle tone)	Absent	Flexed arms and legs	Active
P	Pulse	Absent	Below 100 bpm	Over 100 bpm
G	Grimace (reflex irritability)	Floppy	Minimal response to stimulation	Prompt response to stimulation
A	Appearance (skin color)	Blue; pale	Pink body, Blue extremities	Pink
R	Respiration	Absent	Slow and irregular	Vigorous cry



Is an ulcer malignant?


- **Simple algorithm – 7 equally weighted variables predicted cancer well**
- **Algorithm compared with expert diagnosis of x-rays of 96 ulcers**
- **Physicians' diagnoses all over the place, inconsistent on hidden repeats (errors 20% of the time), little agreement**



Algorithms win


The same inputs generate the same outputs every time. They don't get distracted. They don't get bored. They don't get mad. They don't get annoyed. They don't have off days. They don't fall prey to the litany of biases humans do.

The algorithm doesn't have to be complex. As demonstrated with the radiology example, simple rules work well.



A study of 101 independent auditors asked to evaluate the reliability of internal corporate audits showed similar inconsistencies.

A review of 41 studies of the reliability of judgments of auditors, pathologists, psychologists, organizational managers, and other professionals suggests that this level of inconsistency is typical, even when a case is reevaluated within a few minutes.



The surprising success of equal-weighting schemes has an important practical implication: it is possible to develop useful algorithms without prior statistical research. Simple equally weighted formulas based on existing statistics or common sense are often good predictors of significant outcomes.

Daniel Kahneman



Small Steps

We have a sense that large, complex problems require large, complex solutions.

Organizations and software are examples of complex adaptive systems where the impact of any change is difficult to predict

The often-overlooked approach of Small Steps (it's a pattern!) is a better road to success where the result of each small experiment can be seen before the next step is taken



Continuous experiments

Ask System 1 questions and wait for an answer, e.g. “How can I find more time for practicing?”

The answer, when it comes, may not be definitive, but can suggest a small experiment that likely leads to more questions and more experiments. This process never ends.

Thanks for listening!



References

- *Brain Rules*, John Medina, brainrules.net
- *The Art of Changing the Brain*, James Zull
- Any book by Dan Ariely
- <http://youarenotsmart.com/podcast/>
- *Thinking Fast and Slow*, Daniel Kahneman