Fundamentals of Learning:
Build skills to learn faster and better according to neuroscience

Saraswati

Connie Missimer

Principal, Critical Thinking at Work

Minerva

Overview of the workshop

First and second hour— Taking it in, Giving it out

Eleven recent findings about learning and three on presenting

Exercises and group chat

Breaks after first and second hour

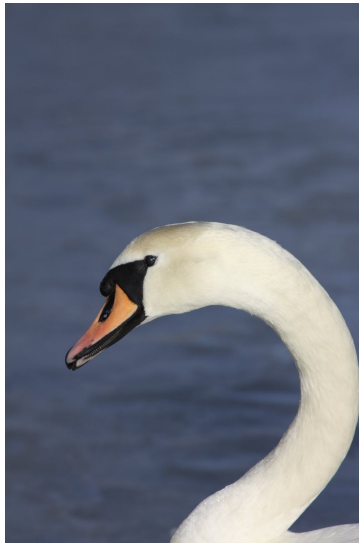
Third hour

Evaluating information

Learning practice

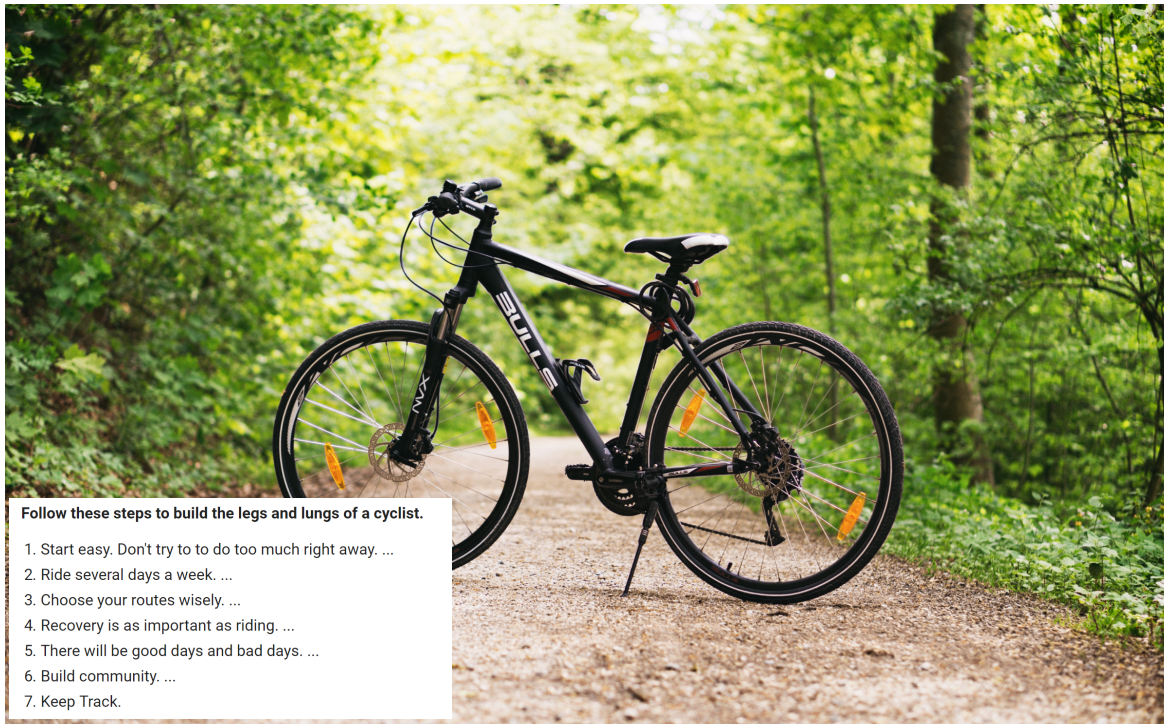
Exercises and group chat

Summary and final quiz



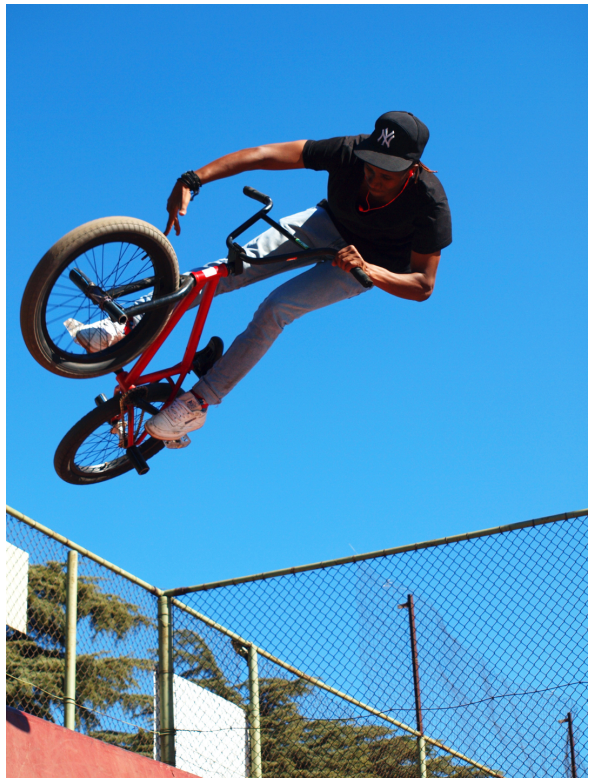
Level-setting this course

We will be here for the most part



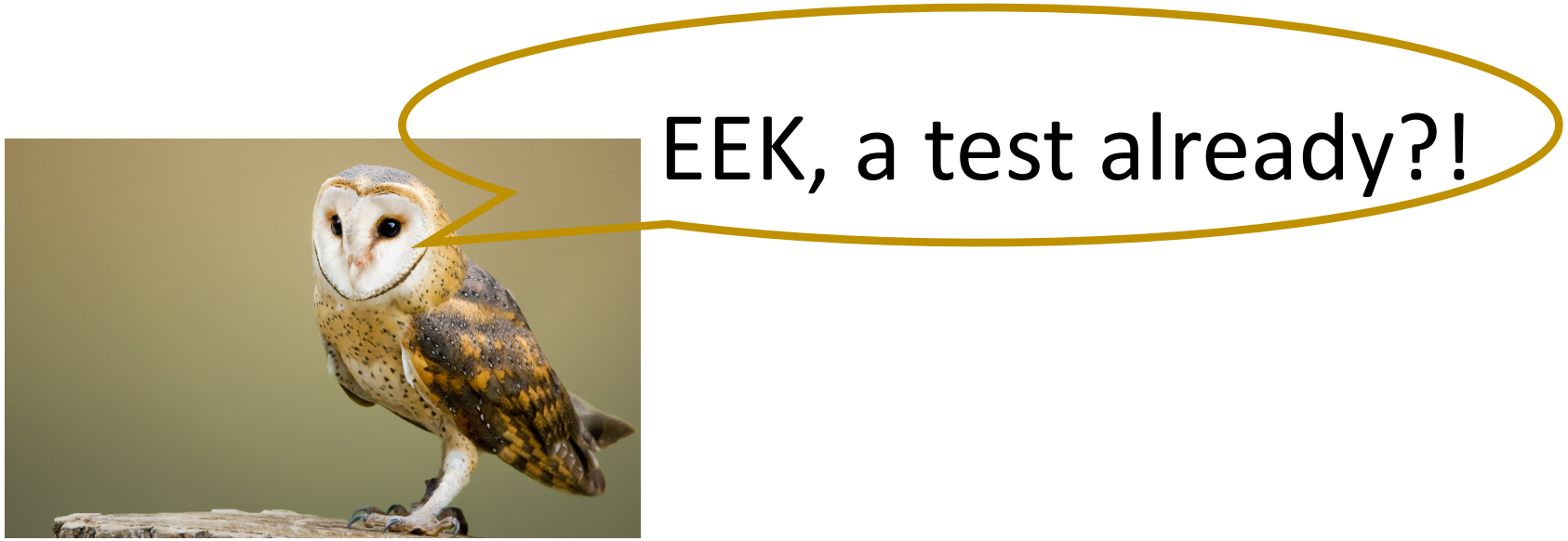
[The Beginner's Blueprint to Road-Cycling Greatness]

Actual riding well comes with time



Thanks for joining today!

To help me better know what you think, let's start off with a few questions about learning....



Poll: Select all that you think are true about learning

a) Keep reviewing the material until you know it
b) If you take breaks, you're that much farther from your goal of knowing
c) Take the material step by step
d) Pose questions about the material to yourself
e) After you learn, memory of the material steadily degrades
f) Keep a tight focus on each element until a bigger picture emerges
g) All the above are true
h) All the above are false

Poll results

Myths vs. Evidence about learning

- Keep reviewing the material until you know it
- If you take breaks, you're that much farther away from your goal of knowing
- Take the material step by step
- Pose questions about the material to yourself
- After you learn, memory of the material steadily degrades
- Keep a tight focus on each element until you see the big picture

- Mistake of "fluency" – we think we will remember but only recognize
- Breaks help learning!

- Jumping around can give you the big picture, very helpful
- Quizzing yourself is crucial
- Keep trying to recall; often you will remember more
- Best to move from focused to diffuse thought about a subject

Poll: Select all that you think are true about learning

a) Try to make many associations, even nonsensical ones, with the material
b) People have different learning styles (prefer to hear over see, read)
c) This poll will help me learn even if I get things wrong
d) Go to different places to study
e) Mix together different things rather than one thing at a time (e.g., in art history, mix up the paintings of several artists and guess who created them rather than studying the work of one artist in depth at a time)
f) All these are true
g) All these are false

Poll results

Myths/Evidence about learning

- Try to make as many associations, even nonsensical ones, with the material
- People have particular learning styles (some do better reading, others seeing pictures, or hearing info)
- Associations (mnemonic devices) add neural connections, strengthening memory
- This has not been borne out by the evidence. Different material requires different approaches

Myths/Evidence about learning

- This poll will help me learn even if I get things wrong
- You took a pre-test, which should to help you learn, even when you get the questions wrong (set the stage)
- Go to different places to study
- True, weirdly. Evidently our minds make extra associations with our environment and what we are studying.

Myths/Evidence about learning, cont.

- Mix together different things rather than learning one thing at a time (e.g., in art history, rather than studying the work of one artist, mix up the paintings of several)

- True, not only about academic subjects but in sports
  - Shoot baskets from different angles
  - Mixed practice far outperforms “one-at-a-time” drills during games

Interleafing

A study in study contrasts

Laura the lazy

- Moves from details to scan for the big picture (Focused → Diffuse → Focused)
- Takes lots of breaks
- Naps after studying
- Mixes up study of her subjects
- Asks herself and her instructor lots of questions
- Goes to different coffee shops to study

Griselda the grind

- Starts at the beginning of the book and takes lots of notes, underlines
- Studies for hours at a stretch
- Defers sleep to get in more study
- Tight focus on one thing at a time until she feels she has mastered it.
- Independent, doesn't ask anybody else because she feels she will be able to figure things out.
- Sticks to the same place, routine

Poll question

According to recent evidence, who will learn more efficiently?

a) Laura the Lazy
b) Griselda the Grind
c) Both their learning approaches are equally effective
d) It depends on an individual's learning style

Poll results

This learning research is so new that…

- We rarely get pre-tested
- We're not encouraged to learn by napping, taking breaks
- No one tells us to stop and quiz ourselves
- We wouldn't dream of going to a bunch of different places to learn something
- We wouldn't imagine that going from focused to diffuse brain states would make a difference
- The idea of "interleafing" isn't intuitive
- We've been taught to feel guilty about procrastinating, without the all-important distinction of waiting to iterate as better

A silly mnemonic summary sentence....

I asked for a mixed-up nap break at several Starbucks associations

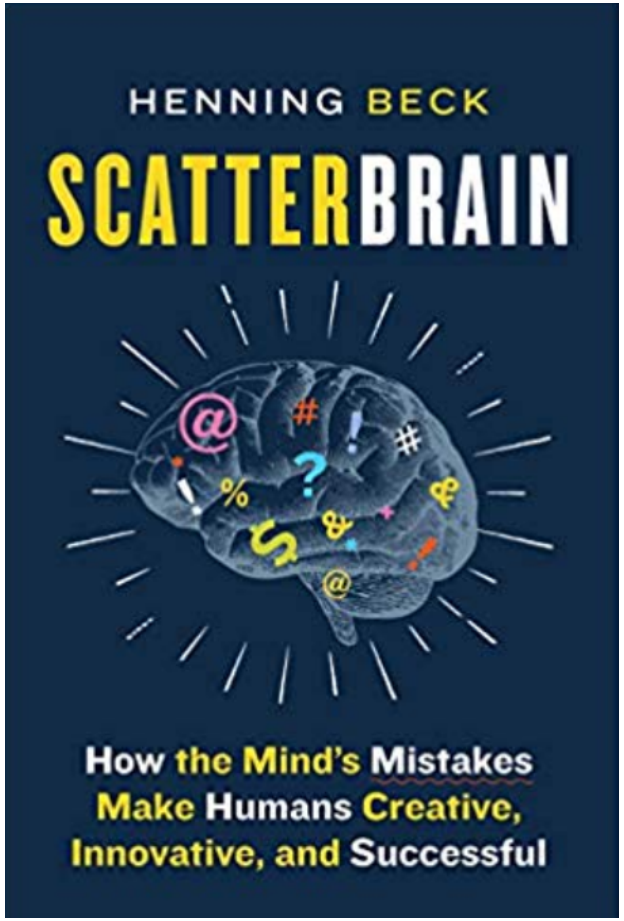
Ask- quiz self
Mix- different material
Up- Go to diffuse, back to focus, then diffuse etc.
Take lots of naps and breaks to cement learning
Several Starbucks– different venues
Associations– connect material with as many associations as you can

And now, a word from our sponsor

The Brain

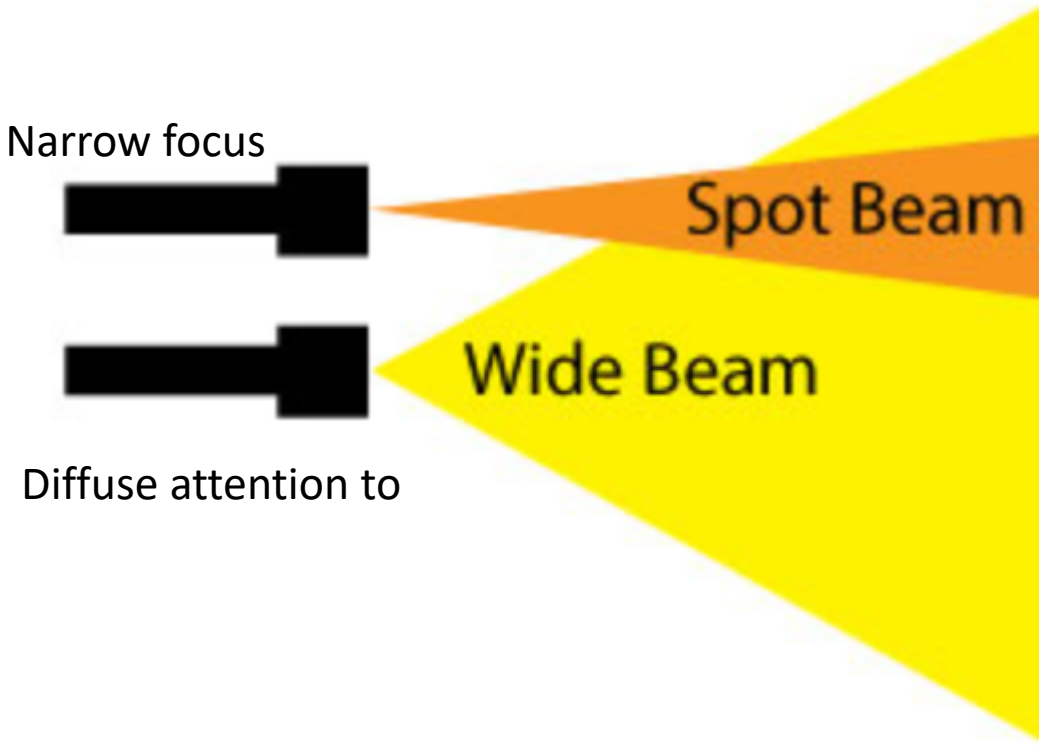
Hi,

- I’m pretty bad at rote learning
- Just so you know
- Sorry about that
- Actually, not sorry
- I’m really good at making sense of the world, finding larger patterns
- “Your brain has become an expert at throwing things away to keep them from distracting you...[so] incoming information is placed on a trial period.”

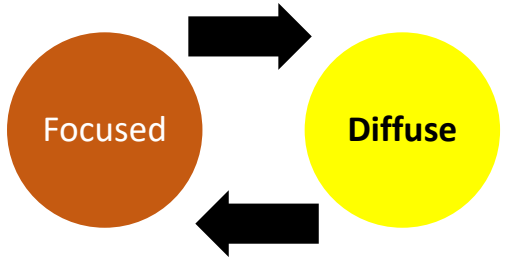


Diving into particular findings

Move between focused and diffuse thought



- Focused- What exactly is this fact in front of me?
- Diffuse- What's going on here in general? Fuzzy, "back burner"
- Toggle



Watch yourself!

Example: If I "go diffuse," I can often remember a name that concentration couldn't catch

Focused vs. Diffuse thinking about this talk

Focused

- Think about each recent finding about learning one by one
  1. Focused vs. diffused
  2. Location
  3. Interleaf…
  4. Etc.

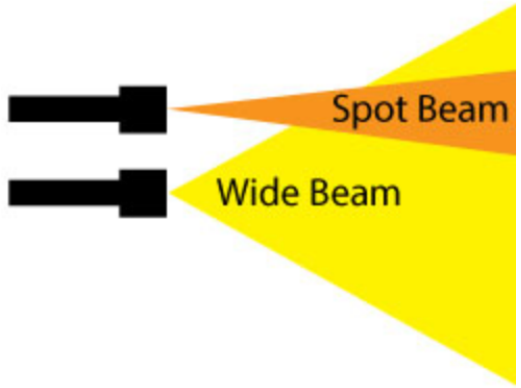
Diffuse

- It’s a bit of a ragbag of findings that, practiced together, will make learning faster and easier
- (And fuzzy, haphazard thinking about this workshop, learning)

Exercise

Choose any subject and move between focused and diffuse thought about it

Examples—



Your day so far

Your work for the week

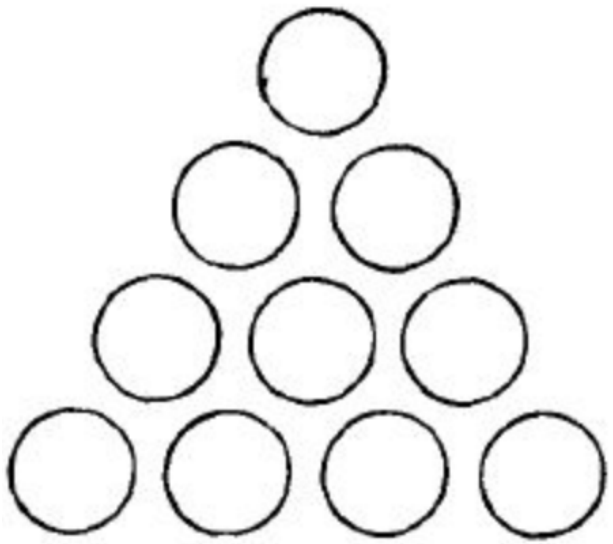
If you decided to learn Japanese, now might you integrate focused and diffuse thinking?

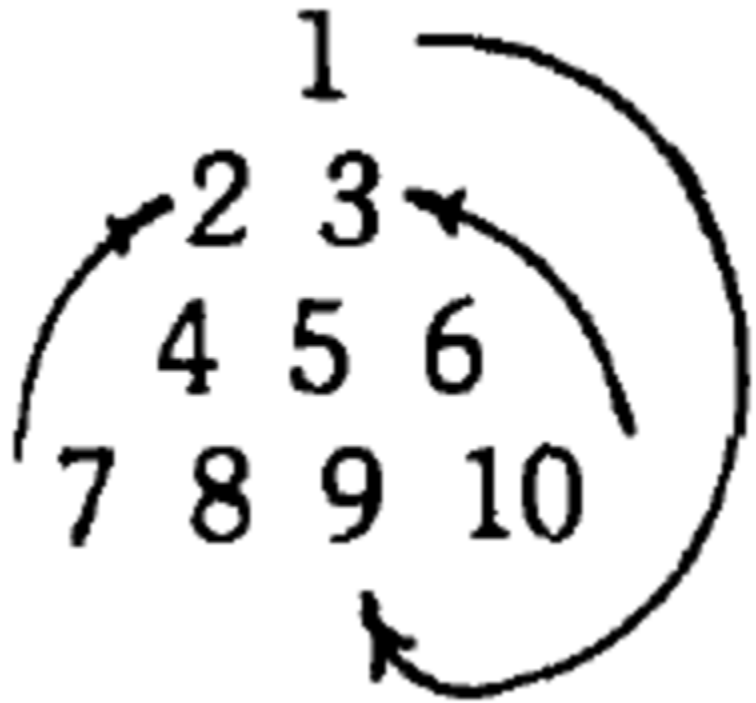
Focusing on diffuse and getting puzzled

- Focused or diffuse thinking– you can't be simultaneously in both
  - Metaphor: learning tree by tree vs. getting an overall idea of the forest
- Focused seems clear (focused!)
- But what exactly is diffuse thinking?
  - Is that even a fair question? It's very loose; is insisting on a crisp answer fair?
  - I'm quizzing myself on whether both focused and diffuse are slow thinking
- Interleaf alert! I've been using another learning technique, asking persistent questions, quizzing myself
- Ziegarnik Effect

Exercise: Focused vs. Fuzzy challenge

Can you form a new triangle pointing downwards by moving just three circles?





7 2 3 10
4 5 6
8 9
1

Interleaving– the “mixed” in “mixed up”

- Instead of blocking out learning, e.g,
  - “skill A” before “skill B” and so on, forming the pattern AAABBBCCC
- The learner rapidly moves from one skill to another, e.g,
  - ABCABCABC
- Less effective during practice
- More effective during performance (game or test)
- Mixing types of math problems
- Must have some familiarity with the material before interleaving begins

Exercise

Can you think of some subjects that would be good for interleaving?

Have you noticed any interleaving in this presentation?

Exercise

How much can you recall of that silly sentence summarizing learning data?

Just remember the comforting news that your brain does not want to (immediately) remember things.

I asked for a mixed-up nap break at several Starbucks associations

Ask- quiz self
Mix- different material
Up- Go to diffuse, back to focus, then diffuse etc.
Take lots of naps and breaks to cement learning
Several Starbucks– different venues
Associations– connect material with as many associations as you can

Breaks and naps

- What would you ask yourself about breaks and naps?

Breaks and naps

And by the way, time for a break!

Break for 10 minutes

What about that silly sentence?

I asked for a mixed-up nap break at several Starbucks associations

Ask- quiz self
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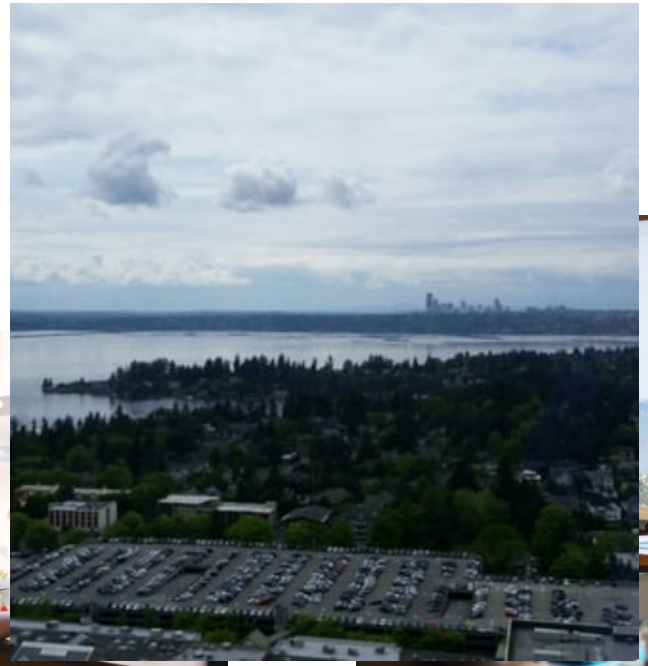
More specific learning techniques

Location, location, location

- Pick many venues to learn
- While getting there,
  you could go diffuse!



Poll

Do you think adhering to this strategy of finding new locations would be easy or hard?

a) Very easy
b) Somewhat easy
c) Somewhat hard
d) Very hard
e) Not sure

Poll Results

A common trap

The Jedi mind-trick of *fluency*

- I must know this because I've read and reviewed it– I'll remember!
- Problem is that reading is mentally passive
- Confuses understanding with being able to recall
  - Stopping to ask for directions
  - Being introduced to somebody
- Quiz yourself
  - Don't refer to the material you've read
  - Repeat the directions to the person
  - Create even crazy associations to recall
  - What was the silly sentence for the concepts in this talk?

Associations– an old trick

The names of the goddesses on the first slide?

Association, association, association

Saraswati –
Hindu goddess of knowledge, music, art, wisdom, and learning

- Sara swatting away ignorance
- What is Sara wanting?
- High wattage for wisdom
- Sara and swan start with same letter

No matter how weird; more = better

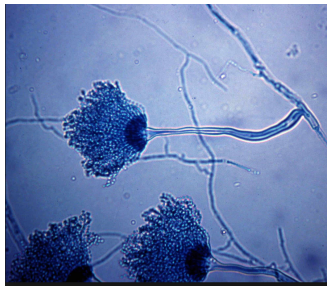
Minerva –
Roman goddess of wisdom, strategic warfare and arts (aka Athena)

- Mini has her nerve
- Minor but vast
- My nerve

Exercise

Think of four associations to remember aspergillus and these facts about it

Aspergillus



A group of fungi (or molds), some of which can cause a lung disease called aspergillosis

What about that silly sentence?

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Data on cooking for others

For Producing: Procrastination makes perfect?!

- Procrastinate = Delay or postpone
- Procrastinate until after the deadline – not good, very bad
- Procrastinate to iterate – good!

Delay completing your project for some divergent [diffuse] thinking rather than jumping in on one idea. “Start early and finish late.”

Adam Grant, *The Originals*

Truthful and positive → open to your message

- Two cognitive urges: Feel good and learn the truth
  - Humans seek comfort and control
  - Medical personnel and hand-washing in hospitals
  - Safety instructions on airplanes
- Any way to show facts in positive light for listeners will greatly help acceptance! Tali Sharot, neurobiology research, *The Influential Mind*
- Wait – There's also *negativity bias*
  - Our brains glom onto negative news and recall it more clearly
    - A criticism more than a compliment; newspapers concentrate on worrisome issues
    - Evidence suggests we do derogate ("shoot") the messenger! (Harvard Business Review, April 2019)

“Our research suggests that messengers can take measures to avoid the likability penalty through the way they convey bad news. Specifically, we have found that recipients are less likely to dislike bad news messengers when those messengers explicitly convey the benevolence of their motives...”

Relatedly... we have been finding that prefacing negative feedback with a piece of positive feedback leads to [taking] that negative feedback more seriously, and [being] less likely to dislike the feedback-giver.”

Harvard Business Review

Exercise

You have to present information to senior management that customers find your software product cumbersome (too many steps) and confusing.

From your learning course you heard that:

- If people feel comfort and control they're more likely to act/fix
- People tend to remember bad news and derogate its messenger
- You can deflect "blame" by indicating your good intentions and adding positive feedback

Can you think of any ways to present the information in the best way for the company to act on it as well as for your future standing? Procrastinate for a couple of minutes and cook up some options.

Interleaf alert!

What was the wacky sentence you saw that summarizes the data about learning? Take a minute and write down every word you recall.

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Interleaf alert

What were the three tips you got to more effectively present your data?

- Why, you should procrastinate properly (start early, end late)
- Be as truthfully positive from your recipients' perspective as you can
- Be aware of the tendencies for bad news to be more memorable than good news and bad-news-givers to be blamed— soften with showing good intentions and positive feedback

Break for 10 minutes

Evaluating information

Tips for evaluating

- Look for one or more alternatives and their evidence
- Use sources that
  - Don’t contradict themselves
  - Post retractions in cases of error
  - Explain change of opinion
  - Offer evidence in support of the claim or opinion
- Distinguish between “feels good to believe that” and “that evidence looks well grounded compared to the alternative(s)”
- Identify *ad hominem* attacks as not arguments or theories

Poll Question

Ralph says that widgets cost $100 each.

John responds, “Ralph is always trying to say that widgets are more expensive than they really are.”

How would you evaluate the price of widgets?

a) Check out the current value of widgets

b) Check out Ralph’s reputation

c) Check out John’s reputation

Poll Results

Look for evidence first

Ralph says that widgets cost $100 each.

John responds, “Ralph is always trying to say that widgets are more expensive than they really are.”

- Check out the current value of widgets
- Unless you have detailed evidence that Ralph or John exaggerate (lie), it’s safest to go to evidence first

Exercise

You learn that the head of your company announces that she does not want anyone to concern themselves with decisions she makes or has already made.

Does that announcement affect your ability to contribute to the company?

Does having people think only about their immediate duties help or harm the company?

Now learn this! Practice, practice

Excerpts from *Factfulness* and *Scarcity*

From Factfulness by Hans Rosling

- He often leads sections with a quiz question!
- In the last 20 years, the proportion of the world population living in extreme poverty has
  a. Almost doubled
  b. Remained more or less the same
  c. Almost halved
- What is the life expectancy of the world today?
  a. 50 years
  b. 60 years
  c. 70 years

Are you as surprised as I was to learn that...

- World poverty has halved in the past 20 years
- Average life expectancy worldwide is 70 years

How can we be so far off?

His argument

- We erroneously divide countries into “rich” and “poor,” whereas it’s better to think in terms of four levels of average national well-being
- Most countries have moved from lowest (level 1 or 2) upwards, including European countries such as Sweden, Norway, and the US

Why should we care about this?

- It makes a huge difference whether someone makes $1 vs. $4 vs. $16 vs. $32 per day
- We’ve made progress and should keep going
- Thinking historically shows that there are not static “rich” and “poor” countries
- We need to think simultaneously “bad” and “better:” Many things are still bad while at the time many things are getting better

Take a couple of minutes to study these claims. Use “ask” and “association”

Exercise

- Write down as much as you can remember about the previous slide

How much did you remember?

His argument

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Why are the four levels so crucial?

Level 1	Level 2	Level 3	Level 4
~$1 per day	`~$4 day	~$16 day	$32+ per day
Barefoot	Sandals, bicycle	Motorbike	Automobile
Walk miles for water	Short trip to water	Indoor plumbing	Shower, hot tub
Gather wood	Gas stove	Electricity	12+ yrs. education
Hunger, no medical care	Buy food, raise chickens	Factory (60+ hr/week)	Eat out, vacation
~1 billion people	~3 billion people	~2 billion people	~1 billion people (us)

Take a couple minutes to study this chart. Use focused/diffuse thinking if possible

Exercise

- Write down as much as you can remember about the previous slide

How much did you recall?

Level 1	Level 2	Level 3	Level 4
~$1 per day	`~$4 day	~$16 day	$32+ per day
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Poll Question

Did you find this information interesting?

a) Yes
b) No

Poll Results

Scarcity changes our brain

Sendhil Mullainathan and Eldar Shafir

Scarcity overview

The authors have shown through research that the same neurobiological behavior underlies some surprisingly disparate problems

- Time management
- Financial management
- Weight management
- Social isolation

"The busier you are, the greater the need to say no. The more indebted you are, the greater the need not to buy. Plans to escape... are hard to implement. They require constant vigilance. When vigilance flags– the slightest temptation in time or in money, you sink deeper." p.3

Exercise

What’s the big idea behind Scarcity?

Move from focused to diffuse if you can.

What happens under scarcity

- Tunneling-- The brain becomes fixated on what it can't have
- Hypervigilance means important things outside the tunnel are not attended to or discounted
- A distorted sense of reality, difficulty seeing the big picture

In contrast

- People not suffering scarcity have slack in the system (extra time, money, can splurge on dessert), hence are not fixated or tunneling

Exercise

Do you recall what happens under scarcity?

Can you recall what happens when someone is not suffering from scarcity?

What the evidence suggests

- Since scarcity can be reliably created under experimental conditions, it suggests that brain changes, not individual weakness, are the cause

- What remedies to this condition can you think of?

Poll Question

Did you find this information interesting?

a) Yes
b) No

Poll Results

Final Learning Quiz

True or not?

- Keep reviewing the material until you know it
- If you take unnecessary breaks, you're that much farther away from your goal of knowing
- Take the material step by step
- Pose questions about the material to yourself
- After you learn, memory of the material steadily degrades
- Keep a tight focus on each element until you see the big picture

- Mistake of "fluency" – we think we will remember but only recognize
- Breaks help learning!

- Jumping around can give you the big picture, very helpful
- Quizzing yourself is crucial
- Keep trying to recall; often you will remember more
- Best to move from focused to diffuse thought about a subject

True or not?

- Try to make myriad associations, even nonsensical ones, with the material
- People have particular learning styles (some do better reading, others seeing pictures, or hearing info)

- Associations (mnemonic devices) add neural connections, strengthening memory
- This has not been borne out by the evidence. Different material requires different approaches

True or not?

- This poll will help me learn even if I get things wrong
- You took a pre-test, and pre-tests are supposed to help you learn, even when you get the questions wrong (set the stage)
- Go to different places to study
- True, weirdly. Evidently our minds make extra associations with our environment and what we are studying.

True or not?

- Mix together different things rather than one thing at a time (e.g., in art history, mix up the paintings of several artists and guess who created them rather than studying the work of one artist in depth at a time)
- The brain tries to forget things but looks for the main message

- True, not only about academic subjects but in sports. Shooting baskets from different angles at first produces poorer performance than shooting from one position; at the time of performance, however, the mixed practice far outperforms the “one-at-a-time” practice.

  Interleafing
- True!

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Thanks for learning about learning, presenting, and evaluating with me!

Saraswati

Connie Missimer

connie@criticalthinkingatwork.com

Minerva

Extras

Now learn this info

- Article, “Ageism is a prevalent and insidious health threat”
- The World Health Organization is studying how to find ways to combat it
  - Initial $500k research project
  - Four teams collecting evidence on causes and consequences
- Why should this matter?
  - Ageism is unfair and a prevalent, insidious health threat
    - Those with a positive view of aging take better care of themselves and live longer
    - Those with a negative view more prone to depression and dementia
    - We still don’t know how to change older people’s attitudes about themselves
    - But attitudes are far more malleable than researchers had thought

*Adapted from https://www.nytimes.com/2019/04/26/health/ageism-elderly-health.html

Now learn this info*

- Good news about ageism!
  - Researchers have shown that interventions can change attitudes
  - Meta-analysis of three types of studies involving over 6,000 people from pre-schoolers to young adults. Types of study
    - They receive instruction on ageism
    - They interact with older people (email, gardening)
    - They interact and receive instruction
  - Instruction and interaction are the most effective

- Why should this matter?
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    - Those with a positive view of aging take better care of themselves and live longer
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*Adapted from https://www.nytimes.com/2019/04/26/health/ageism-elderly-health.html

Exercise

Try to recall as many facts as you can about ageism.

Did you find the more positive version easier to remember?

What strategies did you use?

Poll Question

Did you find this information interesting?

a) Yes
b) No

Those Puppy Dog Eyes You Can’t Resist? Thank Evolution

James Gorman, New York Times, June 17, 2019

Overview

- Dogs can make faces, quizzical, maybe sad, their eyebrows slanted
  - “Don’t be sad. I can help.” Or, “No salami for me?”
- Scientists have given it a label: “AU101: inner eyebrow raise.”
  - The muscle is called the *levator anguli oculi medialis*.
  - Many dogs but not wolves, have this muscle.
  - Dogs with this muscle are far more likely to be adopted from shelters
- Evolutionary psychologists and anatomists reported in the Proceedings of the National Academy of Sciences that dogs make this face more often and way more intensely than wolves
- Horses also have this muscle but cats do not although they can express skepticism, disdain, deep self-satisfaction and world-weary ennui. That research may have to be left to the cats themselves.

Exercise

How much do you recall from the article?

What is the name of the muscle that makes some dogs’ faces so expressive?

Do you know what strategies you used?

Poll Question

Did you find this information interesting?

a) Yes
b) No