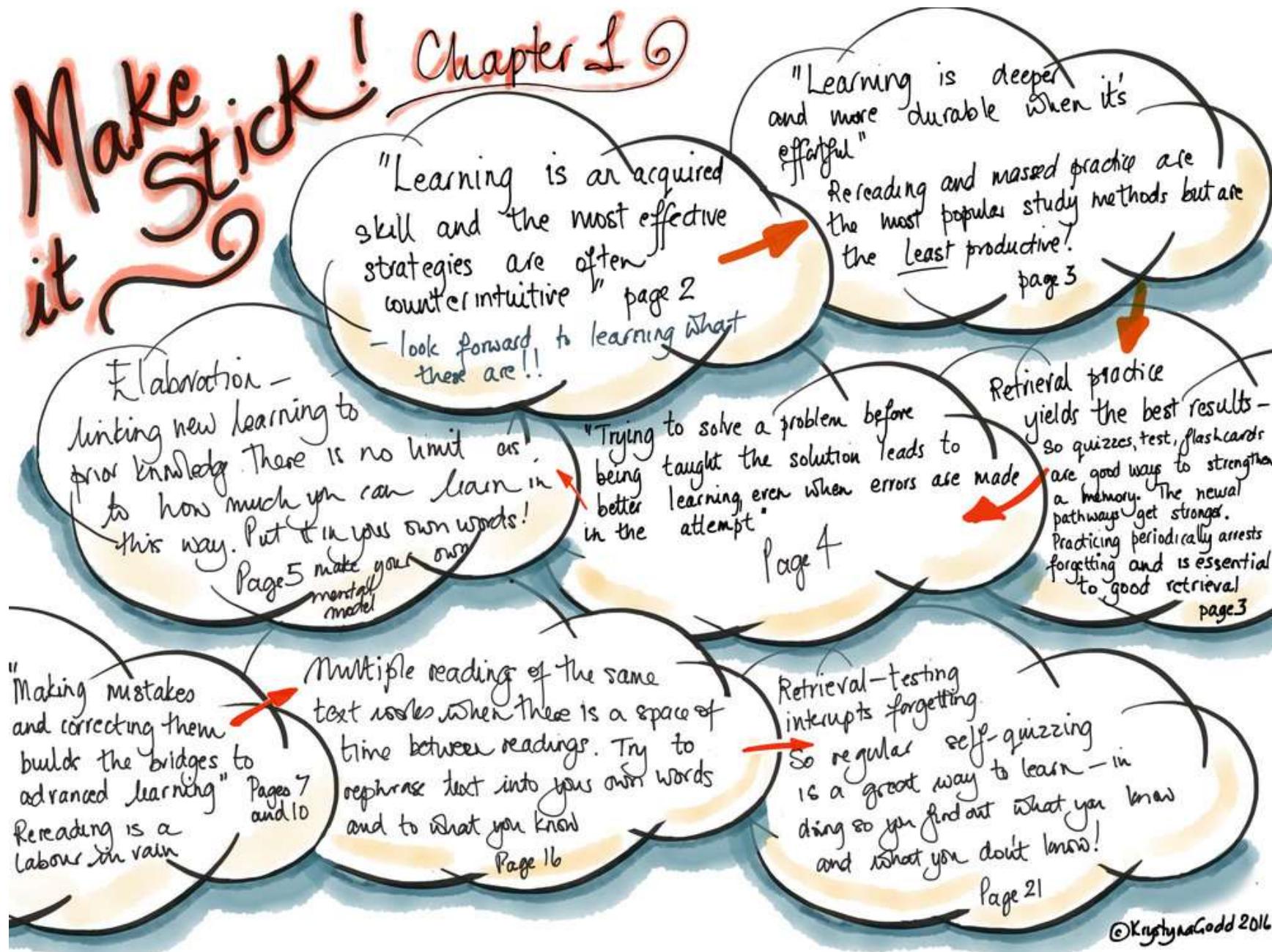


Make it Stick! Chapter 1



Learning IS MISUNDERSTOOD

CHAPTER ONE

MAKE IT STICK

THE SCIENCE OF ★ SUCCESSFUL LEARNING
BROWN, ROEDIGER, McDANIEL

LEARNING IS STRONGER WHEN

IT MATTERS
THE ABSTRACT IS MADE CONCRETE
IT'S PERSONAL



RETRIEVAL PRACTICE
SPACED PRACTICE
INTERLEAVING
VARIETY



ILLUSION OF MASTERY



1 LEARNING REQUIRES MEMORY

2 WE NEED TO KEEP LEARNING & REMEMBERING



3 LEARNING IS AN ACQUIRED SKILL



CONTENT KNOWLEDGE — AND — CONCEPTUAL UNDERSTANDING

MASSED PRACTICE GAINS

MELT AWAY QUICKLY



TESTING IS

THE MOST EFFECTIVE STRATEGIES ARE OFTEN COUNTERINTUITIVE



→ A GOOD THING



@MRSKEMPER

To LEARN, RETRIEVE

Testing helps learning!!
- research pages 38-

"Reflection can involve several cognitive activities that lead to stronger learning" Page 27

Remember to tie a knot in the string, or your berries will fall off!!

The power of retrieval is a learning tool known among psychologists as the Page 28

TESTING EFFECT

and the "Retrieval-practice effect"

In 2010 the New York Times reported a study. Students recalled 50% more when they had been tested than not Page 29

...the addition of feedback!

classroom
tool!

Giving delayed feedback on wrong answers strengthens retention more than testing alone. Even for motor skills! Page 39



begin to depend on them!

Tests that require an essay or short answer are more effective than multiple choice Page 44

Chapter 2

Make it Stick

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TO LEARN,
Retrieve



MAKE IT STICK

THE SCIENCE OF SUCCESSFUL LEARNING

BROWN, ROEDIGER, McDANIEL

WHEN THE MIND HAS TO WORK,
THE LEARNING STICKS BETTER.

NO STAKES

TESTING EFFECT \leftrightarrow RETRIEVAL-PRACTICE EFFECT

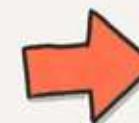
REFLECTION



PETRIEVING KNOWLEDGE
& EARLIER TRAINING FROM
MEMORY



CONNECTING TO NEW
EXPERIENCES



VISUALIZING & MENTALLY
REHEARSING FOR NEXT
TIME



MASSED STUDYING
HIGHER SCORES ON
IMMEDIATE TESTS

=FASTER FORGETTING=



POWER OF
TESTING AS A
LEARNING
TOOL



REPEATED RECALL

- ★ CONSOLIDATE MEMORY
- ★ STRENGTHEN &
MULTIPLY NEURAL ROUTES

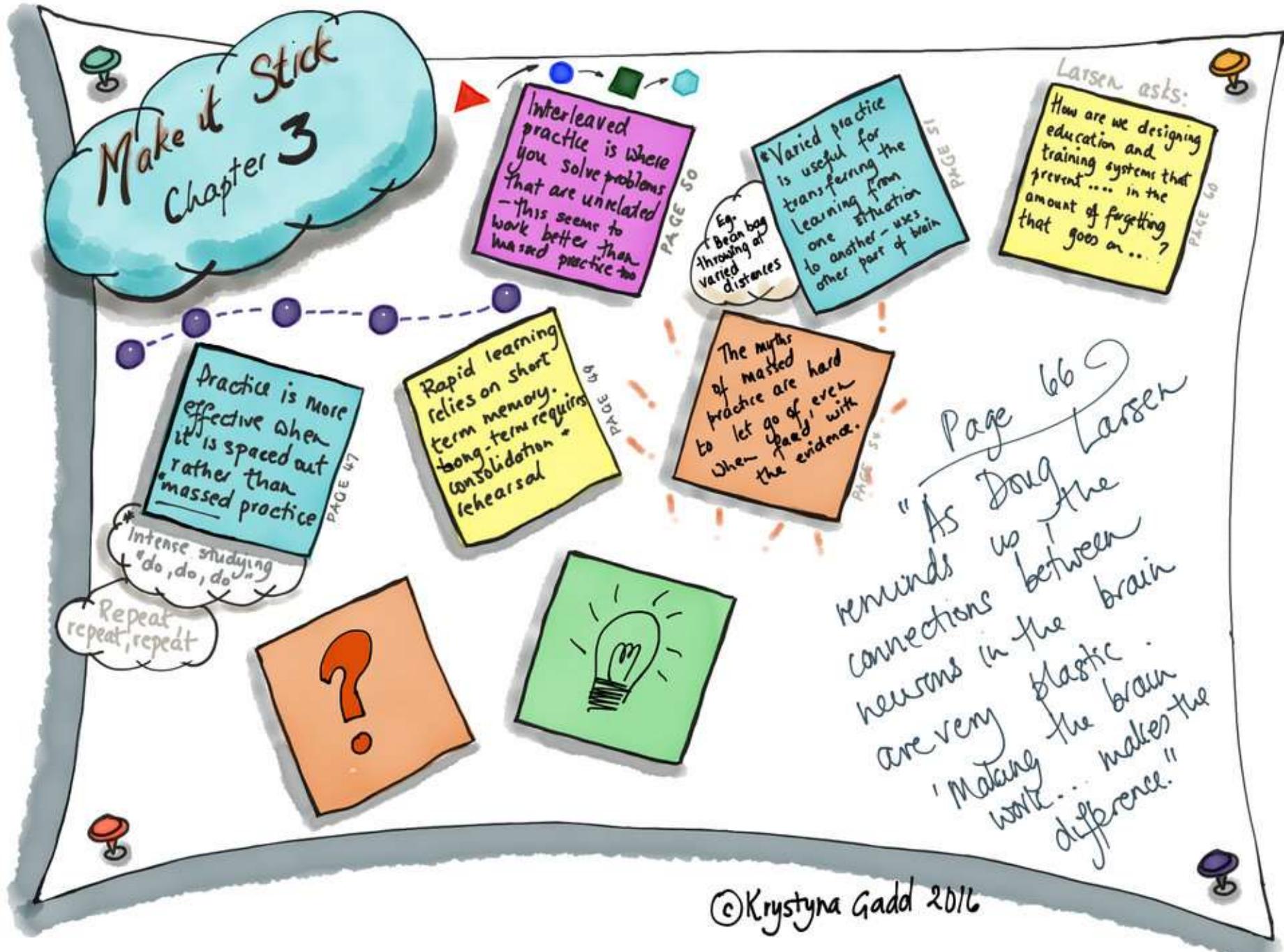


SELF-
QUIZZING
★

MISUNDERSTOOD
& UNDERUTILIZED

DELAYED
FEEDBACK

↑ COGNITIVE EFFORT
↑ RETENTION
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MIX UP YOUR PRACTICE

CHAPTER
THREE



VARIED PRACTICE

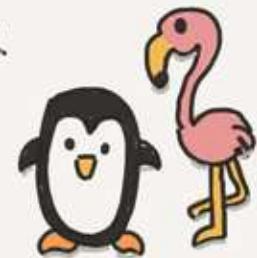
PRACTICE-PRACTICE-PRACTICE



S-P-A-C-E-D PRACTICE

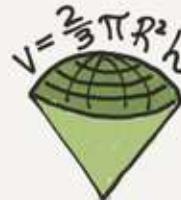
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THE SCIENCE OF SUCCESSFUL LEARNING
BROWN, ROEDIGER, McDANIEL



CONCEPTUAL KNOWLEDGE

INTERLEAVED PRACTICE



$V = \frac{2}{3} \pi R^2 h$

DEVELOPING SKILLS
DISCRIMINATION



SKILLS

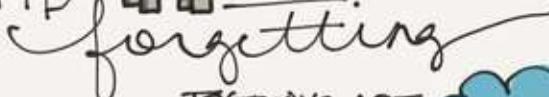


DIFFERENCES > COMMONALITIES



LEARN·ING I. PICKING UP NEW KNOWLEDGE OR SKILLS
/lərnɪŋ/ [AND] BEING ABLE TO APPLY THEM LATER

MASSED: RAPID PRACTICE



forgetting

MORE EFFORT: PRACTICE
MYTHBUSTERS
SPACED, INTERLEAVED & VARIED

TEXTBOOKS ARE TEXTBOOK



SAD, BUT TRUE
PUN

MASSED PRACTICE



CRAMMING IS LIKE
WITH ELABORATION
BINGE & PURGE EATING @MRSKEMPER



CHAPTER 4 Make it Stick

Embrace Difficulties

generative learning - trying to solve a problem before learning has

Easier is not better - mixing interleaving and seem harder, but it is more effective

"write to learn" - put in your own words - better than just copying down notes

Create mental models - avoid set of skills & ideas that make a whole

Built through practice

Like learning to drive!



Foster conceptual learning - differences, similarities, broad brush concepts & comparisons. Interleaved practice can help this.

generation ↗ act of attempting to solve a problem

ENCODING
Converting your perceptions into meaningful representations in the brain - not completely understood

reflection ↗ Asking yourself questions about experience

RETRIEVAL
We must associate the material with a diverse set of cues - to help recall. Context is helpful

CONSOLIDATION
- making it stick - rehearsing, replaying, filling in blanks, linking to other old memories... and SLEEP!!... and ZZZZZZ

Supplying an answer better than multiple choice!

Can you tell the difference?
Need to know that errors are a natural part of learning

The retrieval difficulties in spacing, vartheta and interleaving mimic real life challenges and help with transfer of learning

G
EMBRACE
DIFFICULTIES

CHAPTER
FOUR



#THESTRUGGLEISREAL



LEARNING
FOR THE
FUTURE



MAKE IT STICK

THE SCIENCE OF SUCCESSFUL LEARNING
BROWN, ROEDIGER, McDANIEL



MENTAL
MODELS

INSTANTLY:

- DISCERN
- EXECUTE



VERSATILITY



CONCEPTUAL
UNDERSTANDING
CAT DOG

POWER OF THE PRACTICE TO
ENTRENCH LEARNING

MORE

LESS

AMOUNT OF FORGETTING

MORE

LESS

EASY — DIFFICULT

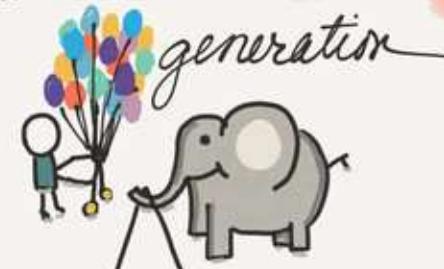


EASE OF
RETRIEVAL PRACTICE

MASSED PRACTICE
SHORT-TERM
MEMORY



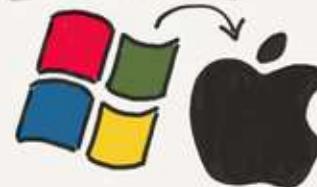
RETRIEVAL



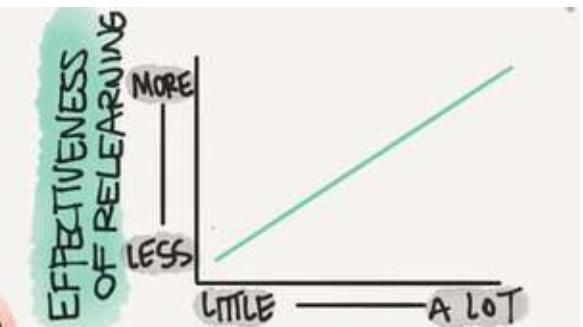
FORGET CUES
OF OLDER
MEMORIES



MEMORIES



SOLVE PROBLEM
MEMORIZIZE SOLUTION
@MRSKEMPER



MORE

LESS

EASY — DIFFICULT

Make it Stick!

Chapter 5 "Avoid Illusions of Knowing"

Daniel Kahneman
"Thinking fast, thinking slow"
System 1 (fast) - intuition, reflex
System 2 (slow) - controlled, learned
exerts self control on 1.

Accounts that sound familiar can give the illusion of being true.

Propaganda repeated begins to sound true!
Social influence can create distortions where people are recalling joint events together - becomes reality.

Memory can be distorted in many ways. **Imagination inflation** is where when asked to imagine an event vividly people eventually believe it happened.
Suggestion can cause a memory illusion - using words to enhance a memory. **Interference** where information viewed at a time can be confused with another event.

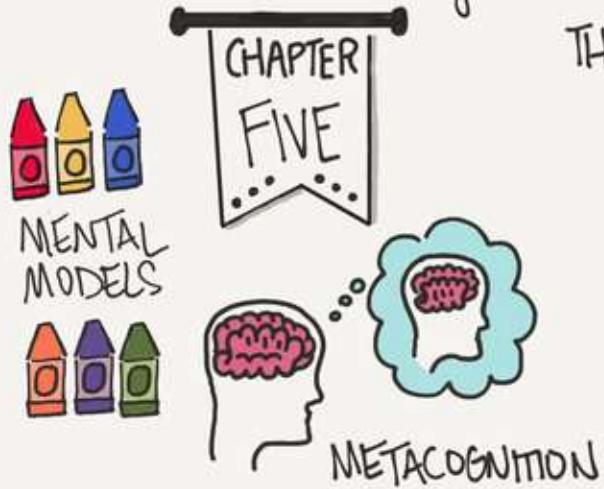
System 1 & 2 judgments can be led astray by:
- faulty memories
- misconceptions
- failure to recognise new problems that need a new solution

People who are unskilled and unaware can raise their competence by being able to judge their performance. Teach them ways to more accurately judge how they might be

Objective gauges of our own performance, checked regularly, will give us good ideas as to where we need to improve (like a pilot in a simulator)

- Tools & habits for calibrating your judgment
1. Frequent testing
 2. Peer instruction
 3. Pay attention to cues
 4. Instructors give corrective feedback
 5. Work alongside an expert
 6. Learn from your mistakes

AVOID ILLUSIONS OF Knowing



INCOMPETENT PEOPLE
[OVER ESTIMATE] COMPETENCE



[CONFIDENCE ≠ ACCURACY]



MEMORY IS A SHAPE-SHIFTER → IT DISTORTS & RECONSTRUCTS

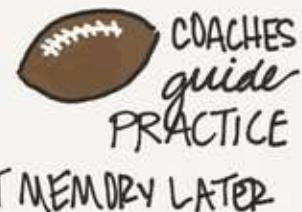
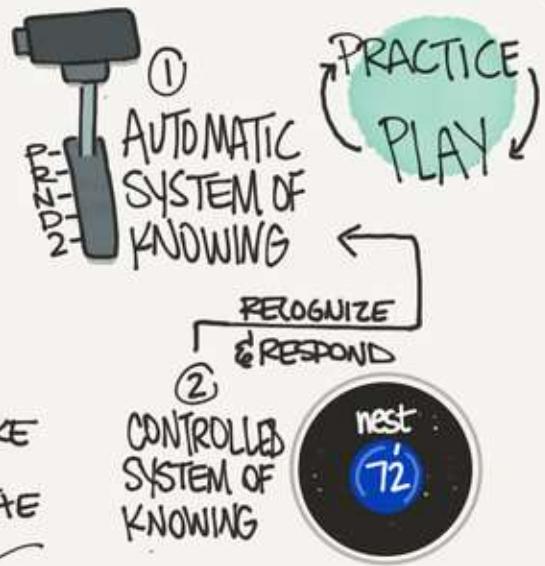
MAKE IT STICK

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@GENCY:

ABILITY TO TAKE ACTION & BE EFFECTIVE IN THE WORLD



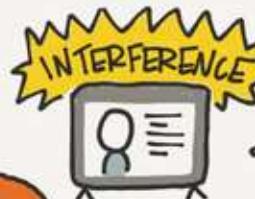
MORE CONNECTIONS TO PRESENT KNOWLEDGE
ASSOCIATIONS TO A MEMORY
MENTAL CUES TO FIND & RETRIEVE THAT MEMORY LATER



SOCIAL INFLUENCE



FEELING OF KNOWING



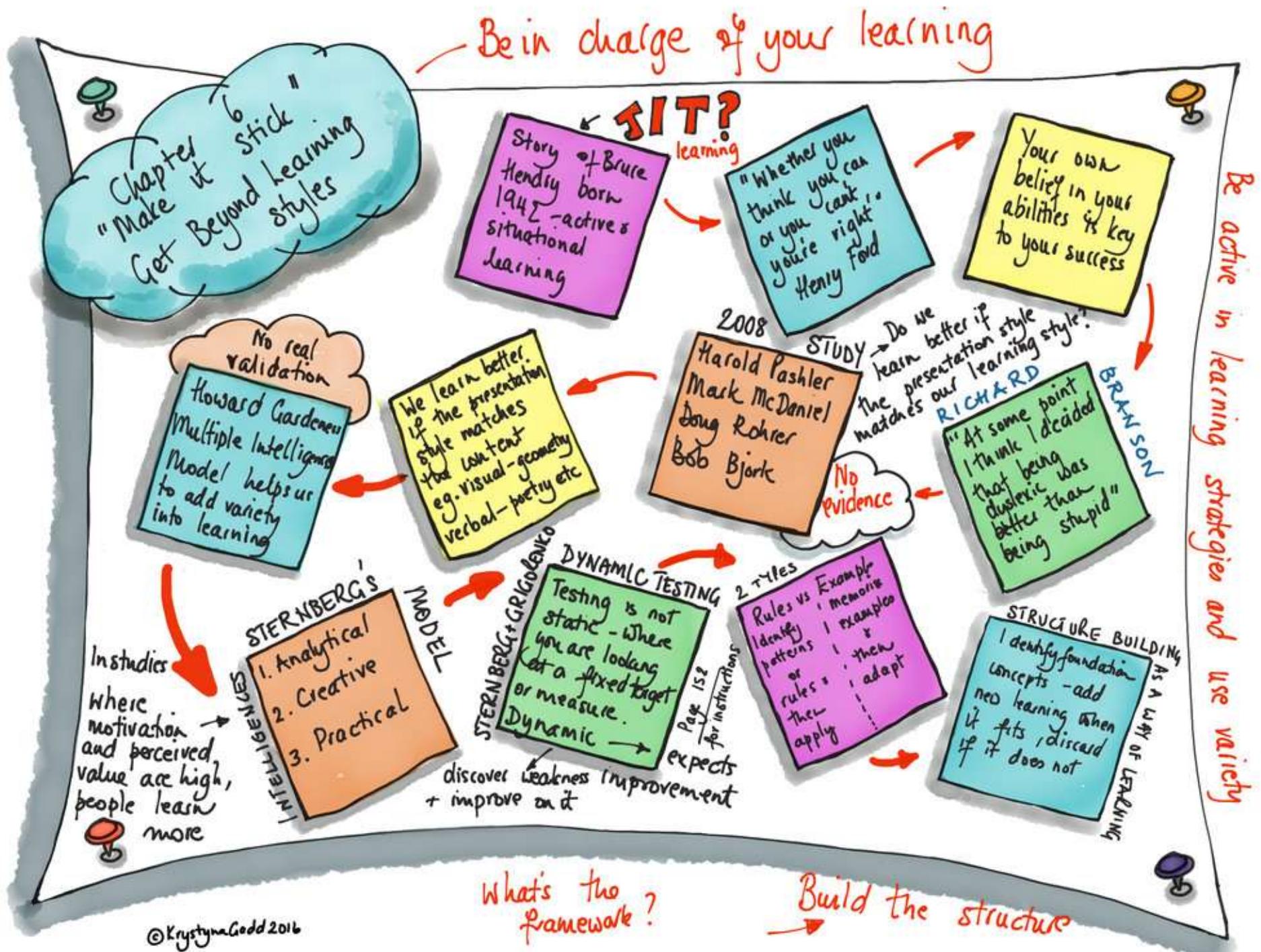
CURSE OF KNOWLEDGE

fluency ILLUSION



A DISCIPLINED SYSTEM 2
PREVENTS SPATIAL DISORIENTATION

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BEYOND LEARNING STYLES

CHAPTER
SIX



MAKE IT STICK

THE SCIENCE OF SUCCESSFUL LEARNING
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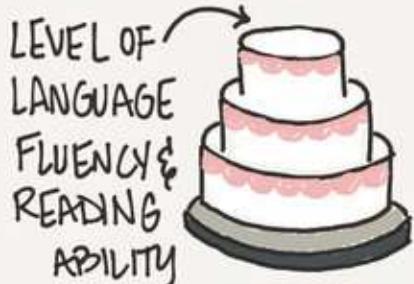
DISCOVER MORE THAN OTHERS KNOW

RULE
LEARNING
AND
STRUCTURE
BUILDING

EMBRACE
THE NOTION OF
SUCCESSFUL
INTELLIGENCE

DYNAMIC
TESTING

BE THE ONE
IN CHARGE
—OF YOUR OWN—
EDUCATION



LEVEL OF
LANGUAGE
FLUENCY &
READING
ABILITY



RULE VS EXAMPLE
LEARNER

DISTILL THE
UNDERLYING PRINCIPLES;
BUILD THE STRUCTURE



SHOULD
MATCH
NATURE OF CONTENT

ACTIVE LEARNING TECHNIQUES
RETRIEVAL — SPACING — INTERLEAVING

ABILITY TO ABSTRACT
UNDERLYING PRINCIPLES
FROM NEW EXPERIENCES
& CONVERT NEW KNOWLEDGE
INTO MENTAL STRUCTURES

VERBAL OR
VISUAL
LEARNING
STYLE

LEARNING STYLES THEORY &
MULTIPLE INTELLIGENCE MODEL

PERCEIVED LIMITED
ABILITIES

@MRSKEMPER

MAKE STICK CHAPTER 7 INCREASE YOUR ABILITIES

We can help ourselves learners, but it requires some effort on our part

Delayed gratification
marshmallow experiment

Fluid intelligence is the ability to problem solve and grasping new concepts. Crystallized intelligence is the storehouse of knowledge we have accumulated. Only very limited research on brain training and its effect on fluid intelligence.

GROWTH MINDSET

"If you think you can or you think you can't, you're right." Carol Dweck's research showed children achieved more with a "growth mindset" ie. Their intellect was not fixed.

Learning goals are shown to trigger different chains of thought & actions to performance goals. (can hold people back from risk taking)

If the brain is plastic, if we keep using it
John T. Bruer

Mnemonics

Neurogenesis - ability of hippocampus to generate new neurons. This is where we consolidate learning and memory

starts before learning and continues for some time after

Actions we take by habit are directed by the basal ganglia, deep in the brain. The more we repeat the learning, the deeper it goes

35 people of similar high intelligence
The Brain is not a muscle so strengthening in one way does not improve others

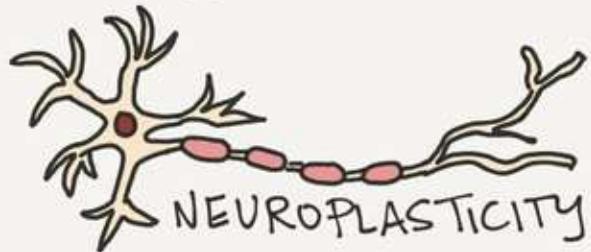
"Great effort" works better with kids than "you're smart" as it implies there is something they can do

In the reading, the brain is thought to chunk motor and cognitive action sequences together so they can be performed as a single unit - sequences then become reflexive

Takeaway allows knitting plus talking at the same time

INCREASE YOUR ABILITIES

CHAPTER SEVEN



$$IQ = \text{GENES} \times \text{ENVIRONMENT}$$

MULTIPLIERS



VISUAL > WORDS

MASTERY
— THEN —
MNEMONICS
— THEN —
AUTOMATIC

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BROWN, ROEDIGER, McDANIEL

WHAT APPEARS TO BE
genius
IS ACTUALLY

DELIBERATE PRACTICE
(10,000 HOURS)



BRAIN
STRUCTURES
GROSS FINE



EXPERIENCE
MODIFICATION

* GROWTH MINDSET [¹DISCIPLINE & GRIT]

* PRACTICING LIKE AN EXPERT

* CONSTRUCTING MEMORY CUES



MEMORY
PALACE



TIE TO
LOCATION
&
KEY
IDEAS

VISUALIZE
IN MIND'S EYE

@MRSKEMPER

Make it Stick

Chapter 8

"Make it Stick"

TIPS FOR TRAINERS

Do all of the things suggested for the previous categories LEARNING should be effortless so that recall seems effortless

GET them to GENERATE the solution - don't TELL SHOW DO REVIEW
Make it RELEVANT
REMY IT TO THEM

TIPS for STUDENTS

The most successful ones are those that take charge of their learning: know that good learning requires effort, and there will be setbacks, not failure.

3 STUDY STRATEGIES

- 1 Practice retrieving new learning from memory
- 2 Space out the retrieval practice
- 3 Interleave the study of different problem types

self-quizzing
Pause, question what is new

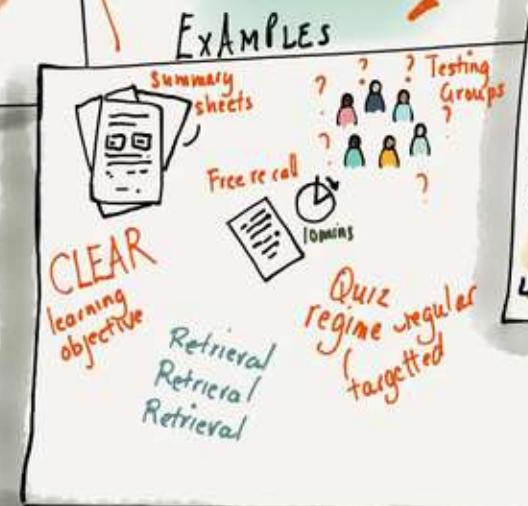
+ Elaboration
eg metaphors
+ Generation
Answers before knowing about Better
Answers to's before knowing about Better
Went well?
mix topics up

Retrieval Practice

Generation
Reflection
Elaboration

TIPS For Lifelong Learners

Memory is like a forest - the answer is in there somewhere



- 1 Explain how learning works
- 2 Teach students how to study
- 3 Frequent quizzing + other study tools that use retrieval practice
- 4 Be transparent - it's tough tell them why

TIPS for TEACHERS

Help them to understand where they are and where they need to be on BLOOMS TAXONOMY

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MAKE IT STICK

CHAPTER EIGHT

MAKE IT STICK

THE SCIENCE OF  SUCCESSFUL LEARNING
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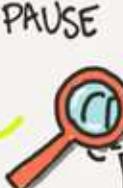
STUDENTS

PRACTICE RETRIEVING
NEW LEARNING
FROM MEMORY

THROUGHOUT



|| & ?



PAUSE QUIZ
CENTRAL PRECEPTS



WRITER'S BLOCK



LIFELONG LEARNERS

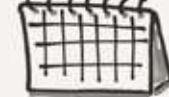
REFLECTION AS:
 GENERALIZATION
 VISUALIZATION
 MENTAL REHEARSAL



S-P-A-C-E
OUT YOUR
RETRIEVAL PRACTICE



MAKE A
SCHEDULE



INTERLEAVE
PROBLEM TYPES



STUDY
BLOCKS

ELABORATION

LOOK FOR
LAYERS OF MEANING

GENERATION

REFLECTION

CALIBRATION

TEACHERS

TEACH STUDENTS
HOW TO STUDY

HIGH-
STRUCTURE
CLASSES



WEST POINT
THAYER METHOD

TRAINERS



KAIZEN {IMPROVEMENT}

MNEMONIC DEVICES

@MRSKEMPER