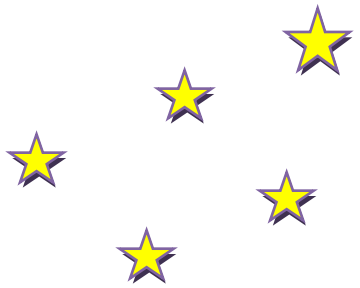
UC San Diego

How To learn

by Dr. Terrence Sejnowski, Dr. Barbara Oakley



☆Minta☆

[2014.Aug.28]

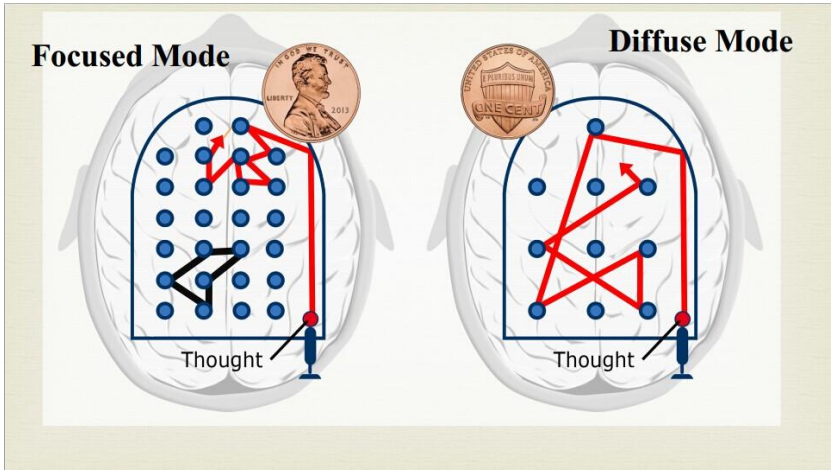
How to Learn

Dr. Barbara Oakley UC SanDiego

1-1. Two fundamentally different models of thinking

- Focus mode
  - Get familiar thought pattern
  - Understand the finest aspects of a concept
  - Finalize some kind of problem solving
- Diffuse mode
  - Easily to get a new pattern
  - look at things broadly, big pic perspective
  - Make new neural connections traveling along new pathway

✓ You can only have one pattern at the same time



✓ Metaphor and analogy are helpful when you try to learn something new.

1-2 Happy Learning

1-3 Using the focus and diffuse modes

Dali & Edison
- Relax in the chair
- get into diffuse mode
- Sth drop and wake them up
- write diffuse model down and make connection with focus mode

✓ **Learn sth difficult and new**: Minds needs to be able to go back and forth between the two different mode → learn effectively

✓ **Trick: a little bit every day** e.g. building our strength by lifting weights

Summary

★ Metaphors provides powerful techniques for learning

★ Focused and diffuse modes

★ Learning something difficult takes time

1-3A What is learning

✓ Brain is the most complex device in the known universe

✓ Brain evolved to help us navigate complex environments.

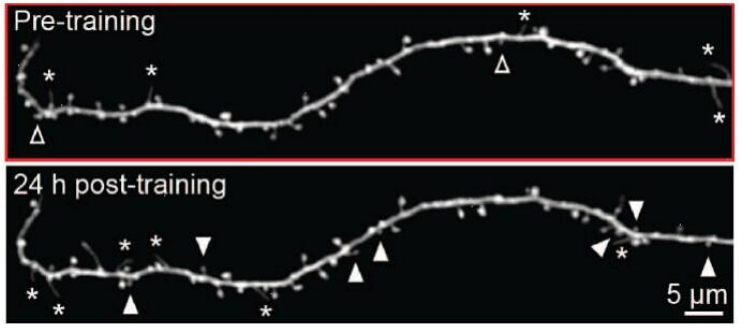
- Default mode network is active when people in the resting state
- Focus mode is highly activity when the subject interacts with the world
- The diffuse mode will appear when you are not concentrating during study.

✓ There are a million, billion synapses in the brain, where memories are stored.

✓ **Study can strengths the synapses**, but it doesn't apply to pattern of cognitivity.

✓ When new synapses being formed, others will disappear.

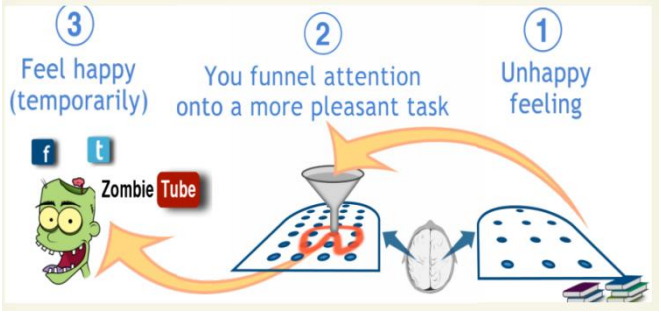
✓ **After learning and sleep, multiple synapses are newly formed.**



✓ Sleep knits up the loose threads of experience and concerns during the day.

1-4A Procrastination preview

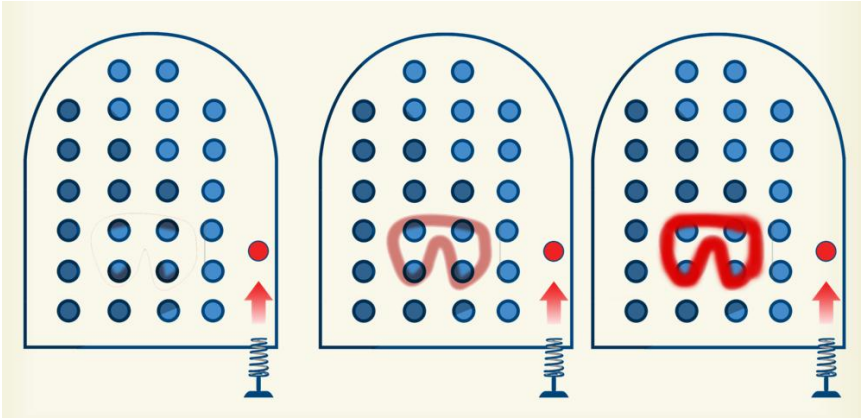
✓ **Formed**: Unhappy feeling→ You funnel attention onto a more pleasant task → temporarily happy 不舒服➡不开心➡抛弃，做开心的事➡暂时开心



- ✓ People might **start actually working out** what they didn't like, the neuron **discomfort disappeared**. 开始做不喜欢的事，难受的感觉就会消失哦~
- ✓ Tool to kill it——**Pomodoro**：Focus for 25 mins, no interruptions → Reward
  番茄工作法，强烈推荐 app 番茄土豆

1-5 Practice makes permanent　　A little bite every day　熟能生巧

- ✓ Math and science are more challenging—abstract nature of the ideas 没法类比
- ✓ It's important to practice with ideas and concepts your learning in math and science
  抽象所以更需要不断练习，强化概念，使其具体化



- ✓ Practice can help enhance and strengthen the neural connection.
- ✓ **Study → Relax**（diffuse mode helps you out with conceptual understanding）
- ✓ If you learn by cramming, your knowledge will be in a jumble with everything confused. 一次性学习太多，没时间理解，基础不牢，一口气吃不成大胖子，只会把胃撑坏

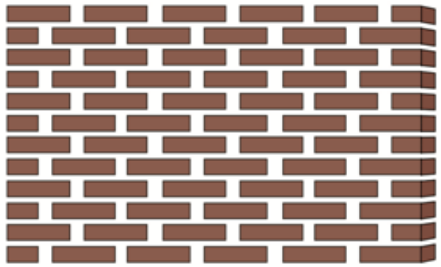
1-6 Introduction to memory

- Working memory
  - To do with the immediately and consciously processing in mind
  - Connect with other parts → access long term memories
  - Hold four chunks of information
  - A bad blackboard → **repeating** so it's stays in working memory
- Long term memory
  - A warehouse → distributed over a big area, immense
  - Revisit → put short term memory in long term memory
  - Repeat few times → able to find the information
  - Store fundamental concepts and techniques

Working memory

Long term memory

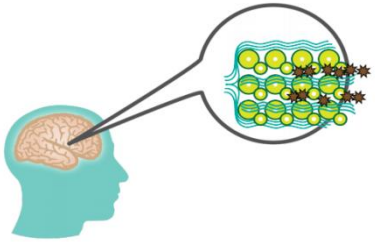
- ✓ New things→Working memory→take times and practice→Long term memory
- ✓ **Spaced repetition**——space the repetition out 一天 20 次不如几天 20 次

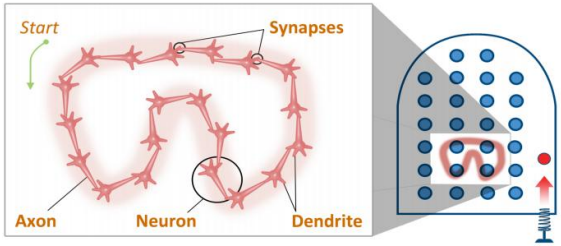


1-7 The importance of sleep in learning

Sleep
- Allow brain to wash away toxins 头脑清醒会产生毒素，睡觉会排毒哟~
- Tidies up ideas and concepts your thinking about and learning
- Erases the less important parts and strength areas that you need
- Enhance the ability of figure out difficult problems and understanding

- ✓ Going over that you're learning right before you take a nap, you have increase the chance of dreaming about it
- ✓ Dreaming about what you're studying can enhance your ability to understand
  睡前复习或思考，可以增加梦见他们的几率，有助于更好理解





1-8 Interview with Dr. Terrence Sejnowski

- ✓ Learning by doing, and learning by osmosis from people who are experts.
- ✓ You learn more by active engagement (asking questions) rather than passive listening.
- ✓ Take a notebook to write the idea down when we are in diffuse mode
- ✓ Multitask is being able to switch back and forth from one topic to another.
- ✓ New neurons are being born even in adulthood → important for learning
- ✓ It's better to surround by other people who are stimulating you instead of stay in the room 出去和能激励你的小伙伴一起玩耍吧~
- ✓ **Exercise** will also increase the number of new neurons
- ✓ A creative environment can enhance your own creativity
- ✓ Talking to sb and explain your own ideas can boost the creative process
- ✓ Take test: Donet get hung up if you cannot answer a question, go to the next and come back later
- ✓ Having youth around is a great way to keep yourself youthful
- ✓ **The key to success——passionate and persistent, not letting go not giving up**
- ✓ To look at ordinary things with a different set of eyes and a different perspective.

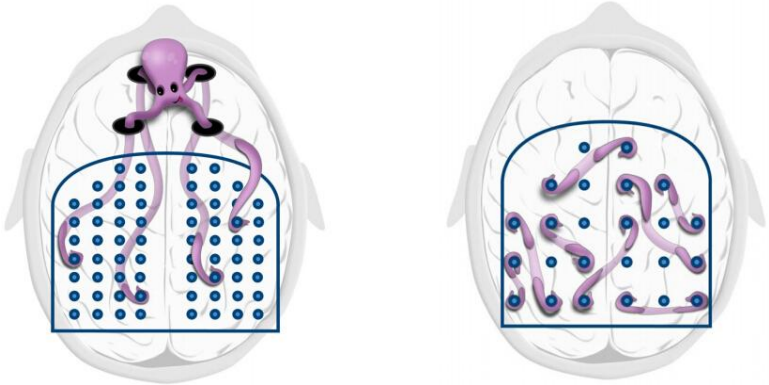
Summary

- ✓ Focus mode: tight, concentration; Diffuse mode: widely, relaxation
- ✓ It's take time to learn something new
- ✓ Pomodoro: 25 mins work (focus mode) and 5 mins rest (diffuse mode)
- ✓ Memory——Repeating until working memory turn into long term memory
  Repeating in several days, a little bit everyday
- ✓ Sleep can wash away toxins, helps you think well and study well
- ✓ Exercise helps memory and ability to learn

2-2 What is a chunk

Chunk
- the mental leap that helps you unite bits of information together through meaning 单了解一个拼图块，是拼不成的
- pieces of information, through bound together through meaning or use
- means a network of neurons that are used to firing together so you can think a thought or perform an action smoothly and effectively

- ✓ Chunks help you make connections to information that you might have in various parts of your brain.
- ✓ Chunking helps your brain run more efficiently.
- ✓ Focusing your attention to connect parts of the brain to tie together ideas is an important part of the focused mode of learning. 集中精神，形成连接
- ✓ When you're stressed your attentional octopus begins to lose the ability to make some of those connections. 生气时，有时会失去理智
- ✓ The best programs for learning language, incorporate structured practice that includes **repetition and rote focus mode learning** of the language along with more **diffuse-like** free speech with native speakers. Focus & diffuse 相结合



- ✓ Focused practice and repetition, the creation of strong memory traces, helps you to create chunks. 练习能够形成新 chunk，且随着练习慢慢长大
- ✓ The path to expertise is built little by little, small chunks can become larger.

2-3 How to form a Chunk Part 1

Form a Chunk
- ①Grasp and master various bits and pieces of the skills you need
- ②creating little neural mini chunks
- ③gradually knit together into larger numeral chunks
- ④hit those larger chunks into still larger and more complex chunks that you can draw up in an instant, in reaction

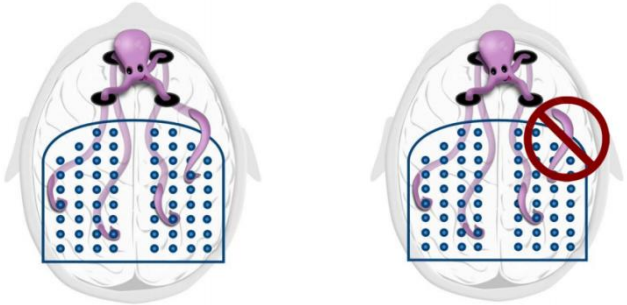
➡ **The BEST CHUNK**: you don't even have to conscientiously think about connecting the neural pattern together. 将一系列复杂行为，自然形成一个简单 chunk

- ✓ First to work a problem → Have a heavy cognitive load 所以要一点一点的学
- ✓ Study the sample solutions
  - ①Why the steps are then the way they are
  - ②why these individual steps connect to other steps.

2-4 How to form a Chunk Part 2

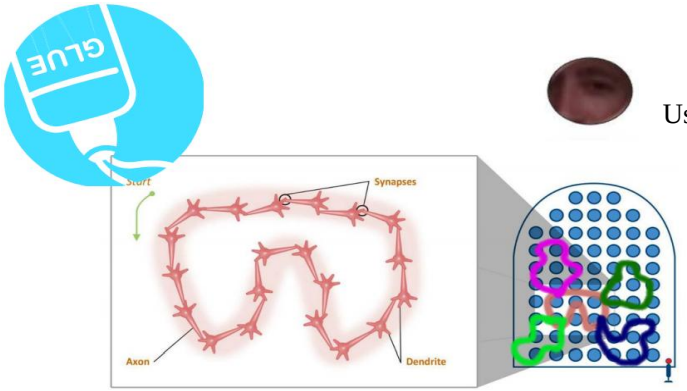
★ **Step 1 Focus Attention**

- ✓ Learn something new ➞Brain is making new neural patterns and connecting them with preexisting patterns that are spread through many areas of the brain.
- ✓ Check your phone every few minutes ➞ brain is not really focusing on chunking the new material.



★ **Step 2 Understanding the Basic Idea**

- ✓ Figure out the main idea
- ✓ Allow the focused and diffuse modes of thinking to help to understand the concept
- ✓ It creates broad encompassing traces that can link to other memory traces.
- ✓ If you don't understand it, you will create useless chunk



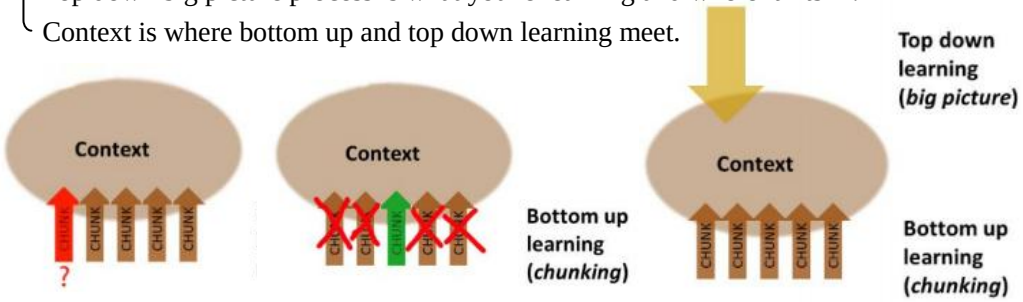
Useless chunk

- ✓ Only doing it yourself helps create the neural patterns that underlie true mastery. It's the same in many disciplines, just looking at someone else's painting doesn't mean you could actually create that painting yourself 光说不练假把式

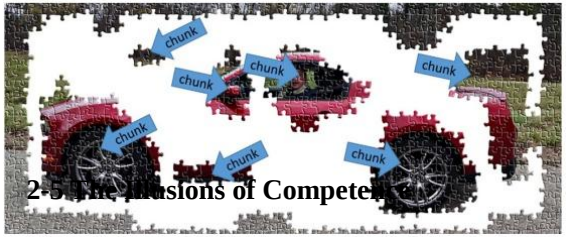
★ **Step 3 Gaining Context**

- ✓ Context means going beyond the initial problem and seeing more broadly
- ✓ Repeating and practicing with problems, so that you will know when to use the chunk, and when not to use it.

Bottom up chunking process, where practicing repetition can help you both build and strengthen each chunk, so you can easily access it whenever you need to.
Top down big picture process is what you're learning and where it fits in.
Context is where bottom up and top down learning meet.



- ✓ Doing a rapid two-minute picture walk through a chapter in a book before you begin studying it, glancing at pictures and section headings, can allow you to gain a sense of the big picture.
- ✓ A picture walk (outline, flow charts, tables, or concept maps) ➞ Fill in the details



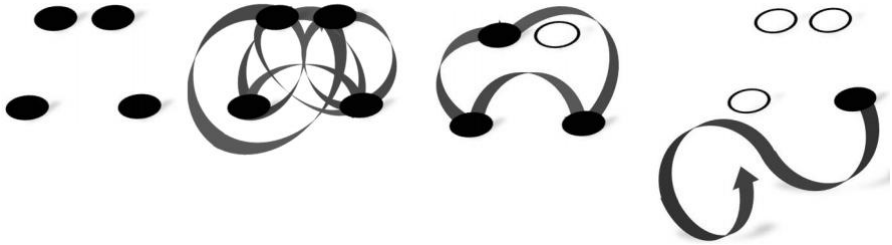
2-5 The Illusions of Competence

- The Importance of Recall
- Illusions of competence in learning
- Mini-testing
- The value of making mistakes

★The importance of Recall★

- ✓ The retrieval process itself enhances deep learning and help us to begin forming chunks 试验证明学生回顾材料比消极的阅读理解的更好更深
- ✓ Concept mapping drawing diagrams that show the relationship between the concepts would be the best after the basic chunks are embedded in the brain.
- ✓ Using recall, mental retrieval of the key ideas rather than passive rereading will make the study time more focused and effective. 概念图+回忆=更专注、有效

- First learning； mad tangle of connections
- Begin to chunk the concept: connecting more easily and smoothly in your mind
- The concept is chunked: it takes up only one slot in working memory
- One smooth strand to make new connections



★Illusions of competence in learning★

- ✓ Merely glancing at a solution and thinking you truly know it yourself is one of the most common illusions of competence in learning. 光看不练，知识成不了你的
- ✓ You are the one doing the problem solving or mastering the concept.
- ✓ Too much highlighting and underlining can be ineffective and misleading.

☆Do Mark Up 手上太多活动，会欺骗大脑已经掌握了

- Look for main ideas before making any marks
- Keep your underlining or highlighting to a minimum 一段最多一句话
- Words or notes in a margin that synthesize key concepts

- ✓ Students like to keep rereading their notes instead of recalling, because it provides the illusion that material is also in their brains. 这样太没效率啦~~~

★A super helpful way to make sure you're learning is to test yourself

- ✓ Mistakes help correct your thinking
- ✓ Recalling material when you are outside your usual place of study can help you strength your grasp of the material. 一样的环境会产生幻觉，要换不同环境学习

2-6 What Motivates you?

Neuromodulators are chemicals that influence haw a neurons responds to other neurons.

- Acetylcholine
- Dopamine → Three of Neuromodulators
- Serotonin.

★ **Acetylcholine** neurons project widely and activate circuits that control synaptic plasticity. Leading to new long term memory.

★ **Dopamine**
- controls our motivation.
- are part of a large brain system that controls reward learning
- is released from these neurons, when received an unexpected reward.
- affects decision making
- predict future rewards and not just the immediate reward 激励更努力

- ✓ Addictive drugs artificially increase dopamine activity and fool your brain into thinking that something wonderful has just happened. 上瘾药会挟持我们的意志
- ✓ Loss of Dopamine neurons leads to a lack of motivation.
- ✓ Anhedonia is a loss of interest in things that once gave you pleasure.
- ✓ Severe loss of Dopamine neurons causes resting tremor, slowness, rigidity, this is called Parkinson's disease. 严重缺乏多巴胺导致帕金森
- ✓ When you promise to treat yourself something after a study section you are tapping into your dopamine system. 学习之后要给自己奖励哦~~

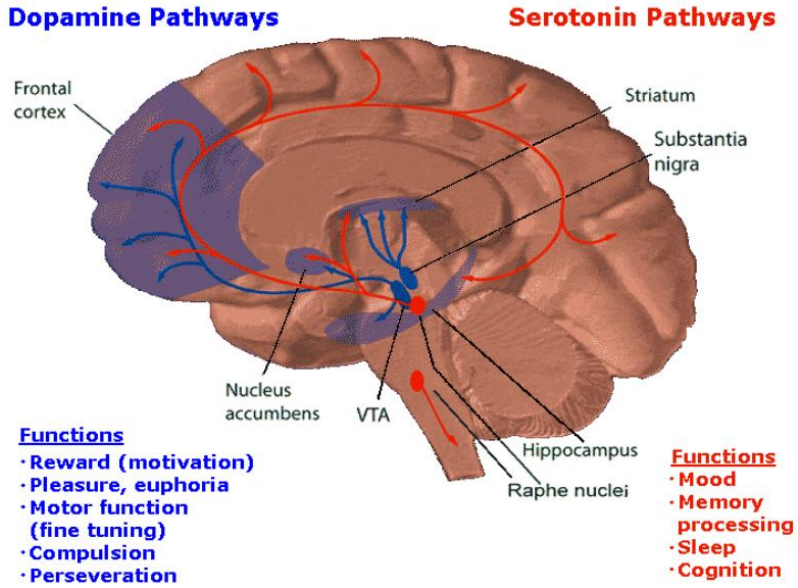
★ **Serotonin** —— 猴子领袖有大量血清素，底层猴子少量血清素

✓ Prozac raises the level of Serotonin activity. 用来抗抑郁症

✓ The level of Serotonin is also closely linked to risk taking behavior. 犯人血清素少

✓ Emotions are intertwined with perception and attention and interact with learning and memory. 开心了才能学得好

✓ You will want to keep your amygdale happy to be an effective learner.



2-7 The value of a library of chunks

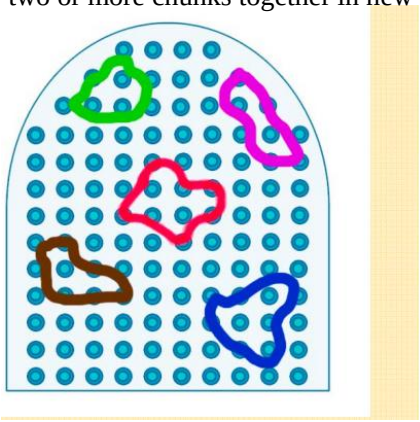
The bigger and more well practiced your chunked mental library, whatever the subject you're learning, the more easily you'll be able to solve problems and figure out solutions.

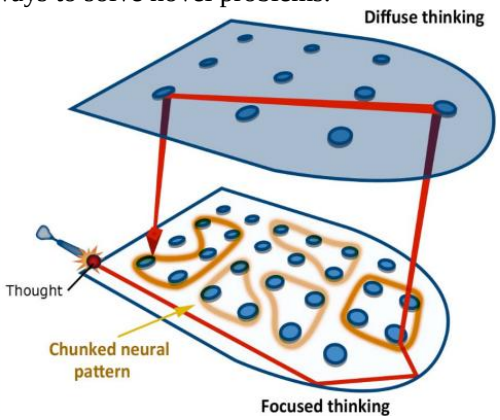
✓ Chunks can also help you understand new concepts.

✓ Transfer means when you grasp one chunk, you'll find that that chunk can be related in surprising ways to similar chunks among different field.

✓ A chunk is a way of compressing information much more compactly.
More experience →create a bigger chunk →ribbons longer →patterns are darker

✓ If you have a good library of these chunks, your diffuse mode can help you connect two or more chunks together in new ways to solve novel problems.

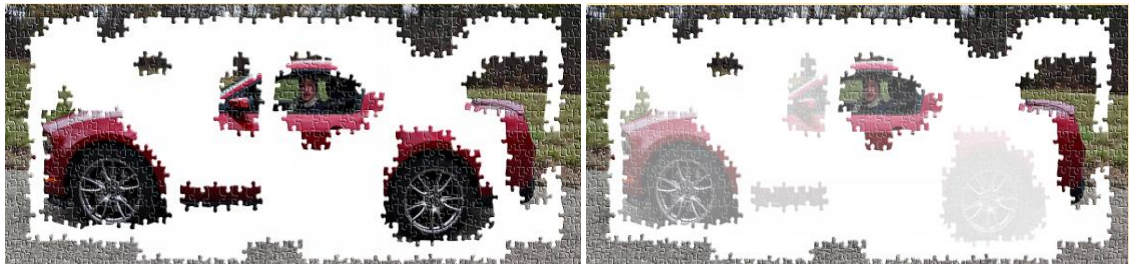




✓ Build each chunk, it is filling in a part of your larger knowledge picture.

✓ But if you don't practice with your growing chunks, they can remain faint.

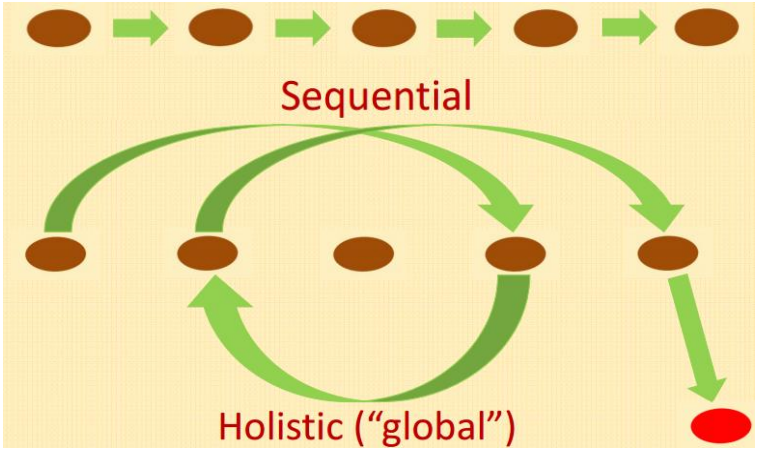
✓ It's harder to put together the big picture of what you're trying to learn.



✓ In building a chunked library, you're training your brain to recognize different types and classes of concepts so that you can automatically know how to solve quickly.

✓ There are two ways to figure something out or to solve problems.

{ Sequential thinking: each small step leads deliberately towards a solution. FM
{ Holistic intuition: creative diffuse mode linking of several seemingly different focused mode thoughts.



✓ Most difficult problems and concepts are grasped through intuition, because these new ideas make a leap away from what you're familiar with.

✓ Intuitive insights aren't always correct.

✓ Too Much to study? Can't study them all?

→ The law of serendipity: Lady Luck favors the one who tries.

★ Focus →Put one concept in the mental library →Gradually, the rest does get easier

2-8 Overlearning, Choking, Einstellung, and interleaving

★ **Overlearning**

1. It is that continuing to study or practice after you've mastered what you can

2. It can help produce an automaticity that can be important when you're executing, serve in tennis, or playing a perfect piano concerto. Ted 演讲者花 70h 练习 20min 演讲

3. It can be especially valuable when you choke on a test or in public speaking

4. But it can be a waste of valuable learning time. 已经了解了的基本内容，再深究并不能加强长久记忆

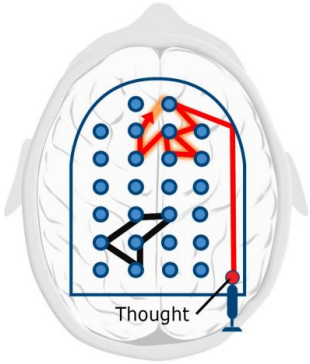
✓ Using a subsequent study session to repeat what you learn is fine and valuable. It can strengthen and deepen your chunked neural patterns.

✓ Repeating something you already know is easy and bring the illusion of competence that you've mastered the full range of material.

★ Deliberate Practice——Deliberate focusing what you find more difficult. 学霸标准

★ Einstellun——Installation 直觉挡道

✓ In this phenomenon, your initial simple thought, an idea you already have in mind or a neural pattern you've already developed and strengthened, may prevent a better idea or solution from being found.

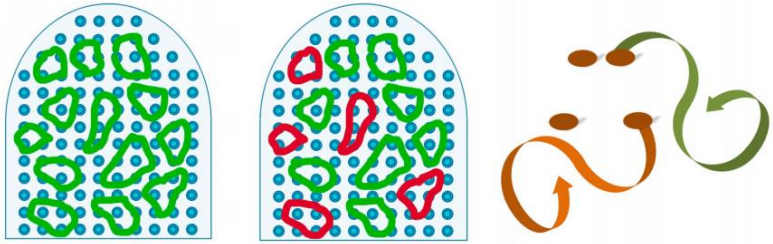


✓ One significant mistake students sometimes make in learning is jumping into the water before they learn to swim. 没学习之前做练习，最后被淹死

靠直觉蒙，并非大脑里的真正答案

★ Interleaving —— starts building flexibility and creativity

✓ By Practicing jumping back and forth between problems or situations that require different techniques or strategies ——Mix up your learning.



✓ Review for a test ， by skipping around through problems in the different chapters and materials, can sometimes seem to make your learning a little more difficult, but in reality it helps you learn more deeply.

- ✓ When you interleave between several subjects or disciplines, you can easily, make interesting new connections between chunks in the different fields, which can enhance your creativity even further. 交叉学习，更容易创新
- ✓ Science progresses one funeral at a time, as people entrenched in the old way of looking at things die off.
- ✓ It is important and exciting learning can be in a variety of non academic disciplines. 并非只能从书本、老师那里学习



3-1 Tackling Procrastination

- ✓ Good learning is a bit by bit activity.
- ✓ By putting the same amount of time into your learning but spacing that learning out by starting earlier you'll learn better. 相同时间，早学早好
- ✓ Procrastination can light up the pain temporarily, but the long term effects of habitual avoidance can be nasty. 暂时逃避痛苦的果子，不好吃
- ✓ When you put off your studies it can become even more painful to think about studying it. 想象更让人痛苦，考试也会遭殃
- ✓ Procrastination shares features with addiction. It offers temporary excitement and relief from sometimes boring reality. 编造各种谎言来欺骗自己，没有天赋之类
- ✓ Habits that worked in earlier years can turn around and bite you. 如毒药，每天一点点，可以产生抗体，长久来看对身体伤害很大

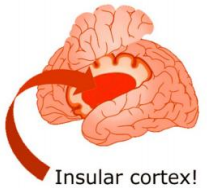
3-2,4 Zombies Everywhere

Habits have four parts
- The Cue （Location, time, how you feel, reactions）
- The Routine (plan)
- The Reward
- The Belief

- ✓ **The Cue**
  - Cue is the trigger that launches you into zombie mode. 如看短信，做作业
  - What we do in reaction to that cue, that's what matters.
  - Procrastination is an automatic habit→prevent the most cues by keeping useself away from the distraction for brief periods of time
- ✓ **Routine**
  - The routine is the zombie mode → useful, harmless, or sometimes harmful
  - Get the cue→brain automatically go into the routine that less painful→rewire habit
  - The key to rewiring is to have a plan 上课把手机放包里，远离干扰
  - Adjust the plan→savor victories when the plan works→change the habit bit by bit
- ✓ **Reward**
  - Every habit develops and continues because it rewards us →immediate pleasure P
  - Procrastination's an easy habit to develop because the reward, moving your mind's focus to something more pleasant, happens so quickly and easily.
  - Good habits can also be rewarded.
  - Only once your brain starts expecting that reward will the important rewiring take place that will allow you to create new habits.
  - Give a solid, mini deadline that can help spur work.
  - The better you get at something, the more enjoyable it can become
- ✓ Habits have power because of your belief in them. 改变坏习惯，先得相信能改变
- ✓ Developing and encouraging culture with like-minded friends can help us remember the values that, in moments of weakness. 多和正能量的小伙伴玩儿

3-3 Process vs Product

- ✓ It's perfectly normal to start with a few negative feelings about beginning a learning session.
- ✓ Quit wasting time and just get on with it → you'll feel better about it.
- ✓ Learn to focus on process not product.
  - Process: the flow of time and the habits and actions associate with that flow of time.
  - Product: an outcome 要完成的作业
- ✓ Attention should be on building processes not product.

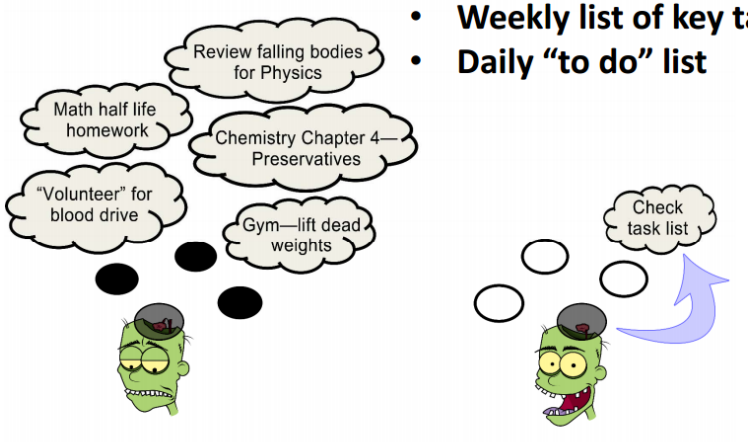


- ✓ Five questions, easy➞they're very lengthy job➞Fantasy: done at last ten minutes
- ✓ Focus on the process → The small chunks of time you need over days or even weeks to answer the questions or prepare for tests.
- ✓ The whole point is that you calmly put forth your best effort for a short period.
- ✓ A quiet space or noise canceling headphones help concentration.

冲浪者只关注
当前的浪花

3-5 Juggling Life and Learning

- ✓ Keep perspective ➞ Once a week write a brief weekly list of key tasks in a planner
- ✓ Try to write this daily task list the evening before ➞ Subconscious can figure out how to accomplish them
- ✓ Don't write the task down→They lurk at the edge of the core zone slots
- ✓ Write the task down → It frees working memory for problem solving



A zombie without a list is listless A happy zombie has a task list!

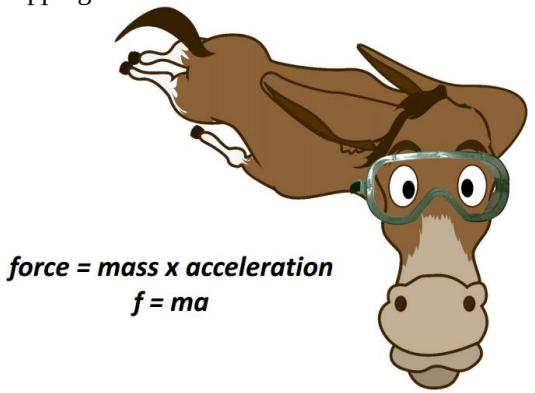
- ✓ Process oriented & Product oriented (switch) → Focus (set a pomodoro)
- ✓ **Mixing other tasks up** with your learning can make everything more enjoyable and keeps you from prolonged and unhealthy bouts of sitting.
- ✓ Overtime, you can gain more experience at gauging how long it takes to do a task.
- ✓ **Finish time** is one of the most important components of the plan
- ✓ Try to work on a **most important** and **most dislike task first** 延迟幸福

Summing up Procrastination

- ☆ Keep a planner journal
- ☆ Commit yourself to certain routines and tasks each day
- ☆ Delay rewards until you finish the task
- ☆ Watch for procrastination cues
- ☆ Gain trust in your new system
- ☆ Have backup plans for when you still procrastinate
- ☆ Eat your frogs first

3-7 Diving deeper into Memory

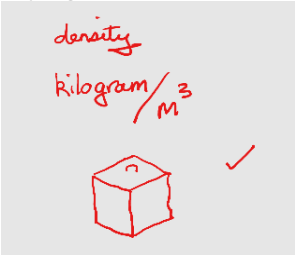
- ✓ Memory is only part of learning and developing expertise but it's often an important part.
- ✓ To begin tapping into your visual memory system try making a very memorable visual image representing one key item you want to remember.
- ✓ The image helps you encapsulate a seemingly humdrum and hard to remember concept by tapping into visual areas with enhanced memory abilities.



- ✓ The more neural hooks you can build by evoking the senses, the easier it will be for you to recall the concept→Visual, Smell, Hearing, Taste 越有趣越好

- ✓ Temporary working memory→ Long term memory: Memorable & Repetition
- ✓ Right hemisphere dominance for visuospatial attention.
- ✓ People often underestimate the benefits of spaced repetition when learning.
- ✓ Index card→ Writing and saying what you're trying to learn can enhance retention

Front

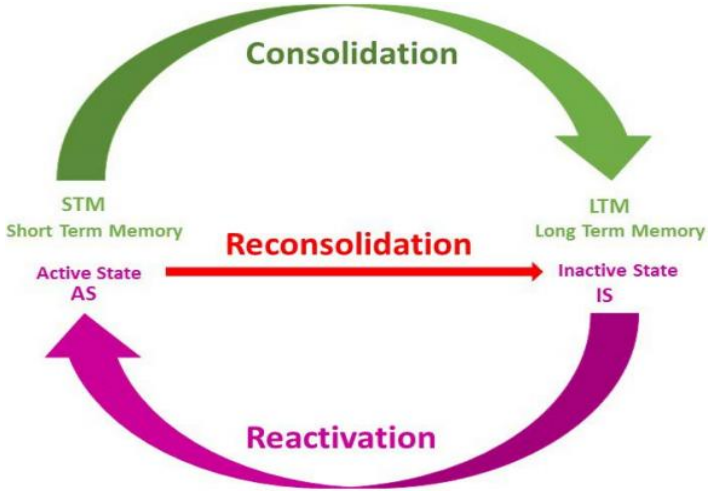


Back

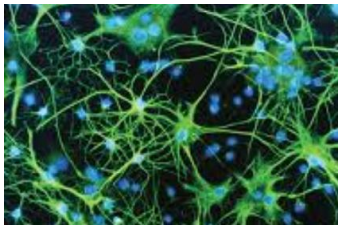
- ✓ Look one side → Remember the other side
- ✓ Several cards → Mix around (interleave your learning)
- ✓ Take them out before you go to sleep → Briefly repeat it over several days 早、晚
- ✓ One of the best ways to remember people's names, is to retrieve the people's names from memory at increasing time intervals

3-7A What is Long Term Memory

- ✓ Hippocampus is important part of a brain system for learning and memory of facts and events. 记忆碎片中的男主人公
- ✓ Without the hippocampus and its inputs, it is not possible to store new memories in the cortex, a process called memory consolidation that can take many years.
- ✓ Memories are not fixed but living, breathing parts of your brain that are changing all of the time.
- ✓ Recall a memory → Reconsolidation: possible to implant false memories



- ✓ The green process of consolidation takes the brain state in active memory and stores it in long term memory by modifying synapses on the dendrites of neurons.
- ✓ Long term memories can remain dormant for a long time until the memory is retrieved and reinstated, by the red process, in short term working memory.
- ✓ The reinstated memory is in a new context, which can itself be transferred to long term memory, thereby, altering the old memory though reconsolidation.
- ✓ Reconsolidation also occurs during sleep. 10min *30day 比一天学 5 个小时好
- ✓ It's more effective to space learning over time rather than mass learning all at once
- ✓ The astrocyte is the most abundant glial cell in the human brain.
- ✓ Astrocytes provide nutrients to neurons, maintain extra cellular ion balance, and are involved with repair following injury.



The astrocytes are staying green

The neurons are blue.

- ✓ 老鼠脑袋置入了人类的 astrocytes 比较聪明
  爱因斯坦脑袋中的 astrocytes 比一般人都多

3-8 Creating Meaningful Groups and the Memory

- ✓ Put the first letters abbreviate to something you can remember

- ✓ It's much easier to remember numbers by associating them with memorable events.

11.0

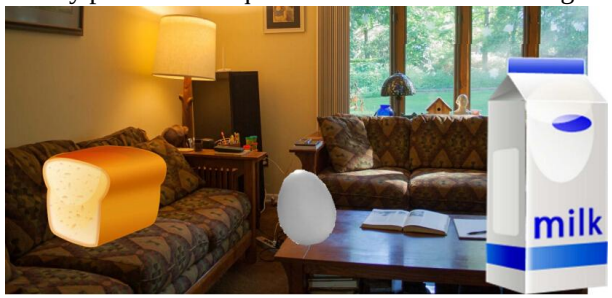
75

- ✓ The first letter of each word in the sentence is also the first letter of each word in a list that needs to be memorized.

Some Lovers Try Positions that They Can't Handle

A = Scaphoid B = Lunate
C = Triquetrum D = Pisiform
E = Trapezium F = Trapezoid
G = Capitate H = Hamate

- ✓ Search the way online or try come up with your own
- ✓ **The memory palace** → involves calling to mind a familiar place
- ✓ The memory palace technique is useful for remembering unrelated items,



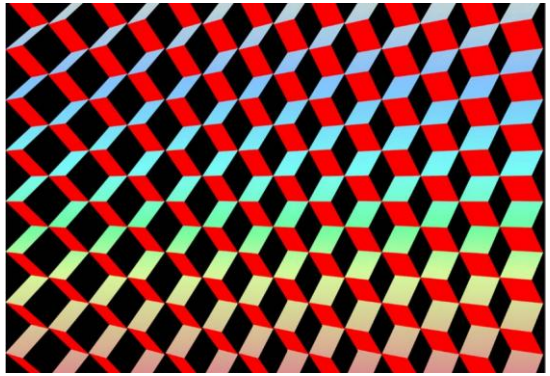
- ✓ The first time is slow → the more you do it, the quicker it becomes.
- ✓ In using the mind this way, memorization can become an outstanding exercising creativity that simultaneously build neural hooks for even more creativity.

  调查表明运用这种方法，学生学得更好，加速形成 **chunk & big pic templates**

  - ✓ When you first build an evocative image, you'll also internalize key aspects of the material. 理解的更深刻，之后复习更迅速，记得更牢

4-1 How to Become a Better Learner

- ✓ Exercise helps new neurons survive. It benefits all of your vital organisms, not just brain. 锻炼对大脑好，身体器官都好
- ✓ Exercise is more effective than any drug on the market today to help you learn better. 锻炼有助于学习，比市面上任何药物都来的有效
- ✓ Practice making perfect, but only when your brain is prepared.
- ✓ The critical period for first language acquisition extends up to puberty. But still very possible to learn a second language
- ✓ One of the best studied critical periods in the brain is when binocular depth perception or stereopsis matures during the first two years of life.

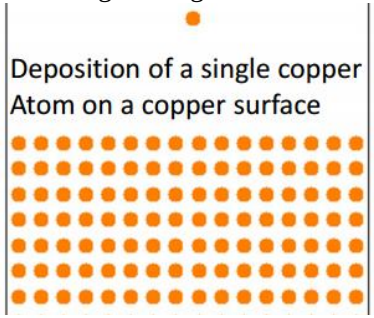


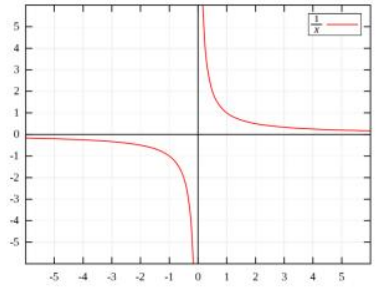
Staircase

- ✓ Practice can repair, as well as train the brain. But this takes much longer, if you past the critical period.
- ✓ The prefrontal cortex is also involved in complex analysis in social behaviors, as well as decision making and planning.
- ✓ Good judgment takes a long time, and a lot of experience to acquire.

4-2 Create a lively visual metaphor or analogy

- ✓ One of the best things you can do are remember and understand concepts.
- ✓ Understand concept is to create a metaphor or analogy for them. 视觉越多越好
- ✓ A metaphor is just a way of realizing that one thing is somehow similar to another.
- ✓ As you climb to a more sophisticated understanding of whatever topic you're concentrating on, you can revise your metaphors or toss them away and create more meaningful ones.
- ✓ Metaphors and visualization, being able to see something in your mind's eye, have been especially helpful not only in art and literature, but also in allowing the scientific and engineering world to make progress. 身临其境

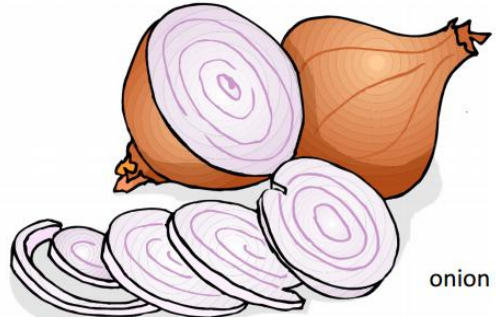




cation

Paws="paws"itive

anion = negative



onion

- ✓ Metaphors and models are often vitally important in giving a physical understanding of the central idea behind the process or concept you are trying to understand.
- ✓ Metaphors and analogies are useful for getting people out of Einstellung that is, being blocked by thinking about a problem in the wrong way. 多路径到达目的地
- ✓ Stories make it more easily retain. Metaphors help glue an idea into your mind.

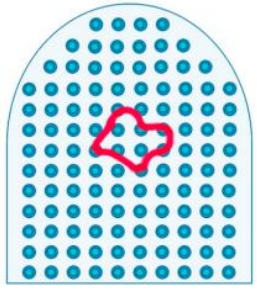
4-3 No Need for Genius Envy

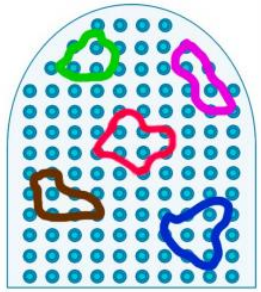
- ✓ Sports need lots of repetition to do it well➞ Create muscle memory➞One chunk
- ✓ Math and science: understand why you do something➞ just know it from memory
- ✓ When you do different types of problems→understand why and how
- ✓ The greater understanding results from the fact that your mind constructed the patterns of meaning 比老师或书本直接告诉你学的更多
- ✓ People learn by trying to make sense out of they perceive.
- ✓ At some point subconsciously understanding why you do what you do, just slows you down and interrupts the flow resulting in worse decisions. → Use intuition
- ✓ Intelligence makes it more difficult for you to be creative → Einstellung

太紧了
挤不进去

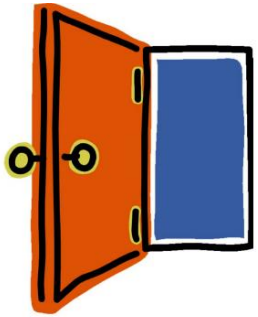
更容易让新 idea 进入

- ✓ Much of the time to understand→take the chunk and put it through creative space
- ✓ Deliberate practice on the toughest aspects of the material that can help lift average brains into the realm of those with more natural gifts.





- ✓ Imposter Syndrome is quite common.
- ✓ Keep your chin up and your eye on the open door



4-3 Change your Thoughts, Change your Life

- ✓ Myelin sheaths, the fatty insulation that helps signals move more quickly along a neuron, finish developing in their twenties. 所以，青少年较难控制冲动行为
- ✓ Santiago Ramony Cajal, a trouble maker to the father of Modern Neuroscience, win the Nobel Prize. 大脑的成熟和自己努力转变思考方式➞控制自己的行为
- ✓ It seems people can enhance the development of their neuronal circuits by practicing thoughts that use those neurons.
- ✓ Cajal felt the key to his own success was his perseverance coupled with his flexible ability to change his mind and admit errors.
- ✓ Approaching material with a goal of learning it on your own, can give you a unique path to mastery. 为自己的学习负责吧~
- ✓ There will always be those who criticize or attempt to undermine any effort or achievement you make. 你学习其他人会感觉威胁。考试考砸，别人冷嘲热讽
- ✓ People are often just as competitive as they are cooperative.
- ✓ Because of the very things that make other people say you can't do it. Take pride in who you are. Especially, in the qualities that make you different.

4-4 The value of teamwork

- ✓ Right hemisphere helps us step back and put our work into big picture perspective.
- ✓ Even subtle avoidance of some of our capabilities can have a surprisingly negative impact on our work. 做完作业不检查，相当于拒绝用部分大脑功能

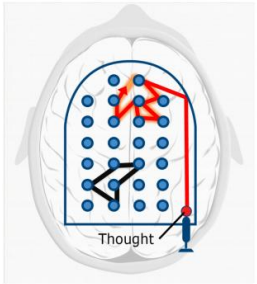
- ✓ Revisit what you've done with the bigger picture in mind to see whether it makes sense.
- ✓ As leading neuroscientist Vilayanur S Ramachandran has noted：
  ①The right hemisphere serves as a sort of devil's advocate to question the status quo and look for global inconsistencies.
  ②The left hemisphere instead tries to cling tenaciously to the way things were.
- ✓ Left hemisphere interprets the world force and will go to great lengths to keep those interpretations unchanging.
- ✓ The problem with the focus is that sometimes a bit left hemisphere leaning mode of analysis. **所以在错误的道路上越走越远，over confidence**
- ✓ You can step back and recheck, you're allowing for more interaction between the hemispheres, taking advantage of the special perspectives and abilities of each.
- ✓ Everyone has blind spots → Study in a group → Important in career building
- ✓ Friends and teammates can serve as sort of an ever questioning larger scale defuse mode outside your brain that can catch what you missed.
- ✓ Explaining to friends helps build your own understanding.
- ✓ A Good group: Starts on time; Focus on your work; Few small talk

4-5 A Test Checklist

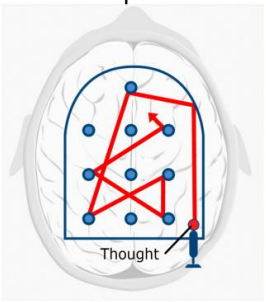
- ✓ Efficiency: One hour taking a test ＞ One hour studying
- ★ **Checklist**
  1. Did you make a serious effort to understand the text?
  2. Did you work with classmates on homework problems, or at least check your solutions with others?
  3. Did you attempt to outline every homework problem solution before working with classmates?
  4. Did you participate actively in homework group discussions?
  5. Did you consult with the instructor or teaching assistants when you were having trouble with something?
  6. Did you understand ALL of your homework problem solutions when they were handed in?
  7. Did you ask in class for explanations of homework problem solutions that weren't clear to you?
  8. If you had a study guide, did you carefully go through it before the test and convince yourself that you could do everything on it?
  9. Did you attempt to outline lots of problem solutions quickly, without spending time on the algebra and calculations?
  10. Did you go over the study guide and problems with classmates and quiz one another?
  11. If there was a review session before the test, did you attend it and ask questions about anything you weren't sure about?
  12. Did you get a reasonable night's sleep before the test?

4-6 Final helpful hints for test

★ take a quick look the test→Start with the hardest problem→Stuck→Easy one



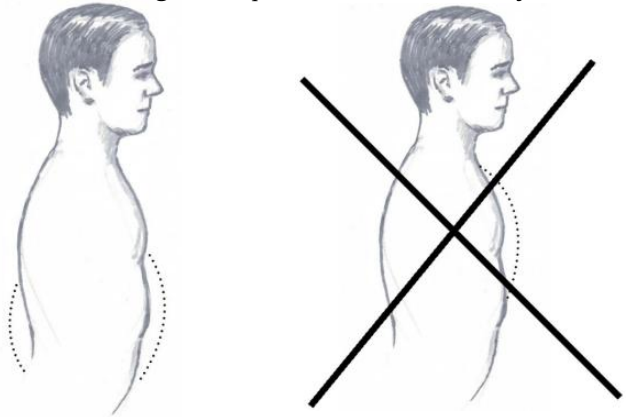
Focused mode



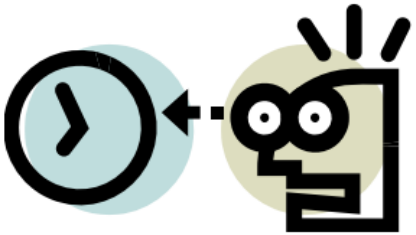
Diffuse mode

★ The body puts out chemicals such as cortisol when it's under stress, and it cause sweaty palms, a racing hear, a knot on the pit of your stomach.

- ✓ The interpret makes difference: This test makes me afraid→ Excited to do my best
- ✓ Momentarily turn your attention to your breathing: Relax stomach, Deep breath
- ✓ Practice this breathing technique in the weeks before just a minute or two



★ Cover up the answers to multiple choice and to try to recall the information



★ Face your fears, have a Plan B for the alternative career

✓ Good worry helps provide motivation and focus, while bad worry simply wastes energy.

✓ The day before a test, or tests, have a quick, final look over the materials to brush up on them. Focus mode ⟷ Diffuse mode

✓ Double check your answer, using a big picture prospective to review it。

✓ When you're checking your work if you start more towards the back and work towards the front, it sometimes seems to give your brain a fresher perspective

☆ **Interview**

✓ 从细节到宏观，再从宏观到细节不断反复，会让自己清楚自己在学什么

✓ 找到自己容易错的地方，然后从错误中学习，不断的测试自己

✓ 从失败中吸取经验，然后慢慢学的更好，也会让自己喜欢上之前讨厌的学科

✓ 学习自己喜欢的学科会有更多的动力，干自己爱干的事情，不会累

✓ 想要学好一门语言，或一门学科，要把自己沉浸在其中，多多练习

✓ 给自己定一个短期的目标，然后驱使自己的动力，一步一步完成

✓ 休息很重要，能保证高效率的学习模式

✓ 尽可能的利用身边一切的资源，多向有经验的老师同学请教，如老师的 office hour， 网上的 MOOC, 其他一些公开课

✓ 大任务分成若干个小任务，每天做一点，半个小时，

✓ 学习语言错误的动机：炫耀，进入大学等。正确动机：喜爱其文化

✓ 学习语言不要怕犯错误，即使犯了错误，别人也听得懂，大胆说

✓ Self fulling Prophecy，告诉自己没有天赋，学不会→恶性循环

✓ 任何人学习一门语言，都是付出了很多的努力，面临很多挑战，他们都战胜了

✓ 学习语言总会遇到很多困难，尝试不同的方法，坚持一段时间不适合，换~

✓ 学习和休息相结合，学习六天休息一天

✓ 重复是需要的，单纯重复不一定是最好的方式。可以运用视觉

✓ 学习数学： What are you trying to do?
What do you want to achieve?
What information do you have?
} Don't panic

✓ 学习数学慢慢来，takes its time，数学问题太抽象，尽量把自己置入问题中

✓ 人类没办法 multitask，所以集中精力干一件事才是最高效的

✓ 关掉所有让人分心的提醒，手机短信，email，网站之类

✓ 遇到难以理解时：analogy, diagram, example, plain English, technical

✓ Visualizing imaginary numbers in math

✓ 所有的人都提到了 focus mode & diffuse mode 和运动的好处