

## MAKING THE MOST OF YOUR MIND: SUMMARY OF WORKSHOP MATERIAL AND PRACTICE TIPS

1. *If cramming at the last minute works for you, then there is no need to bother revising earlier.*

Cramming can help you to remember material in the very short term but it quickly fades from memory. Spaced learning builds stronger neural structures; material learned in this way is eventually stored in the long-term memory and can be retrieved many years after learning it.

Working memory is limited and very short term. You can really only hold about four things at once in your working memory. Working memory is taken up by the information you need as you are focusing on the task before you. In order to keep hold of this material you need to repeat it, to embed it in long-term memory. Moving material from working memory and short term memory into long term memory takes practise and time.

This is because the material needs to be organised in our minds according to its relevance to other things we have learned and their use in helping us to learn and understand more. By repeating and practising material it forms a *chunk* - a body - of knowledge which just increases with use. Think of a chunk as a sort of mental hyperlink; retrieving the chunk is like clicking on a hyperlink which takes you to a website that comprehensively covers that topic. Learning is a matter of creating these chunks of knowledge - a library of chunks - which can be stored in long-term memory and then retrieved when needed to help solve other problems or to contribute in other ways to the subject at hand. Forming a chunk demands focused attention, plenty of repetition but also understanding. We need to understand how the information fits into the larger picture so that we know *when* it might be useful to retrieve it in the future.

Think of memories as neural networks spread out across the entire brain rather than material held in a sort of neural filing cabinet in one corner of the brain. As the memory is retrieved, it changes, new connections are made with other material – it is actually a memory *network*. Imagine taking a favourite walk in the countryside; the more you choose that walk, the more its paths becomes worn and visible to the eye. From time to time, you may make detours or deviations from the path, which over the long term will connect it to other useful paths. You end up with a criss-cross network covering a much larger area which, eventually, you will know really well. You can think of this network of criss-crossing paths as a 'chunk' of information.

Spaced repetition is the most efficient use of time and most effective way of learning and creating this 'library' of chunks. Instead of cramming everything on one day, practise it on Monday, Tuesday and Wednesday, then on Friday, then on Sunday. This spaced retrieval of memory traces strengthens them, building strong long term memory.

### Study Tips:

1. Create a study planner to allocate enough time to space your learning and test yourself on the material you have just learned. Note down what works for you and what does not.
2. Commit to routines of work every day. Chop your work up into small achievable challenges. Look over what you are planning to do the night before. This helps your diffuse mode to start working on the problem in your sleep.
3. Test yourself frequently. Using recall is a sort of mini test.

- 2. If you can make do with five hours' sleep, so much the better as you will have more time for study/leisure.*

Sleep may feel like a waste of valuable time and, for a long time, there was not much scientific evidence to refute this view. However research has since shown that sleep plays a critical role in memory consolidation, the conversion of material from the short-term memory into long-term memory. Every time you retrieve a memory, it is changed through a process called re-consolidation. It is as if the memory is updated, refined through retrieval and reconsolidation. Both consolidation and reconsolidation take place during specific phases of the sleep cycle.

There is evidence that during sleep the brain does a lot of 'tidying up' of recent experience in that it rehearses difficult material and discards irrelevant material. It helps you to understand what you are trying to learn.

Between the neurons in the brain are glial cells. One type of glial cell - astrocytes - provide nutrients to neurons and are involved in the repair of injured neurons. Astrocytes are therefore important in learning. During sleep, neurons in the brain shrink. This allows toxins and waste products formed during waking life to be flushed away.

#### Study tips:

1. Get into a regular sleep pattern.
2. Do this well in advance of examinations so that the night before an exam, you are able to get enough sleep.
3. Go through the task list you have set for tomorrow's work on the evening before. This gives your diffuse mode the chance to get to work (in your sleep!).

- 3. Going through your notes and highlighting the most important concepts is largely a waste of time.*

It can feel to us as if we are imprinting material in our brains as we highlight a sentence or a paragraph. But this is an illusion. The best way of ensuring mastery of the material is to test yourself using recall and self-explanation. Cover the answers or the explanation and see if you can recall the material yourself. Then ask yourself questions about it, explain the material as if you were explaining it to a 10-year old. Try to understand how it fits in with the rest of your knowledge of the subject, understand the context. Every time you do this, you are retrieving a memory, walking the neural pathway again, rediscovering the 'sights along the way' and so understanding how it fits with other material, becoming more familiar with that area of knowledge.

Similarly, re-reading explanations or solutions to a problem, does little to aid recall. It is as if the mind is simply saying to itself, 'oh it's that stuff again, I know that'. It is an illusion of competence known as 'Einstellung'. Einstellung is a kind of mental trap we can sometimes fall into where the brain chooses to go down the familiar pathways rather than range more widely. Einstellung can block a better solution because we're stuck in the rut of the comfortably familiar. This is particularly important when you are practising problem-solving or trying to be creative in your essay, for example.

Interleaving your work helps to avoid this. Mastering a new subject requires not only learning basic chunks but how to select and use different chunks. The best way to learn this is to practise jumping back and forth between problems and situations that require different techniques and strategies. Interleaving will also help you to be more creative because you will be using material from different areas of knowledge.

**Study tips:**

1. Check your understanding of material you have learned by writing an explanation of the material for a 10-year old.
2. Ask yourself how the material fits into the larger picture of what you are learning.
3. Test yourself frequently on the material you have learned.

4. *When negative thoughts about your work arise in your mind, it's best to face the fear and anxiety and keep working. In the end you'll feel better.*

Let's face it, the alternative is procrastination and even more anxiety about the tasks ahead. When we avoid the psychological 'pain' associated with a task, we feel temporarily better, the reward centre of the brain has been activated, but note that the association we are learning here is *avoiding work = reward*. The neurotransmitter dopamine plays a key role in controlling reward learning. It's involved not only in immediate rewards but in predicting future rewards. When you avoid work, there is a release of dopamine and the repeated avoidance becomes associated with a temporary feeling of pleasure. Using the pomodoro technique, where you turn off distractions and focus for 25 minutes at a time, followed by a short break, hijacks this reward system. Now the dopamine released when you take a break becomes, over time, associated with the achievement of those short stretches of work.

This maximises the benefits to be had from our tendency to form habits easily. Habits are built on four foundations: the cue, the routine response to the cue, the resulting reward and the belief (the story we eventually tell ourselves about the habit).

The cue in procrastination is the discomfort we feel that is associated with anxious thoughts about the work, past failures and possible future outcomes. Cues can be an uncomfortable empty feeling in the pit of the stomach but they may also be welcome distractions, like a text message or Facebook notification. The routine response may be to eat a chocolate muffin, answer the text or surf the internet. The reward would be the reduction in anxiety as we remove ourselves from the difficult task (and the pleasurable feeling associated with a release of dopamine). As we repeat this pattern we may end up with a belief about ourselves: "I work better under pressure", or "I can't do any work when I'm tired". The pomodoro technique advises removing the cues (turn off the phone, disconnect from the internet etc), working for a set period of time (acknowledging the discomfort but working through it), then taking a break. Enough repetitions and the pleasure you feel in the breaks eventually become associated with the achievement of pieces of work.

**Study tips:**

1. Use the pomodoro technique to schedule regular work/break cycles. This will not only get the work done but will deepen the material you are learning.

2. Reward yourself for achieving your daily study goals. Create a system of rewards e.g. 6 pomodoros in one day and I can have the evening off.
3. Find out what your procrastination cues are and create new routines to avoid them.
4. Trust the system so that you can fully enjoy your breaks.

5. *When you get stuck, it's best to take a break.*

Sometimes you may just have to plough on. But mostly it's best to move to something else when you come to a mental block. Either take a break or interleave your work.

We have two modes of thinking, the *focused* and the *diffuse*. The focused makes use of well-rehearsed material embedded in strong neural structures; e.g. the rules of grammar or algebra. In contrast, the mind wanders more freely in the diffuse mode, making creative connections between different chunks of learned material.

When you take breaks from your work, the mind does not altogether turn off, especially if you have been doing repetitive practice of problems. The diffuse mode continues working in the background, and even in your sleep! Continually moving between focused and diffuse modes is necessary and ideal for effective learning.

The switch to diffuse mode also happens at the end of a sleep cycle, which is why when we have a tricky problem we might say 'I'll sleep on it' and why so many of us have had the experience of waking up, if not with the solution, at least with a way forward. The diffuse mode is also found to be associated with the brain's resting state; this is why taking regular breaks when you study is so important for learning, it gives the brain a chance to consolidate the material.

So, taking a short break allows your diffuse mode a chance to seek a solution that may not represent the 'logical' next step, yet turns out to unlock the solution. The next step may require drawing from a different chunk of knowledge from a different topic in that subject, or from a different area of study altogether.

Interleaving your work means turning your attention to a different task or piece of work. Note this is *not* what we usually think of as multi-tasking. Interleaving is alternating study periods on different topics. When you leave 'Topic A', say after a pomodoro work period on it, to begin work on Topic C', your diffuse mode continues to work on Topic A in the background. When you return to Topic A for a second attempt (after, say, a pomodoro on Topic C) you have to retrieve all the related material and this retrieval process helps you to learn, remember and recall the material associated with Topic A. Recalling material repeatedly in this way helps to build stronger neural structures and enhances learning at depth and breadth.

There is experimental evidence for this. For example, subjects were given training to do with calculating the volume of solids a, b and c, for example. One group then practised the calculations as massed practice: aaa, bbb, ccc. The other group did interleaved practice: abc, bac, acb etc, making sure that they weren't consecutively doing the same calculation. Massed practice was far more effective when students were tested immediately after the practice session. But the next day, the students who had done interleaved practice achieved much higher scores in the tests.

**Study tip:**

1. Interleave your learning. Mix up your learning tasks. Move between different tasks in the same day.
2. Practise key material repetitively, but do not overlearn in one session.
3. Use deliberate practice. Choose to practice the things you find most difficult.
4. Take regular short breaks to make the most of your 'diffuse mode'.

6. *At busy times, it's natural, and probably best, to reduce exercise so you can devote more time to study.*

The part of the brain called the hippocampus is producing new neurons all the time. Research shows that the hippocampus is very important in memory consolidation. Exercise helps new neurons to survive and is better than any drug on the market in helping you learn better. Exercise improves memory and our ability to learn new material.

**Study Tip:**

1. Take regular exercise. This will also help with establishing a good sleep pattern.
2. Use techniques like the Memory Palace Technique to create strong visual metaphors and analogies. Inserting information about what things might sound or smell like (even though this may be fantastical) can help you to remember things. The more bizarre the stronger the memory trace.

7. *Working with others is a better and more efficient way to study.*

When we work with others we are more likely to be challenged. The right brain is involved in contextualising, seeing the bigger picture. Right brain is like a devil's advocate, questioning the status quo, making sure that it makes sense in the bigger picture. The left brain is preoccupied with seeing the world in a particular way. It clings tenaciously to the way things were. Working with others helps to overcome left-brain bias.

The left brain is associated with focused mode thinking. When you work with others, they act like a larger-scale diffuse mode that can catch what you may have missed or shine a light on your blind spots (which we all have).

**Study Tip:**

1. Cultivate good study partners and be business-like about your joint study sessions. If they start late, and members do not prepare the material beforehand, they are more likely to turn into social events and the work doesn't get done.
2. Make a habit of summarising to yourself (a 30-sec summary) of what you have learned after a study period, a lecture, a presentation, reading a chapter etc.
3. Make a habit of checking through your work. Ask yourself, does this really make sense? You will be using your right brain to spot glaring thinking errors that the left brain refuses to 'see'.

8. *If you have worrisome or fearful thoughts in an exam, it's best to notice them and accept them as a natural consequence of sitting exams.*

You may have no choice but to notice your anxious thoughts and it is no use at all trying to suppress them. However challenging those thoughts may turn your exam nerves into something useful that

enhances your performance. The troublesome thoughts arise as a result of hormones that are released during the stress response, cortisol for example. This is perfectly normal. These hormones help you to be more mentally alert.

So it all depends on how you interpret the anxiety you feel. Taking a few deep breaths can help you to feel calmer and to reinterpret these signals in a more constructive way. Simply focusing on the breath adds tone to the vagus nerve, a key player in regulating emotion. Deep abdominal breathing can help you to feel calm quickly. If you say to yourself; 'uh oh, this is scary', it becomes harder to come out of the negative frame of mind. Practise instead saying to yourself, 'oh, this exam stress is perfectly normal, it's helping to excite me to give my best and perform at my best'.

**Study Tips:**

1. Use deep abdominal breathing to calm yourself if you feel highly anxious in an exam.
2. Change the negative interpretation to something constructive like: these exam nerves are helping me to perform at my best.

9. *In exams, it's best to start with the easy questions first. This will give you confidence to tackle the harder ones.*

This is the conventional wisdom but knowing, as you now do, about the diffuse and focused modes and the need to use both in problem-solving, you might consider experimenting with a different approach. Try starting by reading through the material (the chapter, the exam paper) so that you have a rough idea of the territory ahead. Then begin with the most difficult problem. Make as much progress as you can then switch to something easy. Once you have completed that, go back to the hard problem and see if you can make a little more progress. Continue in this way. You will be making use of your focused and diffuse modes and avoiding that phenomenon that most of us will have experienced - when you leave the exam room only to find that popping into your mind is the idea or solution that so evaded you in the exam. Chopping and changing between problems allows the mind to wander wider and lessens the likelihood of this kind of mental block. Interleaving will also help you to be more creative because you will be using material from different areas of knowledge.

If this strategy is new to you, it's a good idea to practise it on test papers during your revision time; if it works then try it for real in an exam.

**Study tip:**

1. Experiment with starting with the most difficult problem, making what progress is possible, then jumping to complete something easy before returning to the original problem.

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