Creativity – the biology of learning – a time to forget

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I had naively assumed, when I began this neural foray, that the brain happily takes on more and more information ad infinitum. I believed my own constructed myth that the brain had the capacity to hold more thought than I would ever be capable of and therefore all memories and learning would be held and accessible forever. I was wrong.

What I had failed to consider is the brain's ability to sift through new information, compare it with prior knowledge and discard that which is perceived to be of less value.
Artificial Intelligence programmers are trying to figure out how to programme an AI robot to know when to assimilate previous data inputs and work with novel information that comes with new situations. At the moment, when a robot is presented with new data, the old data is simply overwritten, and information is 'catastrophically forgotten'. (1)

Our brains do this assimilation naturally; prioritising information and memories that are appropriate for the current situation and placing old ones into the recycle bin (2). It chooses to forget and does so in various ways, whether under our own cognitive control or not (3. p492). And it does so in order to survive.

A previous blog post highlighted our neural links with Stone Age man:

> "At least 250 million years of hard wiring programme the two oldest areas in our brain, the primitive and limbic systems, to keep us safe and happy. The pleasure and fear centres in the primitive system are effectively in charge of, as
> Andreas Komninos cleverly puts it
>
> "Feeding, Fighting, Fleeing, and… Reproduction (well, we won't use that other f-word here!)
>
> The second area, the limbic system, doesn't occupy a particular area in the brain but is constituted of various structures that are in charge of our "emotional responsiveness, motivation, memory formation and integration, olfaction, and the mechanisms to keep ourselves safe". The third area, the neocortex, is a relatively new kid on the block, having possibly been around for just 5-10 million years. It is in charge of our rational being; our intellect, conscious thought and self-awareness" (4)

The primitive and limbic regions in the brain underpin our newer neocortex's cognitive functions. This younger neocortex developed as our ancestors stood upright and began to walk in search of food. With its human host journeying up to 12 miles a day looking for dinner, the brain used the incoming sensory information to help the host decide how to deal with turning a possible predator into the evening's barbecue and not become a meal themselves in the process (5). Previous knowledge and experiences would be recalled and

scanned for relevant patterns in order to predict next steps (8). Anything that had 'you could be a meal if you do that' written over it would have to be ignored.

A colleague asked if the ignored or forgotten memories are archived or permanently deleted. The neuroscience jury is out on this (3). A memory is held as a memory trace or engram in the brain; a collection of synapses that, linked together, will recall a particular event (6, p918). Current research suggests that we access these engrams via mechanisms such as the secretion of a particular hormone or even a reminder stimulus (3, p493).

A recent reminder brought out an archived memory for me recently when I was taken back to a glimpse of my childhood holidays on the Norfolk coast. Whilst walking on the Yorkshire coast, the overhead telephone and electricity lines thrummed in the sea breeze. The noise reminded me of holidays near Great Yarmouth where the wires over the village made exactly the same sound.

So, whether forgetting is a permanent or temporary issue, it is either due to the engram itself decaying or the access pathway to it being ignored or shut down (3) for various emotional, cognitive or subconscious reasons (7). Either way, it allows the brain to make decisions that are relevant to now and ultimately aim to keep its host safe and satisfied.

How does this relate to life in the classroom?

A classroom with a rich environment and multisensory activities fosters learning or neurogenesis; the process of new neural cell development and connections (3, p498).

However, it also encourages forgetting. Remember our Stone Age man who, as he meets new situations, recalls memories and discards those which are irrelevant to the task at hand? Well, that's also happening when we offer the new experiences to our class of children. Their brains are going through exactly the same process; taking on new ideas, evaluating them against previous learning and making decisions on which to go forward. One possible benefit of forgetting old thinking, even if only temporarily, is that it can create space for new ideas and problem solving; unsuccessful ideas can be replaced with those that are more successful (8). Interestingly, it is the act of movement associated with these multisensory activities that is promoting the forgetting (3, p497). Conversely, sleep and rest promote remembering (3, p493).

As we approach the novel and unfamiliar, two biochemical and cellular processes are working hard in the brain. One is consolidating new memories, the other, the default pathway, is forgetting what it perceives to be outdated or irrelevant data (3. P496). Whichever wins is down to how much repetition occurs, which consolidates previous relevant memories along with growing the new neural cells and their connections (9).

Whilst we want new thinking and creative minds, how do we work with the brain and help children keep and build upon yesterday's learning and not jettison it at the first sign of something different today? (3, p493)

It may boil down to two simple ideas; those of resting and revising. Taking time to sit, nap or sleep does wonders for developing and maintaining memory. The brain has time to do some housework (10), revisiting and consolidating memory traces or engrams, organising and storing as we daydream (11) or in our subconscious when we sleep (12).

From previous blogs, you will note that I enjoy time in the hills and I walk a lot. Between work and walking commitments, I spend the occasional day at home, doing domestic chores and ensuring that my outdoor kit is washed and in good repair, ready for the next adventure. On my days out I am revising; using existing navigation, mountain craft and photography skills. In the evening I use the rest time to sit, eat and reflect on the day and use social media to share images and thoughts from the walk. The new aspects of the walk memory are thereby consolidated as well as current mountaineering abilities being reaffirmed.

I consciously choose to temporarily forget some of these though when I'm offered a new walking opportunity. Following low level town paths needs a slightly different skill set and equipment. Smaller bag, more cash for enroute cafes, knowing how to cross busy roads and being able to read a bus or train timetable for return journeys come into play. I usually don't need a compass, walking poles or large rucksack with emergency supplies and clothes, although there have been times when they would have been useful even in a city!

If my brain does forget in order to deal with what is current, then continuing with city walking could mean my hill walking abilities would become rusty over time. So, I mix it up. Time in the hills and time in the towns, thereby revising and regularly consolidating the memories needed for both.

I wonder therefore if our classrooms therefore need a similar mixture of the multisensory activities that are regularly revisited alongside some time to rest, daydream a little and take stock?

One without the other could either generate children who simply overwrite yesterday's learning with today's news or a classroom where no one has anything new to say.

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