



**SUPERHUMAN
ACADEMY**

DOES SCIENCE SUPPORT THE SUPERLEARNER[®] METHODOLOGY?

A REVIEW OF THE SCIENTIFIC EVIDENCE

Doran Amos, PhD & Jonathan Levi



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INTRODUCTION

Wherever we go in life, there are opportunities to read, learn and remember new and useful information — whether it's the periodic table at school, quotes from literary masters at university, or the names and faces of our colleagues at work — wherever we go, we can thrive and succeed when we learn.

How can we figure out the best way to learn? Although each person is unique and has their own favourite way to learn, we share things in common about how we read, learn and remember. Using science, we can look at how our bodies, eyes and brains function during learning. In the last decades, we have learnt a great deal from scientific experiments about the cognitive processes occurring during reading, learning and remembering.

It's an appealing prospect to be able to learn faster and more effectively — and this is what SuperLearner® techniques promise to allow us to do. But what does the science say?

This e-book offers a brief introduction to the latest scientific understanding of how we read, learn and remember. It then asks “*What does science say about the SuperLearner® methodology?*” Which SuperLearner® techniques have the weight of scientific evidence behind them, which are yet to be investigated, and which are counter-productive to our learning?

Let's find out!



THE SCIENCE OF MEMORY AND READING

“Are SuperLearner® techniques scientifically supported?” To answer this question, we’ll first orient ourselves with a brief overview of the science behind how we read, learn and remember things. This will help to make sense of the discussions around the scientific evidence for or against each technique in the next chapter.

If you find that the information below is going over your head, then feel free to skip directly to the next chapter, which focuses on the techniques themselves. You can always come back to this chapter to look up any scientific terms you don’t understand.



How do we remember and learn?

What do you picture when you think of the word “memory”? A room full of file drawers, each filled with pages and pages of information? A computer hard drive, with data written, rewritten and erased? A nebulous realm from which information magically pops into our head, or sometimes, frustratingly, doesn't?

Memory comes in multiple types

Scientists have found that in fact, **there is not just one type of memory, but several**. These different types of memory work together to allow us to re-live our first day at school, recognise faces, and name all of the countries in South America. They allow us to learn and remember how to walk, to talk, and to calculate sums.

Each type of memory relies on a different **brain region** to function, or sometimes from the coordinated activity of several regions working together as a **brain network**.

Since the focus of this book is on how we can consciously train ourselves to learn more effectively, we'll focus just on the types of memory that help us to do that.

Different types of memory can be distinguished from each other in two key ways:

1. The **duration of the memory**, including:
 - **Working (short-term) memory** — normally just 15–30 seconds
 - **Long-term memory** — from hours to days to years
2. The **kind of information in the memory** (known as its “modality”), including:
 - **Visual information** (real or imagined images)
 - **Verbal information** — spoken or written words and phrases
 - **Episodic information** — vividly remembered or imagined events from daily life
 - **Semantic information** — abstract factual knowledge

Let's take a look next at these different types of memory and why they are important to learning.

Working (short-term) memory

Working memory is actually made up of **three distinct working memory “buffers”** that hold different kinds of information for up to 20–30 seconds ¹:

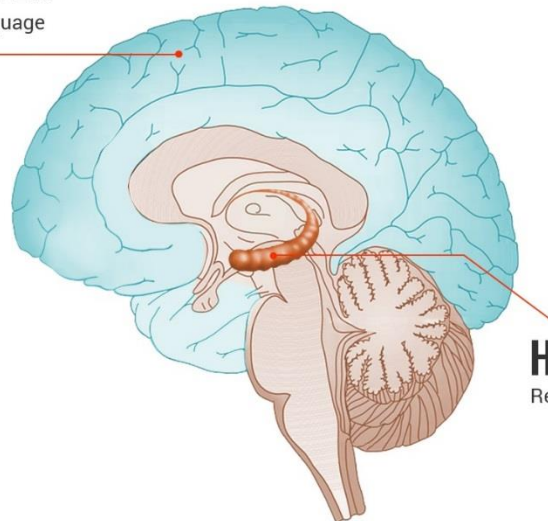
1. **Visual (“inner eye”)** — for holding images in memory
2. **Verbal (“inner voice”)** — for holding words and phrases in memory
3. **Multimodal (episodic)** — for combining and working on different kinds of information (visual, verbal, and others)

The key thing to notice is that there are separate visual and verbal working memory buffers. Based on this, psychologist Alan Paivio developed **dual-coding theory** ², which has provided a basis for educational strategies that try to improve learning by using both visual and verbal working memory simultaneously.

Working memory capacity is very limited — on average just 4 items ³. Despite its small capacity, it has a key influence on cognitive performance. People with larger capacity working memory show greater academic performance and improved reading comprehension.

CEREBRAL CORTEX

Remembering facts and language



HIPPOCAMPUS

Remembering and imagining events

Long-term memory

Information stored in working memory has to be transferred and integrated into long-term memory, otherwise it will be lost. There are two key types of long-term memory that we will consider here:

- **Episodic memory** — this type of memory stores vivid, first-person memories of events from everyday life.

These memories include lots of details about the who, what, where and when of events that allow us to “mentally time-travel” and reminisce. It relies on a small seahorse-shaped region at the centre of the brain known as the **hippocampus** (Latin for “seahorse”). Importantly for the memory techniques discussed later, the episodic memory system is not just for remembering, but is also used in imagining events and scenes.

- **Semantic memory** — this type of memory stores factual knowledge, including names, dates, words and concepts.

It also integrates new information into existing knowledge into **schemas**, which are schematic models of how concepts relate. They tell you, for example, that “beech” is a kind of tree and that a “saucepan” belongs in the kitchen, not the bathroom. Semantic memory is stored throughout a large “sheet” of brain tissue covering

the surface of the brain, known as the **cerebral cortex** (or “cortex” for short).

These two memory systems work together, so that information learnt from events experienced in daily life can be integrated into our existing knowledge. Using the schemas stored in the cortex, the hippocampus can figure out what information is new, so it can focus on remembering that. During sleep, they talk to each other to ensure that what we have learnt is stored long-term and update our schemas.



How do we read?

The cognitive components of reading

Reading can be broken down into a series of steps, each of which relies on a different cognitive process going on in your brain. For our purposes, the most important steps to understand are:

1. **Vision** — Looking at small portions of the text, one at time, and recognising letter and word forms
2. **Language** — Understanding what the words we are looking at mean; using inner speech (subvocalisation) to “hear” words in our head and link concepts together
3. **Memory** — Combining the meaning of words and phrases over time to understand what the text is saying, using what is written and what we already know (existing knowledge). The science behind memory was covered in the previous section.

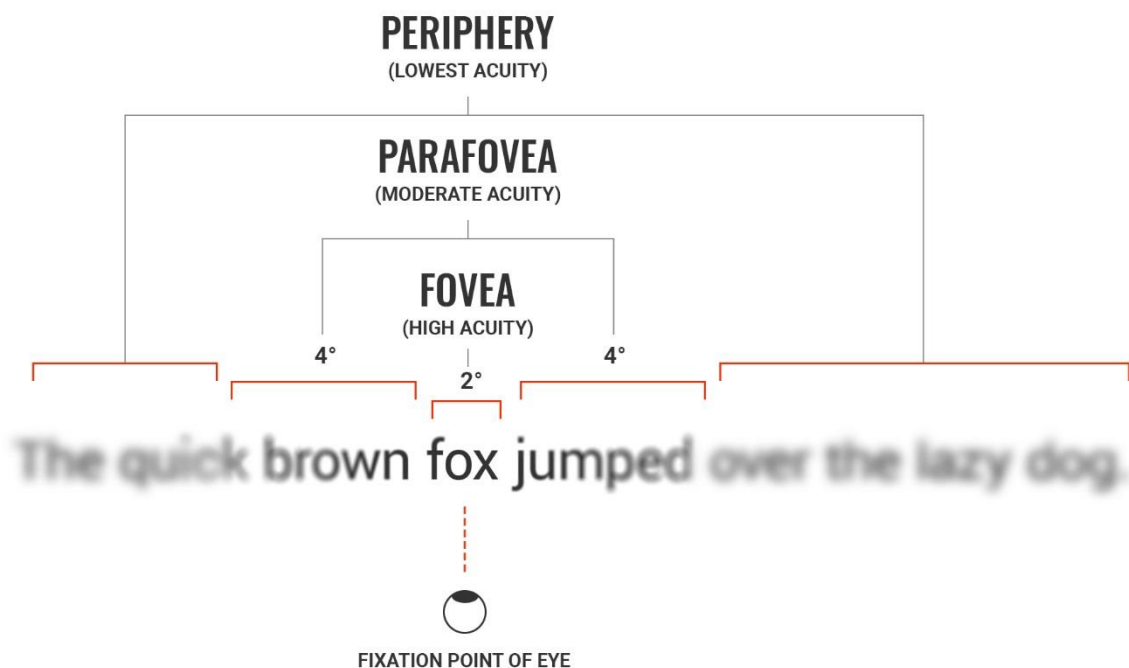


Vision

Seeing the text: foveal, parafoveal and peripheral vision

The first, most basic question to answer is — how do we see the letters and words on the page? To answer this question, we must first understand some simple facts about the biology of the human eye.

The back of each of your eyes is covered by a thin layer of light-sensitive cells known as the **retina**. When you focus on a point on the page (termed the **fixation point**), light coming into the eye is focused onto the retina by the lens at the front of the eye. The pattern of light that falls on the retina gives the information needed by the brain to figure out the shapes of the letters and words.



However, importantly for reading, the visual resolution of the retina is not the same across the whole of the retina. In fact, there are three distinct “zones” which can be identified, each with a different resolution:

1. **The fovea — a densely packed zone in the centre of the retina.**

This part of the retina gives a very high resolution image in a very

narrow window around where your eyes are focused on the page, known as the “fixation point”. To get a sense of just how small the fovea is, hold your thumb away from you at arm's length — the fovea covers just the width of your thumb, around 1° on each side of the fixation point! This corresponds to about 6-8 characters on the page.

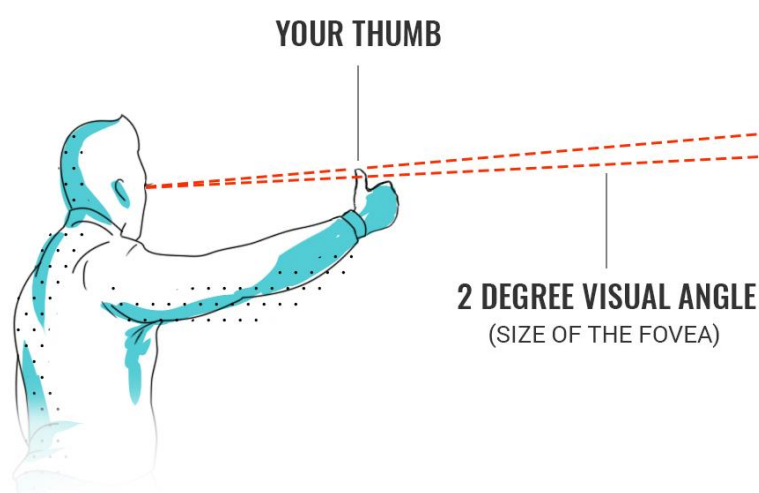
2. **The parafovea — the region of the retina immediately surrounding the fovea.**

The resolution of the parafovea is much lower than the fovea, but is still good enough to make out some details of the letters on the page. It extends to about 3° away from the fixation point on each side.

3. **Peripheral vision — the remaining part of the retina outside the fovea and parafovea.**

This forms a very low resolution image that is too blurry for reading.

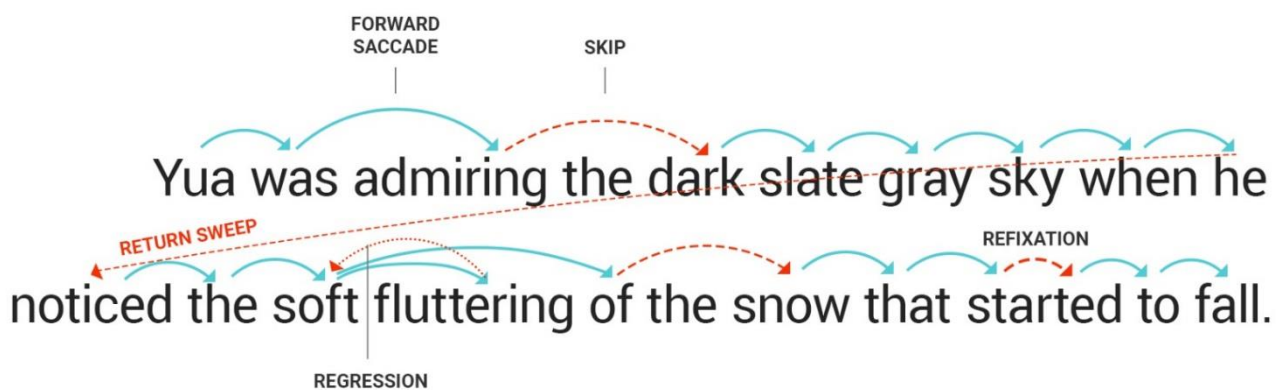
The take-home message is that reading mainly relies on visual information about the text coming from the foveal region, covering a 1° circle around the fixation point. Poorer resolution information from the parafoveal region, extending up to 5° from the fixation point, can help to guide reading to some extent too. Outside of this narrow window provided the fovea and parafovea, the resolution is too low for reading.



Sampling the text with fixations and saccades

The limited resolution of the retina outside of the fovea and parafovea has important implications for how we read. As the fovea only takes in 6–8 characters for each fixation point, the eyes must move repeatedly during reading to change the word that is being focussed on, gradually sampling all of the text on a page.

These eye movements happen in rapid, abrupt shifts known as **saccades**⁴. Just think of when someone drops a glass on the floor at a bar or restaurant and your eyes immediately jump to see the broken glass — that's a saccade. The saccades that happen during reading are generally much smaller than this.



Five main types of saccadic movement are used during reading:

1. **Forward saccades** — these move the eyes along each line of text. In normal readers, fixations are made on nearly every word, one after another.
2. **Skips** — very common words like "the" tend to be skipped over by the saccades.
3. **Return sweeps** — at the end of each line, the eyes make a saccade to beginning of the next line.
4. **Regressions** — normal readers also make occasional backward saccades that move the eyes to earlier points in the text. These generally occur when the reader has failed to take in information during the first reading pass, or needs to re-check their understanding.

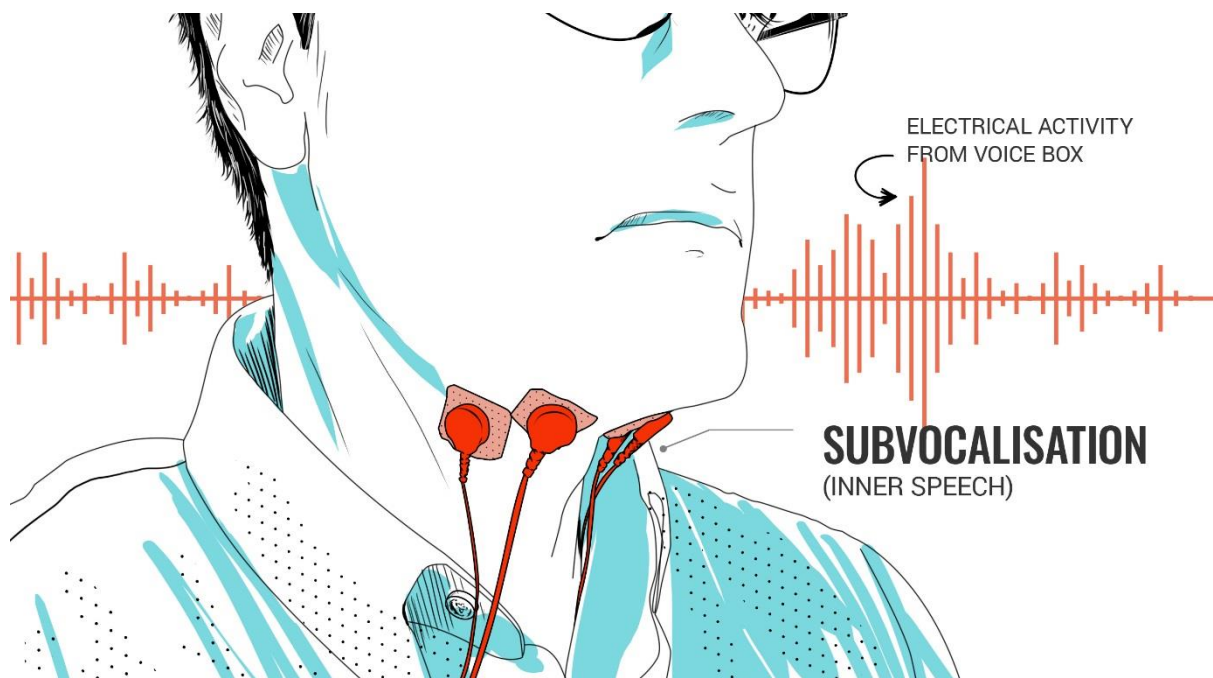
5. **Refixations** — if the word is especially long or some aspect of its meaning needs to be considered for longer, readers might fixate again on the same word instead of moving on to the next.

A final key concept for understanding how we read is the **perceptual span**. This is a measure of how many characters to the left and right of fixation someone can use to guide their reading. In other words, it roughly corresponds to how many characters a reader can take in with a single glance.

In normal people reading English, this is about 15 characters to the right of fixation and 4 characters to the left ^{5,6}. The perceptual span is a key factor affecting reading speed as it defines the maximum “window” through which text on the page can be read ⁷.



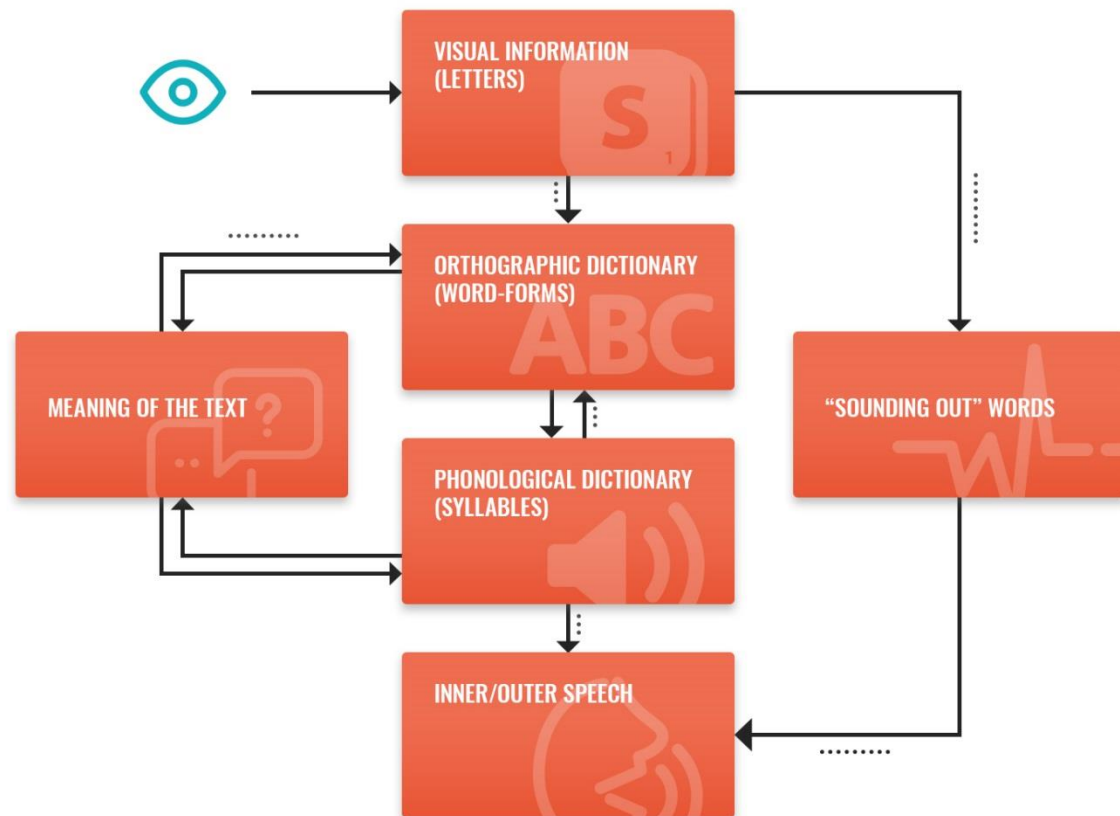
Language



Inner speech (subvocalisation)

When most people read silently, they “hear” the words on the page as inner speech in their head. This inner speech is known as **subvocalisation**⁸. It actually uses some of the same pathways in the brain as real speech — in fact, electrical signals are still sent from the brain to the larynx (voice box) and lips during subvocalisation, as if the person were speaking aloud. However, these signals are too small to generate muscle activity leading to audible speech.

Subvocalisation is thought to allow words and phrases to be actively held in mind (in working memory), helping their meanings to be understood.



Understanding words, phrases and themes

There are two main pathways for reading in the brain. The first relies on “**sounding out**”, which simply means reading the word as it appears on the page without understanding the meaning. This is how children learn to read at first, and how adult readers can say a made-up word like “joobala”.

The second pathway is the one typically used by skilled readers — it rapidly and automatically translates words into meaning. The brain uses the visual information about the letters on the page to progressively build up an understanding of the words, then the phrases, and finally the overall themes and story of the text.

This occurs in several stages ^{9,10}. After the **visual information** is used to identify letters, the letters are processed using an **orthographic dictionary** — this recognises visual features such as known words, sentence structure, and punctuation. These features can then be used to decipher the **meaning of**

the text and to generate phonetic syllables using a **phonological dictionary** for subvocalisation (inner speech) or outer speech.

The important point to grasp here is that meaning can be derived directly from the visual form of the words themselves, without subvocalisation. However in normal reading, the orthographic and phonological systems work together to allow the meaning of the text to be fully understood.

Now that we have a good understanding of how memory and reading work, we can move on to answering the big question in the next chapter — are SuperLearner® techniques scientifically supported?




SUPERLEARNER® TECHNIQUES: ARE THEY SUPPORTED BY SCIENTIFIC EVIDENCE?

This chapter looks at each of the SuperLearner® techniques one-by-one in the light of the latest scientific evidence to decide if they are scientifically supported or not.

In considering scientific evidence, it's worth saying that it works like any other kind of evidence — it comes in degrees. With just a little bit of it, you can't give a confident yes or no answer for or against a technique; with a lot of it, the picture becomes much clearer.

In science, often there are just so many questions that can be asked that direct evidence is missing just because no-one got around to answering that specific question yet. In these cases, relevant evidence from related questions and topics has to be combined to estimate the weight of evidence for or against a technique.

To help you easily gauge the strength of the scientific evidence for or against each technique discussed below, you'll see a coloured "evidence symbol" beside each one. Here's what each of the symbols means:

Symbol	Meaning
 STRONG EVIDENCE	Strong evidence — a wide range of scientific studies have consistently found evidence in favour of the technique.

 <p>PARTIAL EVIDENCE</p>	<p>Partial evidence — either: 1) there have only been a handful of studies providing direct evidence for the technique; or, 2) parts of the technique are widely supported, but the technique as a whole has not been tested.</p>
 <p>UNDECIDED</p>	<p>Undecided — either: 1) there has been no evidence either for or against the technique; or, 2) the evidence collected so far is mixed or inconclusive.</p>
 <p>PARTIAL COUNTER EVIDENCE</p>	<p>Partial counter-evidence — there are a handful of scientific studies which provide evidence against the technique.</p>
 <p>STRONG COUNTER EVIDENCE</p>	<p>Strong counter-evidence — a wide range of scientific studies have consistently found evidence against the technique.</p>

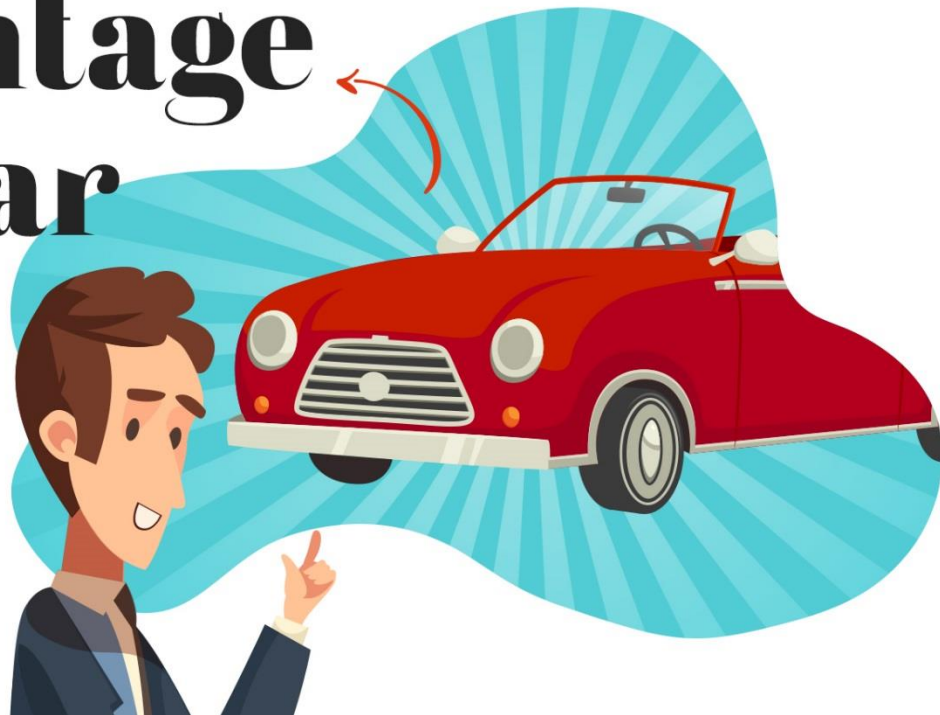
If you are really short on time, then check out the **Executive Summary** at the end of the book, which gives a 5-minute summary of the scientific evidence for or against each technique.

Otherwise, let's dive right in and see what the science says about the SuperLearner® techniques!



Boosting learning with vivid mental images

Vintage Car



Using markers to remember words or numbers

How is this technique supposed to work?

SuperLearner® argues that by using “markers”, you can improve your learning and memory. A marker is a mental image that a person visualises to help them to remember a piece of information, like a concept or a detailed fact from a text. A single marker captures something specific that can be described in one or two words. For example, if you were reading an article about the automobile industry, you could use a mental image of a Cadillac to memorise “vintage car”. By adding at least four details, the marker can be made more vivid and memorable — so instead of just a Cadillac, you could picture a red Cadillac with black leather seats and polished wheels.

Numbers can also be memorised using a specific marker for each digit, such as using a donut for 0 and a fat lady for 8. The number 80 might then be



**PARTIAL
EVIDENCE**

pictured as a fat lady eating a donut. An alternative method for memorising numbers is the “major system”, in which digits are represented by different consonants — for example, 4 is “r” and 2 is “n”. These consonants are then combined into words and memorised as vivid marker images — so 42 could become “r(ai)n” and visualised vividly as a torrential downpour.

What does the scientific evidence say?

Research has clearly shown that remembering information in more elaborate and meaningful ways leads to better memory — this is known as “elaborative encoding”^{11,12}. Elaborative encoding makes more associations between the piece of information, for example the number 42, and other memories, for example a personal memory of being caught in a torrential downpour. This makes the information easier to recall later.

A variety of elaborative encoding techniques have been shown to improve memory — for example, encoding a word (“Paris”) by generating a related word (“baguette”)¹³, or asking a question related to the word (“Which river runs through the city?”)¹¹. These techniques rely on using verbal strategies, but what about using marker imagery to boost learning and memory of words and numbers?

There is good evidence that using markers improves memory compared to rote learning of word lists, especially when the words refer to real objects (such as “fork”)^{2,14}. In general, combining words with real pictures leads to better recall than using mental images or words alone¹⁵. However, when real pictures are not available, markers can be used by those who can visualise words well to improve memory.

The ability to form mental images has been found to vary a great deal between people, so how effectively someone can use markers to remember words or numbers will vary on an individual basis^{16,17}. The more vivid the imagery, the better the recall¹⁸. Is it possible to train your “baseline” ability to visualise vivid imagery? The limited research conducted so far suggests not¹⁹. However, it is clear that images that evoke personal experiences result in better memory than ones that have little personal meaning²⁰.

Is this technique supported by scientific evidence?

In the absence of real pictures as learning aids, the evidence suggests that people who can form vivid enough imagery can use markers to memorise words and numbers more effectively. It's not clear yet if people with poor visualisation can improve their "baseline" ability — the limited evidence so far suggests not — but the majority of people can form vivid enough images to use markers.



Chunking: grouping items and markers into small groups



**STRONG
EVIDENCE**

How is this technique supposed to work?

SuperLearner® suggests “chunking” information while learning. Chunking involves breaking up long lists or sequences of information into smaller groups of items to make them easier to remember. With a grocery shopping list, you might group together vegetables, dairy products or baked goods so you don’t forget anything. Telephone numbers are often written with spaces or dashes to help with chunking — 0784-313-19-60 is a lot easier to remember than 07843131960. The ideal number of chunks is suggested to be around four.



What does the scientific evidence say?

Scientists studying working memory capacity have recognised for decades that chunking helps memory and that there is a maximum number of chunks that can be held in mind. In the 1950s, the psychologist George Miller identified the “magic number” of chunks as being around seven ²¹. However, on the basis of evidence collected since then, this estimate has been revised to around four ^{3,22,23}.

Why the difference? One reason is that our scientific understanding of what a chunk is has improved. The take-home message is that a chunk contains

pieces of information (e.g. names of vegetables on the grocery list) that are associated strongly with each other, but not with the information in other chunks²³. Put another way, a chunk needs to be distinct from other chunks to be remembered. So while vegetables and cleaning products might be chunked separately, root vegetables and legumes are closely associated and could be chunked together.

Is this technique supported by scientific evidence?

There is strong evidence to support chunking being an effective way to memorise lists or sequences of information, with the maximum number of chunks being around four. Chunks are a way to bind together information with strong associations in information-rich bundles.



Leo went to Paris in 1980 to prepare for his attempt to climb Mont Blanc in world record time.



Using markers to increase reading speed and comprehension

How is this technique supposed to work?

During pauses after reading a section of text, SuperLearner® suggests generating markers (mental images visualised by the reader to remember specific words or numbers) to improve learning and memory by linking them together or using them to build a story. The markers used should focus on specific details in the text, and emphasise conclusions, not questions or unresolved issues. Based on these markers, the “gist” of the text can be pieced together without losing the important details.

The markers are linked together in the order they are read, so SuperLearner® says that it’s essential to associate them together strongly by creating a vivid story or logically connected series of images. With strong associations, the markers can then be recalled either forwards or backwards. It’s especially important to remember the first and last markers, as these provide the starting points for recalling the rest of the markers in a forward or backward order.



UNDECIDED

What does the scientific evidence say?

For tasks involving a lot of verbal information, such as reading, it might be better to use markers than verbal elaborative encoding techniques (such as creating a stronger memory for the word "Paris" by asking yourself when you read it, "Which river runs through the city?")¹¹. As markers are stored in visual working memory, they do not interfere with understanding the meaning of the text, which uses verbal working memory²⁴.

Psychology experiments have provided confirmatory evidence that linking markers together helps to remember the order of lists better than using individual, unlinked markers^{25,26}. Likewise, stories have been shown scientifically to be an effective method of remembering information in order^{26,27}. However, other memory techniques, such as the memory palace (discussed below), have been shown to give better memory for sequences than the linking technique²⁸. This is partly because with linked markers, forgetting one marker can prevent the recall of all of the following markers. Memory palaces can be used to dramatically improve memory for prose²⁹, but they may be too time-consuming to construct on-the-fly while reading compared to linked markers.

There is good evidence that using memory techniques based on mental imagery can improve memory and comprehension of the text in children³⁰⁻³³. However, whether mental imagery can be used to improve reading speed and comprehension in adults has been less well-studied³⁴.

The marker technique itself has not been tested directly; instead, studies have asked adult readers to draw imagery while reading³⁵, or simply rely on naturally-generated imagery without any linking³⁶. These studies have reported mixed results in terms of comprehension, and have found that readers using more vivid imagery read slower, but remember more³⁶. More research is therefore required to investigate the marker technique specifically and clarify whether it improves reading speed and comprehension in adults.

Is this technique supported by scientific evidence?

There is little evidence at present about whether markers can be used to increase reading speed and comprehension in adults. However, there is

good evidence that using markers (linked mental images) can improve memory for lists and sequences of information.



Remembering sequences and narratives with memory palaces

How is this technique supposed to work?

SuperLearner® suggests using memory palaces to remember information in order by imagining vivid mental scenes at specific locations along a familiar route (for example, your everyday route to work). To make the memory as strong as possible, the scenes should incorporate bizarre, contrasting elements (e.g., “the dragon juggling in the kitchen”), which symbolically represent the remembered information.



**STRONG
EVIDENCE**

What does the scientific evidence say?

There is strong evidence that memory palaces can dramatically improve memory for words, numbers, prose and factual information ^{26,29,38}. This ancient technique has existed since at least the time of the Romans, who used it to remember and fluently recall long and elaborate speeches ³⁷. The memory-boosting effects of this technique have been shown scientifically to be superior to other techniques for memorising ordered information, such as linking or progressive elaboration ^{28,39}. Indeed, with extensive training it is possible to remember very long sequences accurately with this method. One famous study looked at a man, code-named “PI”, who under experimental conditions could recite the mathematical constant π accurately to 216



CHINESE STATE CIRCUS



**THE ANSWER TO LIFE,
THE UNIVERSE AND
EVERYTHING = 42**

decimal places ⁴⁰!

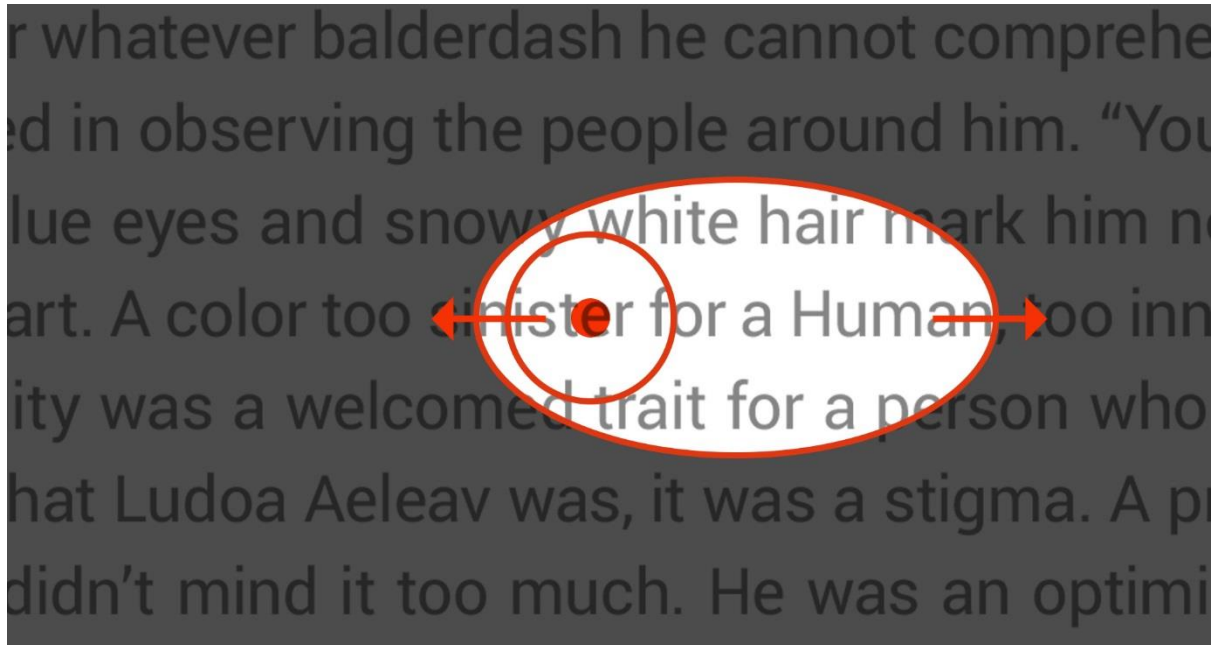
The memory palace technique uses familiar routes as the mental scaffold for ordering memories. Brain scanning studies of top-ranked memory athletes using this technique to memorise long lists of information have shown activation of a brain region called the hippocampus ⁴¹. This makes sense because the hippocampus is responsible for creating a “cognitive map” of places and routes ⁴², and for imagining vivid, spatially-located scenes ⁴³, such as the “juggling tiger in the kitchen”. The size of this region even correlates to the rank that different athletes achieve in the World Memory Championships ⁴⁴. Interestingly, one study found that if people new to the memory palace technique practice it for just six weeks, regions of their brains, including the hippocampus, start to communicate with each other more like those of the memory experts (without a change in brain structure) ⁴⁵.

Is this technique supported by scientific evidence?

There is strong evidence from experiments into memory performance and brain activity that the memory palace technique is an effective way of remembering ordered information.



Improving reading skills and behaviours



Widening your perceptual span

How is this technique supposed to work?

SuperLearner® suggests that you should try to expand your perceptual span (the number of words you can read in one glance) by training yourself to read letters and numbers in the area just outside your central focus (known as the parafoveal region). That should reduce the number of eye movements you need to make to read each line of the text, leading to big improvements in your reading speed.



**PARTIAL
EVIDENCE**

What does the scientific evidence say?

Researchers have carefully measured the perceptual span — how far from the central point of focus (fixation point) people can still read words or use them to guide their saccades (rapid eye movements used during reading in which the focus “jumps” abruptly). The size of the perceptual span varies depending on the language being read. In English (which is read left-to-

right), it is consistently found to be around 15 characters to the right of fixation, but only 4 characters to the left ^{5,6}. This means that words are read through a very narrow window that is at most 2 words to the right and 1 to the left — giving a typical perceptual span of 3–4 words ^{46,47}.

Faster-reading individuals are capable of using information from a wider perceptual span, above 11 characters to the right of fixation ⁴⁸. So a wider span correlates with faster reading speed. The question is — is it possible to increase your perceptual span through training? For decades, many scientists believed that the perceptual span is “physiologically fixed” and that changing it through training is impossible ⁴⁹.

However, more recent studies have begun to provide some preliminary evidence that the perceptual span can indeed be trained to improve reading. In a key study from 2004 conducted by researchers from the Universities of Houston and Minnesota ⁵⁰, participants trained for four days to recognise letters presented in their peripheral vision increased their reading speed dramatically by around 40%. Importantly, this reading speed increase was not just a short-term effect, as it was still maintained when the researchers tested the participants' reading speed again 3 months later. This striking improvement supports the idea that the perceptual span is a “bottleneck” for reading speed that can be widened by training ⁷.

Although these results are compelling, it's still early days with the science and more studies need to be run to see if this evidence stands up to scrutiny.

Is this technique supported by scientific evidence?

Although scientists have believed for a long time that the perceptual span is “physiologically fixed”, a couple of recent studies suggest that it is possible to widen your span, leading to an increase in reading speed. However, more research is needed to confirm this training effect.



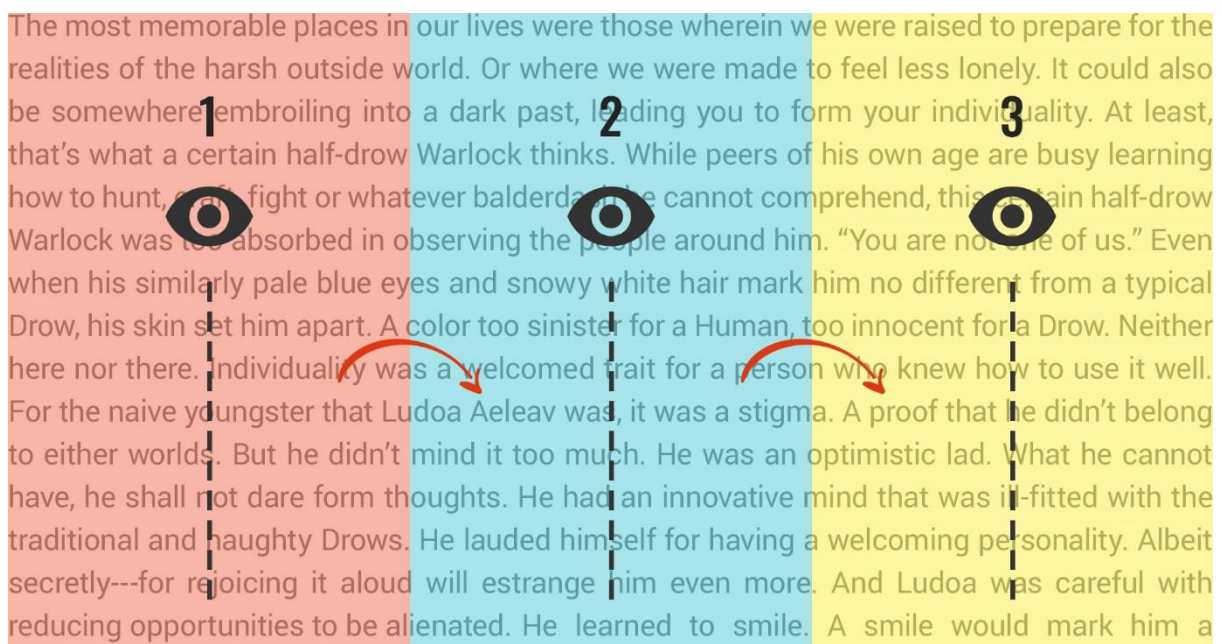
Optimising fixation patterns

How is this technique supposed to work?

During reading, your eyes make rapid movements that shift the point of focus in abrupt “jumps” between words — these jumps are known as “saccades”⁴. As the text is only read within a limited “window” (the perceptual span) around the focal point of the eyes⁵¹, SuperLearner® argues that controlling where these saccades land is crucial for optimal reading. Typical readers make saccadic jumps of around 1–2 words each time they move their eyes — in other words, they fixate on nearly every word they read. Sometimes, readers also make “regressions” to re-fixate words they have already read.



UNDECIDED



Saccades take time, so to improve your reading speed SuperLearner® says that it's important to minimise the number of saccades and to avoid making regressions. This can be achieved by training yourself to read each line using a set number of saccades. This varies based on the format of the text, but is around 3 for a typical line of text in a book.

What does the scientific evidence say?

According to scientific measurements, saccades during reading typically last 20–40 ms⁵² and occur about every 200 ms⁵³. This is equivalent to a reading speed of 5 words per second or 300 words per minute⁵⁴. The time during saccades is not completely “wasted”, as the meaning of words that have been read continues to be processed⁵⁵.

Interestingly, researchers have found that faster readers fixate for shorter periods of time and make fewer fixations, while maintaining good comprehension^{56,57}. They also avoid making regressions to re-read text they have already passed⁵⁸, although other researchers have argued that this reduces comprehension⁵⁹.

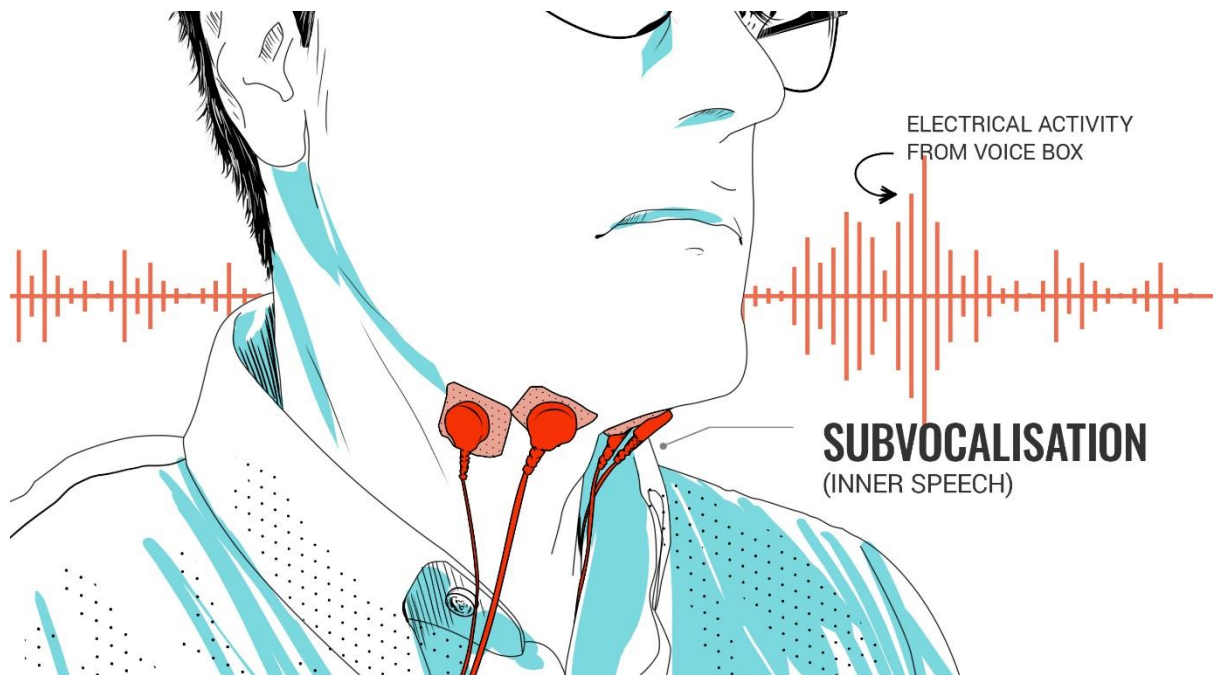
Another factor that increases reading speed in fast readers is their excellent vocabulary⁴⁸. The level of familiarity of different words affects how long they are fixated for, with more frequent words being processed much faster^{60,61}. One study showed that greater familiarity with specific words can speed up their processing by at least 50 ms⁶², which translates to a more than 30% speed increase for a normal reader.

Research into fixation patterns in “speed readers” have generally shown that they either use fixation patterns similar to normal skim reading^{63,64}. In some cases, more bizarre strategies have been employed, such as reading down one page and up the next (leading to terrible comprehension)!⁶⁵.

Unfortunately, no studies yet have tested readers who use fixation patterns similar to those suggested by SuperLearner®. Therefore, it remains to be scientifically tested whether these fixation patterns are trainable and whether they increase reading speed.

Is this technique supported by scientific evidence?

The method of training fixation patterns recommended by SuperLearner® has not been scientifically tested at present. There is some evidence that faster readers make fewer, shorter fixations and avoid making regressions, while maintaining a good level of comprehension. Improving your vocabulary can also reduce fixation times and increase reading speed.



Reducing inner speech (subvocalisation)

How is this technique supposed to work?

Subvocalisation refers to the “inner speech” that readers normally use to make sense of words while reading ⁸. SuperLearner® claims that during normal reading, there is a three step process by which visible words on the page are converted into inner speech, from which the meanings is derived. By reducing and eventually eliminating subvocalisation, the idea is that the visual information from the words can be used to provide the meaning directly. As the conversion of visible words to inner speech is no longer necessary, reading can be faster and more efficient.



**PARTIAL
COUNTER
EVIDENCE**

What does the scientific evidence say?

Researchers have used two main approaches to investigate whether subvocalisation is important to reading. The first is to ask participants in studies to count or repeat meaningless words aloud while reading to prevent them from using their inner voice. Studies using this approach have consistently found that reading comprehension is reduced under these conditions ^{64,66,67}.

The second approach is to ask participants to reduce their subvocalisation directly — but how is this achieved exactly? As well as being “heard in the head”, subvocalised words actually result in small but measurable signals in the muscles of your larynx (voice box) and lips. These signals can be picked up using a technique known as “electromyography”, in which small electrodes are placed near the muscles. Therefore, it’s possible to know if someone is subvocalising just by measuring the muscle signals at their larynx or lips. A study using this method found that when participants reduced their subvocalisation, although their comprehension of an easy text was unaffected, they understood less when reading a difficult text ⁶⁸.

Although subvocalisation appears to improve comprehension, it is not essential for reading. In one curious case, a 54-year-old man became mute and completely stopped subvocalising, but could still read using “highly developed visual imagery” ⁶⁹. Research suggests that skilled readers, too, can derive meanings directly from the visible words on the page ^{70,71}. The role of subvocalisation might therefore not be to translate visible words into meanings, but instead to allow the text to be stored and comprehended in verbal working memory ^{68,72}.

Is this technique supported by scientific evidence?

There is some evidence that reducing or interfering with subvocalisation generally reduces comprehension. However, there is good evidence that the meaning of words can be derived directly from the letters on the page, meaning that subvocalisation is not essential to reading.



Employing strategic learning behaviours



Creating the proper learning environment

How is this technique supposed to work?

SuperLearner® claims that recall of learnt material happens best in an environment which matches the one in which the material was learnt — so if you are most likely to need to use the information in a noisy work environment, then you are advised to learn in noisy environment, too. Conversely, if the place you will be recalling the information is likely to be quiet, you should mimic this situation by learning in a quiet environment. When learning, you should pay attention to factors that help to keep you awake and alert — including the light and oxygen levels in the room, your posture (for example, by standing to stay alert), and the use of tea and coffee (tea might be better for long-term focussed attention).



**PARTIAL
EVIDENCE**

What does the scientific evidence say?

Scientists have studied how memory is affected when the environment (context) is the same during both learning and recall — this is known as “environmental context-dependent memory”⁷³. The beneficial effect that a matching environment can have on recall was first shown in a bizarre study conducted by psychologists Duncan Godden and Alan Baddeley in 1975⁷⁴. They asked scuba divers to memorise lists of words in two environments — either underwater or on dry land. When the divers were later tested, they found that their recall for each list was best in the environment in which it had originally been learnt.

So a matching environment can have a beneficial effect on recall — what we learn in the office we might recall better in the office, and what we learn at home might be easier recalled at home. However, the key question is how strong is this effect? Is it really more important to effective learning than other factors, like reducing distractions? The latest surveys of the evidence show that although the environment does have an effect, if a person’s focus is on their internal process (for example, using marker imagery or a memory palace) rather than the environment during learning and recall, this is enough to result in effective recall on its own⁷⁵.

Should background noise or music be kept the same to improve recall? Research has shown that there is an advantage to recall if a similar sound was present during learning (for example, hearing the same music played on both occasions)⁷⁶. Crucially, however, if the learning takes place in a quiet environment, recall is equally as good in either a quiet or noisy environment. The take-home message is that a quiet learning environment will give you the greatest flexibility about where you recall the information later.

The next section talks more about the importance of maintaining wakefulness by getting good quality rest and sleep while you are learning.

Is this technique supported by scientific evidence?

The evidence shows that although there can be advantages to matching the environment and noise levels during learning and recall, working in a quiet environment will give you good recall regardless of where you are.

Focussing attention on your inner imagery and thoughts during learning and recall will help to make use of internal memory cues that can be used anywhere. By reducing distractions and noise while learning, this inner focus can be maintained to improve later memory recall.



Getting good quality sleep

How is this technique supposed to work?

SuperLearner® claims that regular, good quality sleep and shorter rests of at least 10–15 minutes (ideally, 22–24 minutes) are essential during “brain training” to improve learning and to take on board large amounts of information. During this time when the brain is resting, short-term memories are transferred to long-term memory stores.



**STRONG
EVIDENCE**



What does the scientific evidence say?

Sleep is well-established scientifically to have a crucial role in learning and memory ⁷⁷. During sleep, information learnt during the day is transferred from the hippocampus to the cortex to be integrated into long-term memory. Importantly, this consciously accessible learnt information (known scientifically as declarative memory) is only transferred during deep sleep, which is scientifically termed “slow-wave sleep”.

Through studying brain activity during sleep, scientists have found that as the amount of declarative learning increases, so does the level of communication between the hippocampus and cortex during slow-wave sleep⁷⁷. This is why good quality sleep that includes longer periods of slow-wave sleep is especially important for integrating learnt information into your long-term memory. However, even a quick nap of between 6–30 minutes can be beneficial for alertness, cognitive performance and memory recall^{78,79}.

Is this technique supported by scientific evidence?

There is very strong evidence that sleep is important to learning and memory. To be effective in transferring learnt information to long-term memory, the sleep must be deep enough that you enter the slow-wave sleep stage. However, a quick nap can still help to improve alertness, cognitive performance and recall.



Intelligently structuring your study of texts

How is this technique supposed to work?

Is it possible to improve your learning by approaching your study of a text in an intelligent and structured way?

SuperLearner® suggests using the **SQ3R method** developed by Francis P. Robinson in the 1940s ⁸⁰, which is named after the 5 steps involved:

1. **Survey** — pre-reading the text rapidly to form a “mental map” of it
2. **Question** — actively generating curiosity and interest to form questions about the text
3. **Read** — reading of the text in an engaged way using the questions
4. **Recite** — periodically retrieving what you have learnt in your own words during reading
5. **Review** — at the end of passages and chapters, reflect on the key point or message made.



**PARTIAL
EVIDENCE**



Pre-reading refers to building a “mental map” of a text you want to read by first reading through it at 5–8 times the normal speed. During this rapid first pass, the aim is to gather key information from the title, headings and any other word and numbers that stand out in the text. A “scaffold” of basic markers (mental images) can be formed and filled in with more details during the reading afterwards. Markers that you generate should link into your existing knowledge.

What does the scientific evidence say?

The idea that pre-reading a text can improve reading comprehension and speed has a long history in educational psychology research. An early study from the 1930s showed that college students who conducted a “preliminary skimming” of a text could read it more quickly afterwards ⁸¹. Paying attention to the overall structure of the text is also a common strategy used by readers who make the best summaries later on ⁵⁸. These and other similar studies have provided limited scientific evidence that pre-reading is effective in improving reading speed and comprehension.

From the wide range of possible study strategies that have been proposed (including SQ3R, ReQuest, PreP and more) ⁸², there is little hard evidence so far about which one is most effective in practice ^{83,84}. Therefore at the moment, the question of which one to use comes down to personal experience. However, the basic principles of the SQ3R method are consistent with scientific understanding. For example, questions are an excellent way to increase the depth of encoding of the text, helping to keep information in your working and long-term memory ¹¹. Likewise, rehearsing and reviewing information you have learnt has been conclusively shown to improve learning ^{85–87}.

Is this technique supported by scientific evidence?

There have not been enough studies carried out so far to determine exactly which study strategy is the best to use for reading. However, the basic principles of the SQ3R method are consistent with the scientific evidence. There have been a limited number of studies showing that pre-reading can increase reading speed and comprehension.

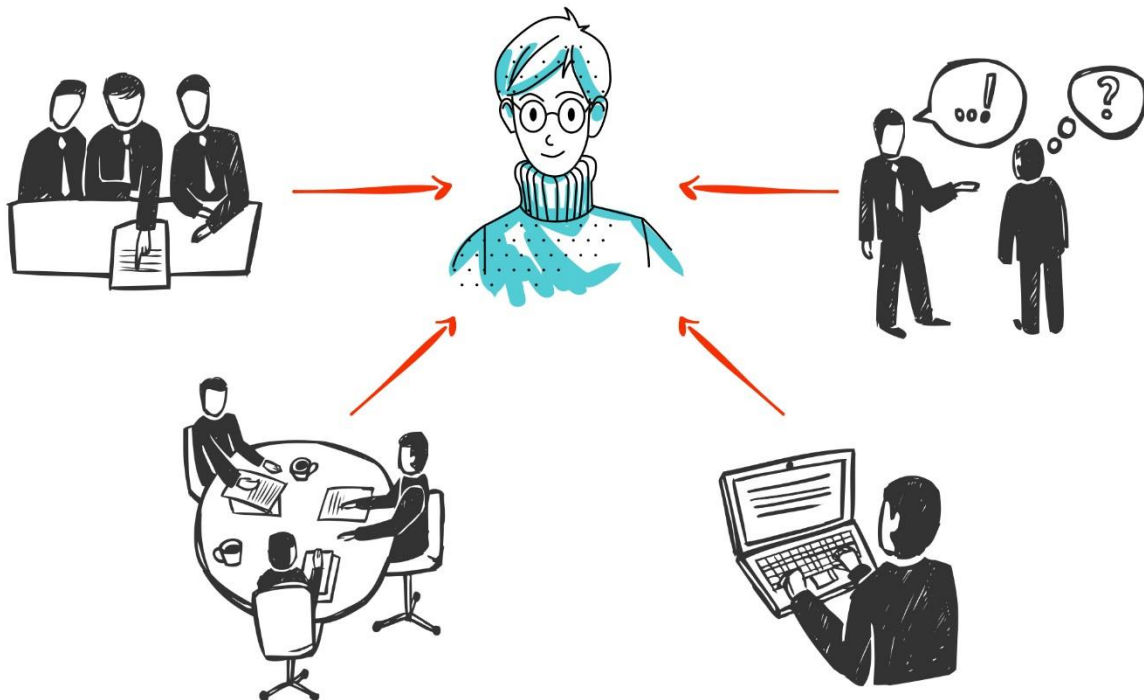
“Brute force” learning: attacking learning from many angles

How is this technique supposed to work?

SuperLearner® argues that the best way to attack a learning problem from as many angles at once as possible — not just reading the materials, but talking about it to friends, reading about it on the web, asking questions, and so on. In other words, engaging with the material in as many ways as possible and applying the skills learnt to your daily life in a relevant way based on your priorities (self-directed learning).



**PARTIAL
EVIDENCE**



This approach is based on the adult learning principles set out by the so-called “father of adult education” Malcolm Knowles⁸⁸. Specifically, you should approach learning with as much curiosity and interest as possible, asking yourself questions about the information that you discover as you go along. According to Knowles, understanding how knowledge can be applied is critical for adult learners to stay motivated. So you should think about how the information is relevant to you and how it can be applied to your own day-to-day life, and link what you learn into your existing knowledge.

What does the scientific evidence say?

Knowles was a pioneer in the study of what is known as “andragogy” or self-directed adult learning. Although his principles have been widely used by adult educators throughout the world, he himself has acknowledged that “andragogy is less a theory of adult learning than a model of assumptions about learning” ⁸⁹. In other words, the principles he put forward are more a set of practical recommendations for adult learning than a scientifically-based theory ⁹⁰.

However, the general idea of engaging with what is learnt from many different angles and applying it to daily life is consistent with the latest evidence-based theories of adult learning ^{91,92}. This engagement with the learnt material should ensure that it is regularly retrieved, helping it to integrate with existing knowledge ^{85,87,93}.

Is this technique supported by scientific evidence?

The self-directed adult learning principles are best thought of as a set of guidelines about how to learn, which have not been scientifically tested yet. However, the recommendation to engage with learning materials in a range of ways and applying the knowledge learnt to everyday life is consistent with the latest theories in adult education.



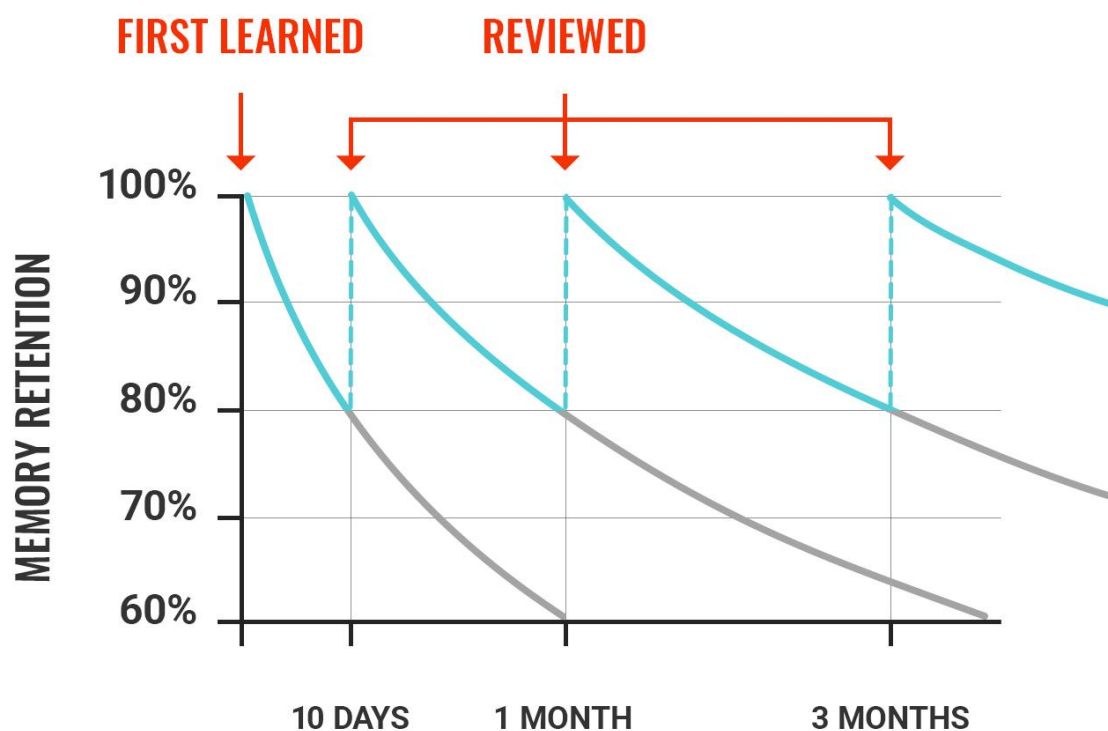
Retaining memories by spaced repetition

How is this technique supposed to work?

SuperLearner® argue that by reviewing learnt information at spaced intervals, you can make sure that you do not forget what you have already learnt. They suggest using software programs such as Anki allow you to automatically schedule reviews of specific materials you have been learning at precise intervals, without you having to organise these yourself. An example schedule would be to review learnt information after 10 days, 1 month and 6 months, but these intervals should be individually tailored based on what you find works for you.



**STRONG
EVIDENCE**



What does the scientific evidence say?

The beneficial effect that reviewing learnt information has on long-term memory storage has been long-established scientifically^{85,87}. Scientists can very accurately track how well memories are retained after different intervals, allowing the optimal schedule to be investigated. With three reviews, the

evidence shows that the time between each review should be at least the same or longer each time ⁹⁴ — so intervals of 10 days, 20 days, 30 days might work, but 10 days, 18 days, 24 days would not.

The technology for computing the optimal review intervals is improving all the time. For example, a recent study tested a cutting-edge approach using a huge amount of data from the Duolingo language learning platform, showing a clear improvement in long-term memory for words and phrases ⁹⁵. Artificial intelligence systems capable of designing review schedules that are individually customised to a person's learning needs are already being developed and tested ⁹⁶.

Is this technique supported by scientific evidence?

There is very strong evidence that reviewing learnt information is important to retain it in long-term memory and to prevent it from being forgotten. By using the latest software, you can automate the timing of your review schedule and optimize the retention of information in long-term memory based on cutting-edge scientifically-grounded methods.



EXECUTIVE SUMMARY

Rating	Technique & Summary of Evidence
 <p data-bbox="245 725 426 824">PARTIAL EVIDENCE</p>	<p data-bbox="509 472 1345 510">Using markers to remember words or numbers</p> <p data-bbox="509 546 1401 801">In the absence of real pictures as learning aids, the evidence suggests that people who can form vivid enough imagery can use markers to memorise words and numbers more effectively. It's not clear yet if people can train themselves to form more vivid images — the limited evidence so far suggests not.</p>
 <p data-bbox="245 1135 426 1234">STRONG EVIDENCE</p>	<p data-bbox="509 882 1401 972">Chunking: grouping items and markers into small groups</p> <p data-bbox="509 1008 1361 1218">There is strong evidence to support chunking being an effective way to memorise lists or sequences of information, with the maximum number of chunks being around four. Chunks are a way to bind together information with strong associations in information-rich bundles.</p>
 <p data-bbox="229 1547 442 1599">UNDECIDED</p>	<p data-bbox="509 1294 1337 1391">Using markers to increase reading speed and comprehension</p> <p data-bbox="509 1426 1385 1637">There is little evidence at present about whether markers can be used to increase reading speed and comprehension in adults. However, there is good evidence that using markers (linked mental images) can improve memory for lists and sequences of information.</p>



**STRONG
EVIDENCE**

Remembering sequences and narratives with memory palaces

There is strong evidence from experiments into memory performance and brain activity that the memory palace technique is an effective way of remembering ordered information.



**PARTIAL
EVIDENCE**

Widening your perceptual span

Although scientists have believed for a long time that the perceptual span is “physiologically fixed”, a couple of recent studies suggest that it is possible to widen your span, leading to an increase in reading speed. However, more research is needed to confirm this training effect.



UNDECIDED

Optimising fixation patterns

The method of training fixation patterns recommended by SuperLearner® has not been scientifically tested at present. There is some evidence that faster readers make fewer, shorter fixations and avoid making regressions, while maintaining a good level of comprehension. Improving your vocabulary can also reduce fixation times and increase reading speed.



**PARTIAL
COUNTER
EVIDENCE**

Reducing inner speech (subvocalisation)

There is some evidence that reducing or interfering with subvocalisation generally reduces comprehension. However, there is good evidence that the meaning of words can be derived directly from the letters on the page, meaning that subvocalisation is not essential to reading.



PARTIAL EVIDENCE

Creating the proper learning environment

The evidence shows that although there can be advantages to matching the environment and noise levels during learning and recall, working in a quiet environment will give you good recall regardless of where you are. Focussing attention on your inner imagery and thoughts during learning and recall will help to make use of internal memory cues that can be used anywhere. By reducing distractions and noise while learning, this inner focus can be maintained to improve later memory recall.



STRONG EVIDENCE

Getting good quality sleep

There is very strong evidence that sleep is important to learning and memory. To be effective in transferring learnt information to long-term memory, the sleep must be deep enough that you enter the slow-wave sleep stage. However, a quick nap can still help to improve alertness, cognitive performance and recall.



PARTIAL EVIDENCE

Intelligently structuring your study of texts

There have not been enough studies carried out so far to determine exactly which study strategy is the best to use for reading. However, the basic principles of the SQ3R method are consistent with the scientific evidence. There have been a limited number of studies showing that pre-reading can increase reading speed and comprehension.



PARTIAL EVIDENCE

“Brute force” learning: attacking learning from many angles

The self-directed adult learning principles are best thought of as a set of guidelines about how to learn, which have not been scientifically tested yet. However, the recommendation to engage with learning materials in a range of ways and applying the knowledge learnt to everyday life is consistent with the latest theories in adult education.



**STRONG
EVIDENCE**

Retaining memories by spaced repetition

There is very strong evidence that reviewing learnt information is important to retain it in long-term memory and to prevent it from being forgotten. By using the latest software, you can automate the timing of your review schedule and optimize the retention of information in long-term memory based on cutting-edge scientifically-grounded methods.



CONCLUSIONS

In this e-book, we've taken a quick look at the science behind memory and reading — just enough to get you up to speed with the key factors that affect your ability to learn factual information. Based on this theoretical knowledge, we've assessed the weight of scientific evidence for or against each SuperLearner® technique to give you a reliable guide of which techniques are supported and which aren't.

Scientific knowledge isn't fixed, but is always expanding as new experiments are carried out and theories are tested. By working with memory “artists”, like the memory athletes from the World Memory Championships, scientists are able to better understand how learning and memory can be trained to peak performance.

So remember — optimising your own learning will always be a mixture between an art and a science. Hopefully the information in this e-book has helped you to get a clearer understanding of the science part — the rest is up to you!

Good luck!



CONFLICT OF INTEREST STATEMENT

Doran Amos declares that he was hired on a freelance contract by SuperHuman Enterprises Inc. to conduct a scientific literature review and to write this e-book.

He is the sole author of the scientific content in this e-book; Jonathan Levi only contributed to ensuring the accuracy of the SuperLearner® technique descriptions and his biography.

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ABOUT THE AUTHORS



Doran Amos, PhD

Doran is a science writer, editor, and neuroscientist.

He completed his PhD in Neuroscience in 2011 under the supervision of Nobel laureate Prof. John O'Keefe at University College London. He has broad experience and expertise within diverse areas of neuroscience and psychology.

He is fascinated by the capacity of the human brain to learn and to intelligently adapt itself. As well as his interest in memory training, he is a long-time Zen practitioner and is intrigued by how mind and heart can be cultivated through contemplative practices.

He offers his expertise and passion for communicating science through his scientific writing and editing business, Nobel Editing:

<https://nobelediting.com>

He lives in Brighton, UK.



Jonathan Levi

Jonathan is a serial entrepreneur, author, and lifehacker born and raised in Silicon Valley.

He's the author of the blockbuster Become a SuperLearner® series, and the host of the award-winning Becoming SuperHuman podcast. His passions include learning languages, musical instruments, acro yoga, weightlifting, and cooking.

He lives in Tel Aviv, Israel with his superwoman, Limmor.