



## CHAPTER 9:

# HOW DOES THE HITCHHIKER'S GUIDE TO THE GALAXY HELP ARTHUR DENT TAKE A COGNITIVE LOAD OFF?

*Mark Childs, Mike Collins and Mark Williams*

*As the three Zillas are leaving the capital city of Behaviourism, clutching their Rosenshine guidebook, they see a pathway to the mines beneath the city.*

*'That must be where you can see the foundations of Behaviourism,' says Mike, in awe. 'The cognitive architecture the Dwarves keep banging on about.'*

*'It's dark, though,' Markzilla observed. 'They've delved too greedily and too deep.'*

*'Never fear, I bought more than one guide in the city.' Mikezilla stuffs Rosenshine's text in his backpack and holds up a small device. 'Markzilla of the Williams clan has produced a guide to cognitive load that will show us the way.'*

We've noted in previous chapters that understanding how the brain functions is key to getting your teaching right. That includes the reward system that can motivate learners, and the ways in which thoughts are processed and memories stored. It's those latter brain functions we're looking at here, and the idea of cognitive load and how it can limit and support learning. We're also digging into *The Hitchhiker's Guide to the Galaxy*, which is another of those narratives that seems to crop up in multiple formats and in multiple versions. We'll be mainly looking at (listening to?) the radio series, as that's how it all started, and asking a question that relates to the central character: **How does *The Hitchhiker's Guide to the Galaxy* help Arthur Dent take a cognitive load off?**

### *The Hitchhiker's Guide to the Galaxy*

For those of you not familiar with it, we should first explain what *The Hitchhiker's Guide to the Galaxy* is. It was originally a radio series, released as six episodes in 1978, which were then adapted into books, and then a towel, and then a play, a text-based computer game, then a TV series, and then an LP [vinyl] and some comic books. Then follow-up novels. Then it was adapted again into a film. And the novels were adapted into more radio series. There's even a huge coffee-table book with photographs of people re-enacting scenes from the radio series.

The episodes that made up that first radio series are about a guy who survives the explosion of the Earth because he escapes with the help of his friend, who turns out to be from Betelgeuse (and not from Guildford after all). That's Arthur Dent and Ford Prefect, respectively. Ford and Arthur then travel around the galaxy trying to find the ultimate question to which the ultimate answer is 42. They're helped on their way by a useful little Guide, which pre-empted Wikipedia-on-your-iPad by about 30 years. The Guide

interjects useful pieces of information into the narrative, which is useful for exposition, but also adds lots of short stories and philosophical observations along the way.

### Cognitive load

Next up, let's break down what cognitive load is. The theory was popularised back in 1988 by John Sweller. It's got deep roots in neuroscience and cognitive science, so you find it cropping up all over the place in other bits of pedagogic theory and modelling. The critical bits are that it's about the division between working memory and long-term memory and the concept that working memory is finite and that you must account for this. When you're trying to teach people, filling their working memory means that they'll struggle to acquire new concepts.

To back-pedal slightly, working memory contains a small amount of things you hold in your mind for a short time – typically, 5-9 pieces or chunks of information. For example, you might be able to remember the digits in a friend's phone number while you open your contacts app, but most people would struggle to remember the digits in two or three phone numbers in that way. Long-term memory, on the other hand, can hold an enormous amount of information for a lifetime. One of the challenges when you're learning is to shift new information and knowledge from working memory to long-term memory.

An excellent book on CLT (to minimise your cognitive load, we should explain that's short for Cognitive Load Theory), if you're interested in finding out more, is one put together by Jan Plass, Roxana Moreno and Roland Brünken (2010). It really digs into the empirical evidence for much of this. And regarding empirical evidence, there's a lot of it based on cognitive science and evolutionary theory. CLT generates principles that can be tested by experiment

and that are reproducible across a wide number of disciplines and learning environments, which is why it's the touchstone for a lot of the positivists, like Barack Rosenshine, who you encountered in the previous chapter.

Cognitive load can be divided into three types.

- **Intrinsic load** is due to how difficult the materials are for the learner
- **Extraneous load** is additional complexity due to the way the materials are designed
- **Germane load** is the amount of mental effort required by the learner to learn the thing you're teaching.

Cognitive load isn't a fixed amount – we vary in the amount we can handle – but there's a capacity limitation. We can reduce the amount of cognitive load of learning by using schema, which is how the learning is structured.

Like the causes of cognitive load, schema can be divided into three elements; there's the direct initial instruction – which can be dismissed as spoon feeding – but the theory says spoon feeding is good, at least at first. There's the expertise principle, which says that if you already know a lot, it's easier to add new information, and there's the small step-size of knowledge change principle, so you break the learning down into manageable chunks. As the Swahili proverb says, 'haba na haba hujaza kibaba'<sup>1</sup>. The ways in which learners gather and process information make a difference too.

So, there's a lot going on, and lots of teaching strategies that can avoid hitting that capacity limit. And it gets more complicated when we look at how we deal with more than one student at a time, because what works for one student won't work for another. A good example of this is something that Slava Kalyuga (2014) calls

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1. Little by little fills the pot. We upped the intrinsic load there for all non-Swahili speakers.

the expertise reversal principle. Basically, what works for a newbie (lots of additional explanatory stuff) just adds to the extraneous cognitive load for someone who already knows it. Of course, you can overcome this problem with online multimedia by making it individually adaptive. In a classroom, you can adapt the learning to suit individuals, but the larger the class the more difficult it is to do this.

Students also differ in their ability to process visual information due to their spatial ability, so showing visualisations to some students will hit their cognitive load limit, whereas the same visualisations might not overload others. To complicate things, cognitive load acts in combination with perceptual load (Naert et al, 2018) which is the amount of information you can pay attention to at once. Metacognitive skills can help reduce the germane cognitive load but the downside, and we'll see this in Chapter 13, is that 'thinking about your thinking' competes with just 'thinking' for capacity in the working memory.

Three more effects worth thinking about, if we haven't reached your capacity limit already, are the modality effect, the redundancy effect and automation. The modality effect is that, if you present information in more than one mode, it's easier to learn it. The redundancy effect is that extraneous information interferes with learning (you may have found that as you tracked down to the footnote to understand the Swahili proverb).

But the tool that is most valuable in reducing cognitive load is automation. Automation is the unconscious processing of knowledge. Although it involves thinking, because that thinking isn't conscious it doesn't add to your cognitive load. The more lower level schemata you have in your head, the easier it is to process higher level schemata. So, for example, unconsciously knowing the plural of 'schema' so you don't have to think about it, means that you have more capacity to think about what you're writing, rather than needing to concentrate on how to pluralise the words you're

using (Sweller, 2010). We'll see this as a core part of the criticisms of problem-based learning in Chapter 11.

Automation is helped by repetition, and much of the construction of learning taking CLT into account ultimately boils down to that division between working memory and long-term memory (or learnt memory), because you can't squeeze too much into the processing or working memory. An effective schema keeps the demand on the working memory to a minimum while building up the unconscious memory. If you bash too many concepts together in too brief a period, while you're still trying to process what one thing means, you've got another thing in collision with it. There's then no way to bring those two separate ideas together to form the actual overlying overriding concept. As a result, you just get lost.

### **In which we criticise much of academic writing**

When we recorded the podcast on which this chapter is based, Markzilla of the Williams clan started by quoting a piece of *The Hitchhiker's Guide to the Galaxy: Earth Edition*, which goes like this:

*Sesquipedalian Obscurantism: One who is inordinately infatuated with polysyllabic obfuscation, preferring never to employ a less complicated syntactic arrangement of descriptive words when there exists a single expressive unit that amalgamates the multiplicity of morphemes comprising the simpler phrase. Among the manifold objectives of multisyllabic, holophrastic verbalism are those of: rendering the author's meaning indisputably precise yet simultaneously incomprehensible; demonstrating through superior orthography and lexical awareness that the writer is manifestly more erudite than the reader; disempowering intellectual challenge to the proponent's argument by using logomachinations to divert discussion to the establishment of*

*the opponent's comprehension of the vocabulary as opposed to addressing the factual import of the treatise which, upon analysis, may well prove amphigorous. The obscurantist sesquipedalian is likely to compound the reader's difficulties by indulging in glossosynthesis, thus enabling the author to dismiss all opposing views as ultracrepidarios. In other words, a sesquipedalian is one who would call a spade a manuo-pedal excavationary implement.*

Saavik2 (2001)


Despite the excellent oratory skills exhibited by Markzilla W, it was pretty difficult to figure out what the passage was trying to say, though basically it just means that cognitive overload is used deliberately by some people, particularly academics, to ward off any criticism by sounding impressive, a technique that is particularly useful when the actual argument is thin. For some excellent examples of this, take a look at *Fashionable Nonsense* by Alan Sokal and Jean Bricmont (1998), incidentally published by the same people who published *The Hitchhiker's Guide to the Galaxy*. If you find any examples of sesquipedalian obscurantism in this book, please contact the authors and we'll find a way to clarify what we've written.

It's worth saying, though, that overwhelming people with terminology isn't always intentional. Sometimes it's done because the person doing it already has in their learnt memory knowledge of what those words or phrases mean. They draw on that information when communicating and they forget that other people don't have the same store of knowledge to draw on. We see the same thing with non-academics inventing words or, worse, changing the meaning of existing words, which is counter-productive because it adds to the cognitive load of everyone you're trying to communicate with. Again, by providing a schema, ideally explaining the words or phrases for people who may be unfamiliar with them, you can help

reduce cognitive load. Or, and this applies to learning in general, check understanding or knowledge, and give people a chance to reflect on new knowledge before moving on to the next bit. The danger here, though, is that you run into the potential for appearing patronising and hitting the expertise reversal principle.

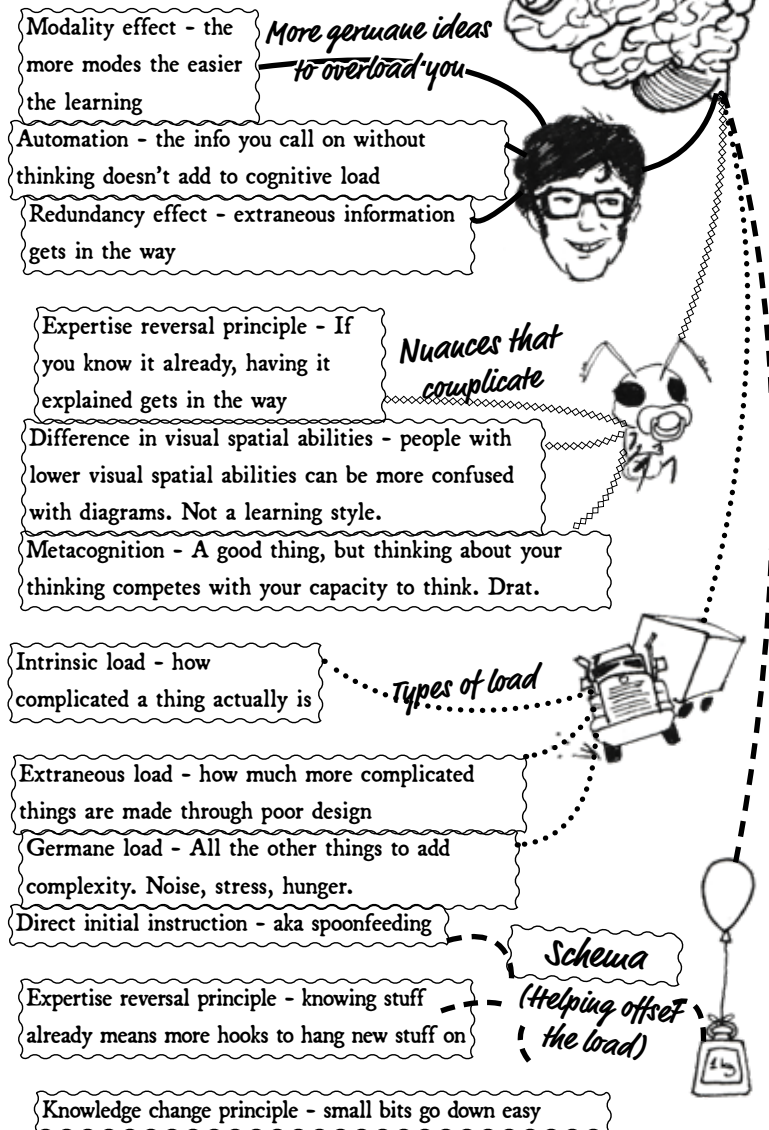
Finally, and something that brings in a whole range of other elements, such as fun, playfulness and so on, is the potential to make learning feel like less effort (or, in CLT terms, to reduce germane load) by making it fun, making the environment more comfortable, or creating rapport with the learners. If they're thinking about how they're going to pay their bills, or are occupied by how much their back aches because of the chair they're sitting on, or are feeling annoyed because you've just patronised them, that's all going to impact on their ability to process information. Which is why it can sometimes feel that you're caught in one of two feedback loops – either the students are comfortable because they're understanding things, which improves their capacity to understand new things, or you're making them feel stupid, which ultimately does actually make them more stupid.

*Cognitive load is one of those nifty concepts that changed how I understood my own previous experiences of learning, and how I've looked at it since. One of the weird quirks I've noticed working in and around education is that cognitive load is often ignored in staff-to-staff learning, where we inflict brain-filling infodumps on one another that we would never consider trying to cram into student heads. Then we wonder why everyone forgets processes or what 'GDPR' stands for. ~Mikezilla*



To practise what we preach, we've tried to reduce your cognitive load with the following diagram summing up the key points.

## Cognitive load: a cognitive map



## The answer

So, how does *The Hitchhiker's Guide to the Galaxy* help Arthur Dent take a cognitive load off? Arthur is first introduced to the Guide when he's transported to the flagship of the Vogon constructor fleet, moments before it destroys the Earth (ostensibly to make way for a hyperspace bypass). When he arrives, he's at first unable to process anything. One moment he was holding onto a rock while an alien spacecraft floated overhead, the next he's on that spacecraft, in the sleeping quarters of the Dentrassi – a race of beings the Vogons hire to cook and mix drinks for them.

That's a lot to take in at once, Arthur is so overwhelmed by culture shock, he's not even in a position to start panicking. It's a completely alien environment, which is the point at which Ford Prefect gives him the book *The Hitchhiker's Guide to the Galaxy* and Arthur reads the following passage:

*Here is what to do if you want to get a lift from a Vogon... forget it. They are one of the most unpleasant races in the galaxy – not actually evil, but bad tempered, bureaucratic, officious and callous. They wouldn't even lift a finger to save their grandmothers from the Ravenous Bugblatter Beast of Traal without orders signed in triplicate, sent in, sent back, queried, lost, found, subjected to public enquiry, lost again, and finally buried in soft peat for three months and recycled as firefighters. The best way to get a drink out of a Vogon is to stick your finger down his throat... and the best way to annoy him is to feed his grandmother to the Ravenous Bugblatter Beast of Traal. On no account allow a Vogon to read poetry at you.*

(Adams, 1979, 45)

Bit by bit, as he encounters new things on his journey, the book explains them for Arthur. So when he gets a Babel fish in his ear, the book tells him a little story about what the fish is for. When he sees the Dentrassi and tastes the food, he gets background information on what the Dentrassi are. Each new encounter is unpacked and contextualised. Obviously, this isn't just for Arthur Dent. This is a device for listeners, so they can understand more about this world as they're hearing it, as it's being told to them for the first time by actors such as Peter Jones or William Franklin or Rula Lenska.

Why do this? Well, anyone who's engaged with any fantasy or science fiction will know that a massive amount of different information is thrown at the reader, or the listener, or the viewer at once. Anyone who's written in these genres will know that finding a way to introduce that information gradually to the audience is a really difficult thing because, on the one hand, you could confuse people by not explaining it (intrinsic load) but, on the other hand, they could get bogged down by masses and masses of explanation (extraneous load).

This is why not only does *The Hitchhiker's Guide to the Galaxy* (the book in the radio show) do a great job of reducing the cognitive load on Arthur Dent, but also *The Hitchhiker's Guide* (the show itself) does a great job of reducing the cognitive load on the audience. It takes crucial bits of information, boils them down and presents them very simply. Nice easy language that's used to break complicated concepts into easy-to-understand gobbets has made *The Hitchhiker's Guide to the Galaxy* one of the most successful books of all time.

Of course, there are limits. In the quote on the previous page there's a reference to the Ravenous Bugblatter Beast of Traal (an animal that's so amazingly stupid it thinks that if you can't see it, it can't see you). In the entry on Vogons this isn't explained, but within the context you have enough information for it to make

sense (it's something you could feed a grandmother to) and when you encounter it again on the entry on towels (you can wrap a towel around your head to hide from these creatures), you can add an additional layer of information to your schema on them. At no point do you need to be working out what a Bugblatter Beast is while you're also trying to learn something else.

As you can see, it's passing on information in bite-sized chunks, at the time that they're most useful, that enables Arthur to assimilate as he goes along, allowing him to continue to manoeuvre around the universe with more success and less anxiety. Though still with a great deal of anxiety.

The use of clear language in *The Hitchhiker's Guide* helps Arthur connect new information to the information he's already learned. This does two things. It strengthens his retention of the knowledge by connecting to his existing schemata (stuff he's already learned or stored in long-term memory). And, because he's not having to keep extra stuff in his working memory as it's referencing the long-term memory, it frees up space in his working memory to learn new things.

This is one of the reasons why just-in-time learning works effectively – you already have the context for the information (your need for it) and the information you receive is just enough to meet that need. These days, the internet on your phone does the same job – you need the information, you Google<sup>2</sup> it, and then read the Wikipedia entry, watch the YouTube video or import the manual to your book reader. If you were travelling round the galaxy, you'd probably be checking Tripadvisor all the time. In fact, that's what gave Douglas Adams the idea for *The Hitchhiker's Guide to the Galaxy*. He was lying drunk in a field in Innsbruck with his *Hitch-hiker's Guide to Europe* next to him, looking up at the stars and thinking, 'I wonder if there's a *Hitchhiker's Guide to the Galaxy*?' Confusingly for proof-readers,

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<sup>2</sup> Alternative websites are available for all those mentioned in this paragraph.

he dropped the hyphen in the process of creating that guide (Roberts, 2014, 29-30).

The difference between a guide and a teacher is that, when you're using a guide, the process is very learner centred because you as the learner are choosing the bits of information you need at that particular time whereas, when you're teaching, you have a scheme (not a schema).

So **how does *The Hitchhiker's Guide to the Galaxy* help Arthur Dent take a cognitive load off?** By providing just the information he needs, providing a schema for that knowledge, and giving him no more than he needs, the Guide reduces the need for him to either develop his own schema or draw on information that's not in his working memory. In doing so, it frees his mind to focus on adjusting to his new situation, so he can get on and go straight to the panicking part.

## Tips for your own practice

First of all, be aware that there is a limit to the cognitive load of your students. You can't exceed it. You can try, but there's no point, because they won't be learning anything. Provide a schema for what you're doing, because that enables the information to be structured as you go along. Use small steps. Reiterate these to make sure the schema is going into long-term memory. Check understanding before you move on.

Once the information is automatic and your students can call on it unconsciously, you can build on it. But your students can't consciously hold the basic schema and build on it at the same time. We won't go into detail here about balancing cognitive and metacognitive elements – but we will dig into it more in our chapter on BeanDad (Chapter 13).

Finally, cut down on the extraneous load elements. If you're online and learners are struggling with the interface, that's going to get in the way of their learning. If learners are offline and they're uncomfortable or have competing demands on their attention, do what you can to create a more comfortable environment, or to reduce the amount of content. You have limited cognitive load capacity if you have an aching pain in all the diodes down your left side. Unless you have a brain the size of a planet, that is.

## Life, the universe and references

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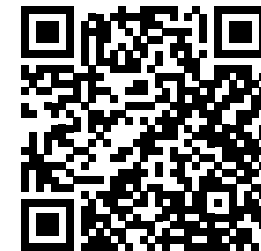
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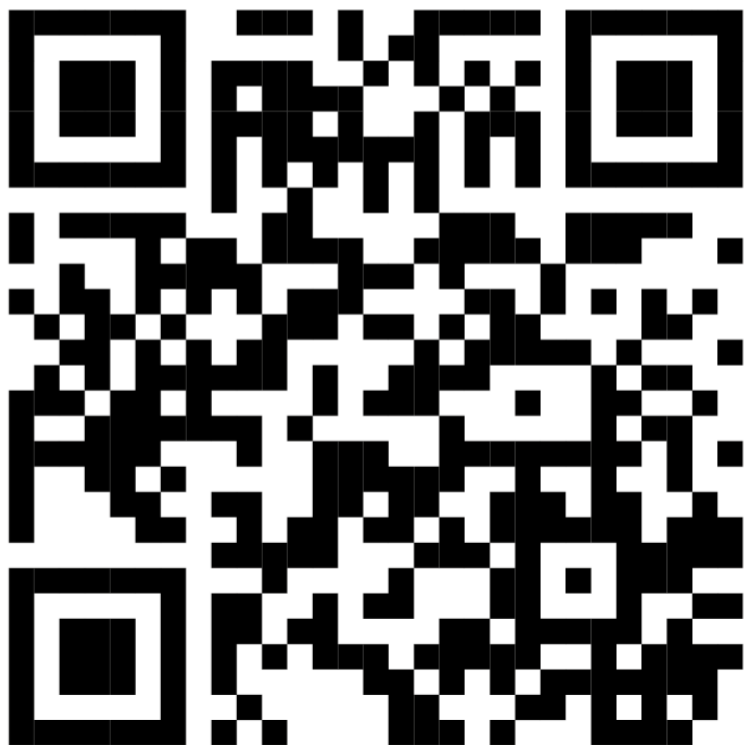




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