DESIGN FOR HOW PEOPLE LEARN

JULIE DIRKSEN

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New Riders

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Julie Dirksen is an independent consultant and instructional designer with more than 15 years experience creating highly interactive e-learning experiences for clients from Fortune 500 companies and technology startups to grant-funded research initiatives. She has been an adjunct faculty member in the Visualization Department at the Minneapolis College of Art and Design, where she created and taught courses in project management, instructional design, and cognitive psychology. She gets ridiculously excited about things like learning applications of loss aversion or the way glucose is regulated in the brain and she's happiest whenever she gets to learn something new. You can find her online at www.usablelearning.com.

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The delightful women at the Blue Moon Coffee Shop, where this was largely written.

and

My parents and family, who managed to not freak out and even to be supportive when I said "I think I'm going to quit my job and freelance so I can work on a book."

FOREWORD

When working within the artificial intelligence group at Control Data Corporation on advanced learning systems, a colleague questioned why we were using such powerful systems as Cray mega computers for adaptive learning programs and learning simulations. He understood why meteorology and military reconnaissance applications needed them, but why educational systems? Meteorology dealt with vast amounts of data and yet needed to predict future weather quickly. Airborne reconnaissance had to compare visual data from separate flights and perspectives to recognize which objects had moved and which hadn't. But instruction?

Many people surmise yet today that instructional software can't make much computing demand. *How hard is it to present and score multiple-choice questions?*

I asked my colleague, what causes meteorology and reconnaissance to make heavy computational demands? He replied, *the extremely large amounts of data to be gathered and managed, the rapid analysis that was needed, and the need to visualize the results.* Hmm. It sounded familiar—like working with human learners. I asked him how much data he thought the human brain might typically contain and what level of complex analysis he thought it capable of. How would it compare to our largest computer? What level of common knowledge and reasoning had we achieved in our intelligent systems? How did that compare to working with people? What level of computation might be required to perform the tasks of a talented teacher and mentor?

With an estimated capacity of somewhere between 10 and 100 terabytes and with little-understood capabilities far beyond our most capable computers, the human brain is phenomenally complex. It's amazingly capable and surprisingly unpredictable. It's both rational and emotional. It's perceptive and yet selectively so. It can remember large amounts of data and yet has the advantages of forgetting. And each of us has a unique one.

The challenges of creating highly effective learning experiences are numerous. We're fortunate that humans are, in many ways, learning creatures. We are generally eager to learn. We intuitively know that knowledge is power. Skills turn knowledge into actionable advantages. We want skills and enjoy having them. But even with all these advantages, it isn't easy to transmit knowledge and build skills. Thinking of instructional technology as computer-delivered multiple-choice questions reveals how misunderstood the challenges are.

Regardless of how instruction is delivered—through instructor-led activities, e-learning, or other means—structuring effective learning experiences requires knowledge of *How People Learn.* So much instruction is developed and delivered through paradigms born of tradition rather than of knowledge. They are ineffective. They are boring. They are wasteful.

And yet, the science of the human brain is not a well-rounded guide for the preparation of learning experiences. Considerations, yes. Helpful, yes. Best practices, no. Eager for cookbook-like guidance, many look to research for widely applicable principles, yet most research findings are applicable only within narrow confines. When brain and learning research conflict with experience, experience is the better guide. Wisdom in learning design takes years to acquire. It takes focus, dedication, hard work, and an observant approach. Yet through this richness of varied context, experience has broad applicability that cannot be gained otherwise.

Through Julie Dirksen's extensive experience in designing learning experiences for wide varieties of learners in very different contexts, she clarifies why traditional instructional approaches are so ineffective. We learn from Julie's wisdom, for example, that while practice is important and so often omitted or minimized, there are more effective approaches to building long-term retention than simple repetition. We learn why words are a poor substitute for demonstration and example. We learn the power of context.

Traditional instructional design approaches focus heavily on content—getting it complete and accurate. Then making presentations as clear as possible. Then making assessments precise. Concerns about the learning experience, making it meaningful, memorable, and motivational, may not even enter into the discussion. I guess it's no wonder that we have so many boring and ineffective programs.

I'm delighted to have this witty, insightful, cleverly illustrated guide. My hope is that it will help designers shed the shackles of "tell and test" traditions from which learners are victimized by passive presentations of information followed by short-term retention tests. True, most of us had no choice but to learn from such instruction and survive. But there's no indication this should be the paradigm of choice. Watching Jay Leno's *Jay Walking* segments or *Are You Smarter Than a 5th Grader?* should be evidence enough that our educational traditions aren't working well. It's time to work smarter.

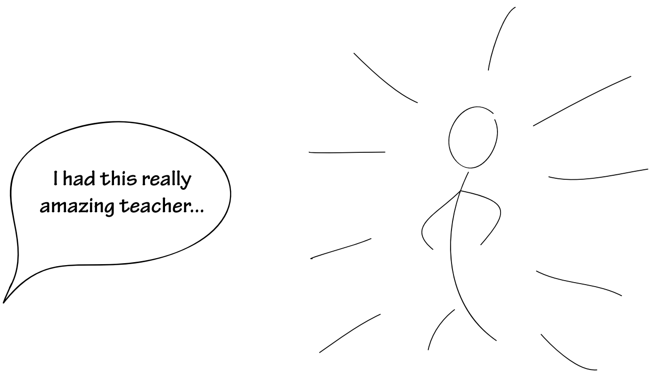
Michael W. Allen, Ph.D.
CEO, Allen Interactions Inc.
CEO, Allen Learning Technologies LLC

CONTENTS

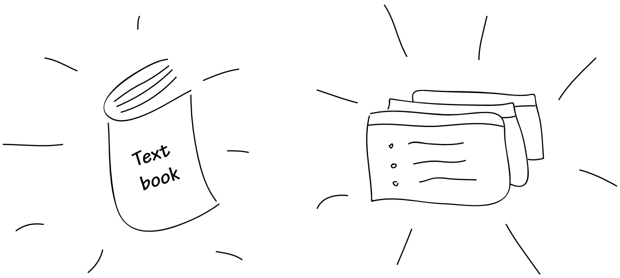
INTRODUCTION

Think about the best learning experience you've ever had. What was it like?

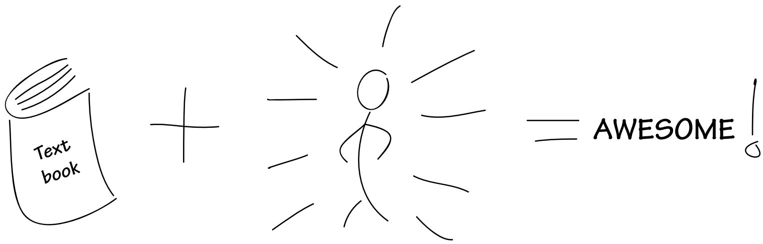
Got one? I've asked this question dozens of times, and gotten a variety of answers. Sometimes the answer is that someone was really passionate about what they were learning, but the most frequent answer is:

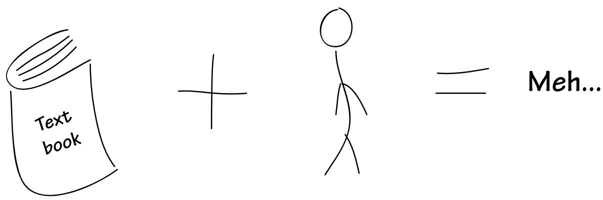


Nobody ever says "I had the most amazing textbook" or "There was this *really great* PowerPoint deck!"



That suggests that a lot of what makes for a great learning experience is not about the content, but is about the way the content is taught. In fact, a class can cover the same material but be very different, depending on how the material is taught:

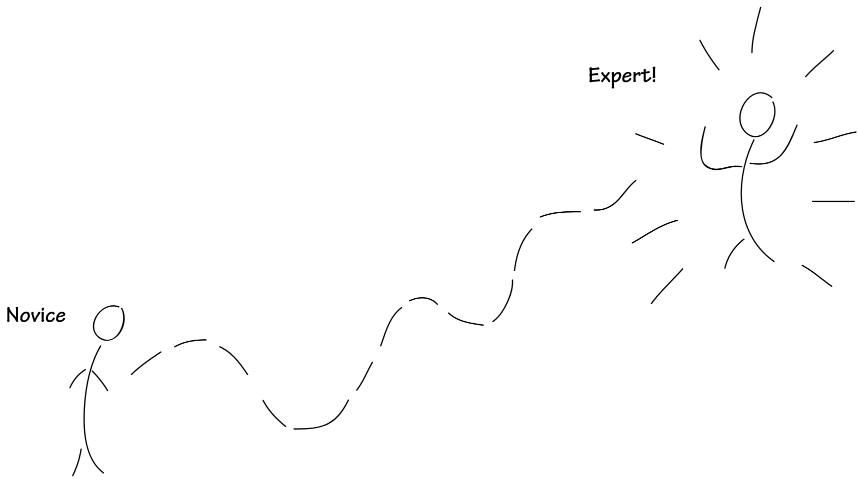




So what's the special sauce? How are the two experiences different? When it's two different teachers, some of the differences are due to personality or charisma, but those aren't usually the only differences. And when it's an e-learning course, there's no teacher at all. How is a really good e-learning course different from just reading a textbook online?

Even more important, what's the difference between a learning experience that's effective versus one that gets forgotten as soon as the learner is done? Even "awesome" classes are useless if the learner doesn't do something different afterwards. While some learning experiences are "learning for the sake of learning," I won't really address those in this book. (Disclaimer: I work with adult learners, usually in a professional setting, so while the book will address examples from multiple contexts, the majority will relate to adult learning experiences.)

For me, the goal of good learning design is for learners to emerge from the learning experience with new or improved capabilities that they can take back to the real world, that help them do the things they need or want to do. If your learners are on a journey from novice to expert, how can you help them along that path?



This book looks at some of the things involved in designing great learning experiences:

Chapter 1: Where Do We Start?
If learning is a journey, what's the route like for your learners, and what's the gap between where they are and where they need to be? Sometimes that gap is knowledge, but just as often the gap can be skills, motivation, or environment. Learn how to identify each of these.

Chapter 2: Who Are Your Learners?
Your learners see the world differently than you do, and to design effective learning experiences, you need to understand their view of the world.

Chapter 3: What's The Goal?
The best learning experiences are designed with a clear destination in mind, but sometimes a clear destination can be harder to pin down than it seems. Learn how to determine your destination with accuracy.

Chapter 4: How Do We Remember?
Learn about how the brain works to focus on and retain information.

Chapter 5: How Do You Get Their Attention?
The first prerequisite for learning is to get your learners' attention. Learn strategies for getting past the distractions and helping your learners to focus.

Chapter 6: Design for Knowledge
The most common type of learning experience focuses on teaching knowledge. Learn strategies to make this as effective as possible.

Chapter 7: Design for Skills
If you ask the question "Is it reasonable to think that some can be proficient without practice?" and the answer is "No," then you aren't teaching information, you are teaching a skill, and skills require practice. Learn strategies for helping your learners get the practice they need to develop skills.

Chapter 8: Design for Motivation
If you've ever heard a learner say the words "I know, but..." then you are probably not dealing with a knowledge gap, but rather a motivational one. Learn strategies for getting your learners not only to learn more, but also to do more.

Chapter 9: Design for Environment
We can get people to hold more information in their heads, or alternately, we can learn better ways to make information available to them in their environment, so they can get it when they need it.

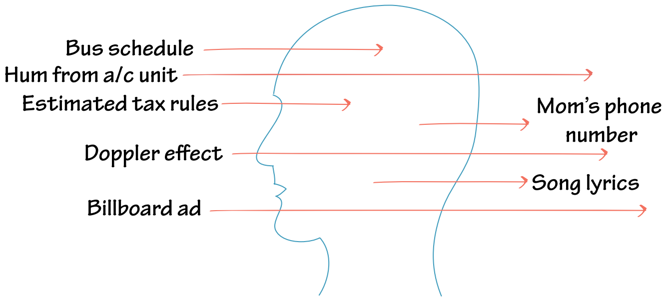
Chapter 10: Conclusion

4

HOW DO WE REMEMBER?

(In which we learn that memory is messy and that biking straight uphill isn't a good way to learn)

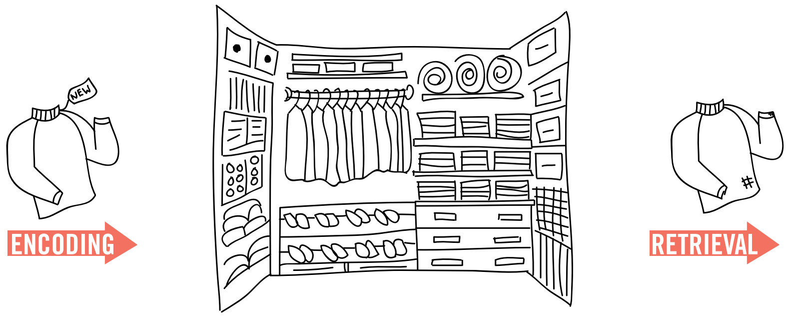
Memory is the foundation of learning, so let's take a few pages to talk about how learners actually learn and remember stuff. How does all that knowledge get in there on any given day? And how do we find and retrieve it when we need it?



There's a lot we still don't know about the nature of memory, but we do have some ideas and models for how it works. First, we'll look at how we pay attention and encode information into memory. Second, we'll look at different types of memory.

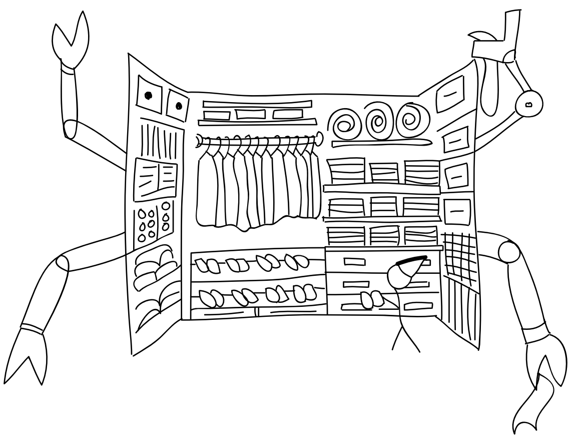
MEMORY IN & OUT

Successful learning involves encoding and retrieval—memory in and memory out. Remembering is a necessary first step, but you need to be able to retrieve, manipulate, combine, and innovate with the information you remember.



Information in your brain doesn't just sit there like a wool sweater during summertime. When you put information in, it doesn't lie passively waiting to be taken out, but instead it interacts with other information. So your brain isn't *really* a closet.

In order for your brain to be like a closet, it would have to be a super-automated closet that reorganizes itself constantly, or one that's populated by some kind of closet elves who are continually moving and arranging things.

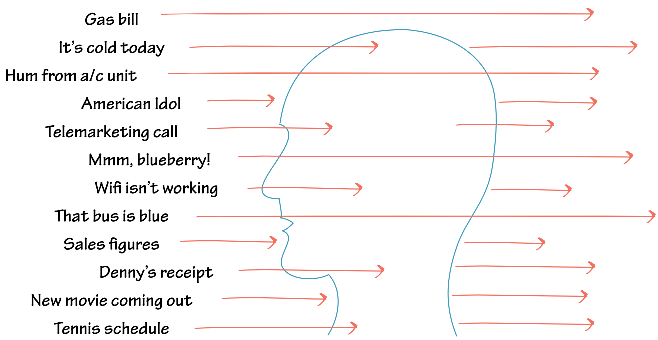


Also, anything you put in your closet automatically gets stored in multiple categories, so the blue socks your grandmother knitted for you would simultaneously (and magically) be put with things that are wool, things that are blue, socks, outfits that go with those socks, stuff from grandma, things that are starting to wear out, and so on.

What's more, the self-organizing closet has multiple, overlapping ways to keep track of things. So when you put away those blue socks in the "socks" drawer, the closet can retrieve them by looking on the "things that are wool" shelf, or on the "things that are blue" hanger.

Your brain is a dynamic, multi-faceted, constantly changing entity. Anything you retain from this book will change the physical structure of your brain by creating new connections and strengthening (or weakening) existing connections.

So what winds up sticking? We are bombarded with millions and millions of data points all day long. We can't possibly attend to—much less remember—all of them.



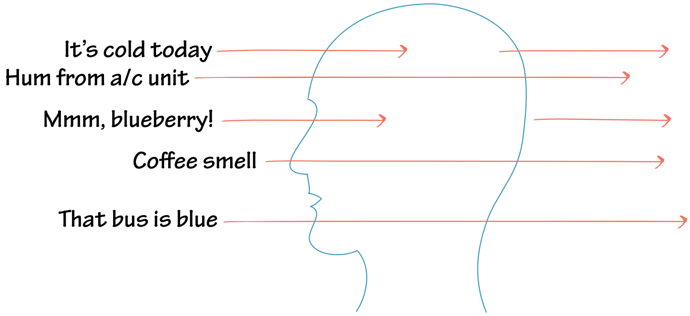
Fortunately, you have a series of filters and triggers that allows you to parse this information:

- **Sensory memory.** This type of memory is your first filter of everything you sense and perceive. If you choose to pay attention to something, it gets passed on to short-term memory.
- **Short-term memory.** This is the memory that allows you to hold on to ideas or thoughts long enough to take action. Most things get discarded out of short-term memory, but some things get encoded into long-term memory.
- **Long-term memory.** This is your closet, where you store information that you'll keep for a while.

Let's take a closer look at each of these.

SENSORY MEMORY

The first level of memory is sensory memory. Basically pretty much anything you sense is held momentarily in your sensory memory.



Most sensations keep right on going, unless there's something unusual or noteworthy about what you are sensing.

For example, stop right now and pay attention to all the noises you can hear. If you are indoors, you are likely hearing the hum of an air conditioning or heating unit, or noise from appliances or computers. If you are outside, there will be environmental noises depending on your location.

Unless someone or something calls your attention to one of these, you probably weren't paying attention to those noises, and you were certainly not encoding those noises into your memory.

HABITUATION

Sensory memory isn't a big concern for learning designers, except for the phenomena of habituation. Habituation means getting used to a sensory stimulus, to the point that we no longer notice or respond to it.

Habituation is what allows you to stop noticing the annoying refrigerator buzz after you've been listening to it for a while, or when you stop even noticing that "check engine" light on the dashboard when it's been on for weeks.

If things are unpredictable, they can be harder to habituate to. For example, the horrible torment of a flickering fluorescent light persists long after you've stopped hearing the hum from the computer monitor, because the unpredictable pattern of the flicker keeps calling our attention to it over and over and over...

Similarly, being stuck in traffic stays infuriating because it's rarely uniform (start… stop…start…little faster…STOP…go…go go …Go…GOGOGOGO… *Stoooop*!).

People can also habituate to things that we don't necessarily want them to. For example, when was the last time you paid much attention to the advertisements in the banner at the top of web pages? You've probably learned how to tune those out. Web designers refer to that as "banner blindness," and eye-tracking studies (Nielsen 2007) verify that people not only don't pay much attention to banner ads, they frequently don't look at them at all. (The same thing can happen with resource and reference material we provide for learners on websites and in e-learning courses!)

IMPLICATIONS FOR LEARNING DESIGN

Consistency can be useful. Consistency can be a useful tool to make things easier for your learner. For example, if you use the same basic format for each chapter of a technical manual, your learners get used to the format and don't have to expend mental energy repeatedly orienting themselves to the format; instead, they can focus on the *content* of the chapters.

Too much consistency is bad. However, too much consistency can lead to habituation in your learners. You want to vary your teaching methods and the way you present information. For example, if you are creating an e-learning program and you give the same type of feedback in the same location every single time, then learners are going to learn to ignore it, particularly if the feedback is the generic "Good Job!" kind. Another example of too much consistency is the "banner blindness" mentioned above.

Annoying variability is bad, too. While some variation is useful for keeping the learner's attention, meaningless differences are just irritating. For example, if you take that e-learning feedback box and have it randomly pop up in different areas of the screen, it will probably keep the learner from habituating to it as quickly, but it's also going to really annoy them. A better approach would be to have different feedback formats that are appropriate to the different types of content you are presenting, or to use a variety of different learning activities to keep things interesting. Variation can be a useful tool for maintaining attention, but it should be used in a deliberate and meaningful way.

The best way to know if something is too consistent is through user testing. Watch your learners interact with print or electronic materials, or pilot test a class—if your learners are inattentive or seem to obviously ignore resource materials, that's a clue that they've start to gloss past those elements.

SHORT-TERM OR WORKING MEMORY

Once something has attracted your attention, it moves into your short-term or working memory. If it succeeds in penetrating your short-term memory, it's probably something that:

- Is significant to you for some reason
- You are looking for
- You need to take action on
- Surprises or confounds your expectations

Working memory has a relatively short duration and limited capacity, but you use it pretty much constantly throughout the day.

WHAT DO YOU RETAIN?

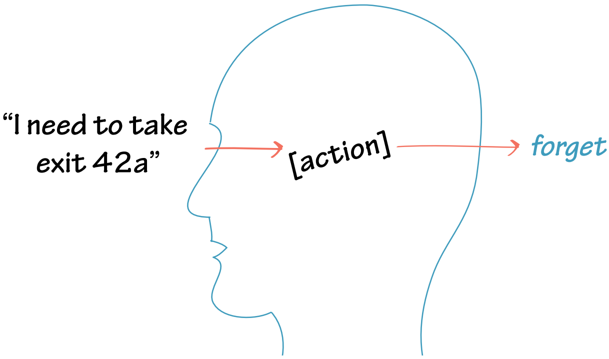
For example, let's say you are deciding what to wear to work today. You glance at the weather (cool and rainy), and at your schedule (client meeting). You hold those two things in working memory while you check your closet. You also retrieve some information from long-term memory (the conference room is always hot; the black suit is at the cleaners because of that unfortunate guacamole stain).

New information in working memory	Pulled from long-term memory
Cool and rainy weather	Conference room is always hot
Client meeting	Black suit is at the cleaners

All this information gets processed together as you make the decision to wear layers.

Working memory will discard most pieces of information as soon as you're done with them, like the wifi password at the coffee shop, the number of the freeway exit you need to take, or the phone number that you recite over and over until you can get it dialed.

All of those types of information are the kind of thing that you might keep in working memory for the few seconds that you will need it. If it takes you longer, you might also keep it there via repetition.



Repetition will refresh the information in working memory until you use it and stop repeating. If you repeat something long enough, you will eventually grind it into long-term memory, but that's not the most efficient method (we'll discuss better methods later). Some information will drop out more quickly if it doesn't have significance.

Let's take a look at the following three pieces of information you might hear in the morning news radio report.

Information: *The temperature is 12 degrees Celsius.*

Factors that influence retention:

- *Is it unusual? If it's significantly different than the weather for the last few days, it's more likely to catch your attention.*
- *Is it important to you? You'll retain it better if the weather affects your plans for the day.*
- *Is it a familiar format? If you ordinarily use Fahrenheit, you're unlikely to remember the Celsius temperature, because you won't know if it means you should wear your coat.*

If you do remember it for the length of the day, it's still unlikely you'll continue to remember it days or weeks later, unless there was something significant about the date (e.g., your brother's wedding day).

Information: *The Dow Jones industrial average is up 56 points, or 0.5 percent, to 11,781.*

Factors that influence retention: *The same issues apply. Does this contrast with previous days or expectations? Is this significant to you because you work with the financial markets, or are waiting to sell some stock?*

Information: *UConn Huskies lost to the Stanford Cardinals 71-59.*

Factors that influence retention: *You are likely to retain this information only if you follow US Women's college basketball, or if you know that this was the first game the UConn team had lost after setting the record for the most consecutive games won (89 in a row). If you don't have that context, you probably won't retain any part of that information.*

WHAT'S THE LIMIT?

How much can you hold in working memory? There is a fair amount of research on the limits of working memory, and there's a well-known statistic about 7±2 items in working memory, but the real answer is *it depends*. (Miller 1956)

In all likelihood, you can't repeat all the data from the previous table (the temperature, the Dow Jones numbers, and the sports scores) without going back and checking it again. The main reason you can't is because those numbers have no significance for you, beyond being an example in this book.

An additional reason would be the quantity of information—there were several discrete facts in that table (12°, Celsius, Dow Jones, 56 points, 0.5%, 11, 781, UConn Huskies, Stanford Cardinal, 71, 59). That's more pieces of individual information than most people can remember without some kind of memory aid or device.

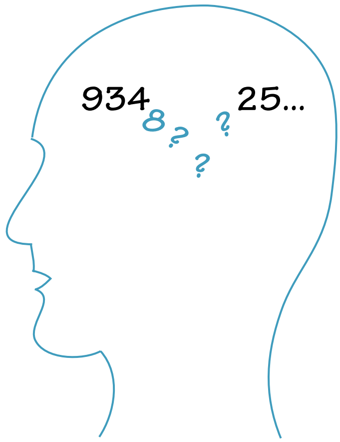
Read this number, and then close your eyes and try to repeat it:

6 7 1 8

How'd you do? In all likelihood you did pretty well at retaining that briefly. Four discrete digits is usually well within the limits of working memory.

Now try this number:

9 3 4 8 7 1 6 2 5



That one is a little harder, right? Maybe you were able to retain all nine digits, but if you dropped some digits they were likely to be somewhere in the middle of the string of numbers. That would be an example of primacy and recency effects, which suggest we are more likely to remember something at the beginning of a sequence or list (primacy) and also more likely to remember the most recent things, as at the end of a list (recency).

OK, now try this one:

100 500 800

That's a whole lot easier, right? It's the same number of digits, but it's *chunked*. Instead of remembering individual digits, you are remembering something like this:

[first three digits] + [next three digits] + [last three digits]

This is three chunks of information, rather than nine separate chunks of information.

Even easier is:

1 2 3 4 5 6 7 8 9

Because you already know how to count to nine, this is just one chunk of information for you:

[digits 1–9 in order]

Chunking can be based on things that are similar, sequential, or items that are in your long-term memory.

For example, try this number:

6 1 2 6 5 1 7 6 3 9 5 2

In all likelihood, this is too much information for you to retain in working memory, unless you live in the Minneapolis / St. Paul area, where these are the local telephone area codes.

WHAT DOES THIS MEAN FOR LEARNING DESIGN?

Who memorizes strings of numbers anymore? Doesn't everybody have a cell phone?

We are fortunate to have devices we can use to offload tedious details, and most people don't have any need to remember random strings of numbers (which is a good thing, because humans mostly suck at that particular task, while electronic devices are brilliant at it).

But using chunking in learning—whether it involves large numbers or large amounts of textual or perhaps even visual information—will help your learners manage their working memory, and help them understand where to focus their limited attention at any given point.

Let's say you are teaching somebody a procedure—for example, how to bake an apple pie. Take a look at this list of steps:

Mix together the flour and the salt.

Chill the butter and water.

Add the butter to the flour and cut it with a pastry blender until it resembles coarse crumbs.

Add enough water until the dough barely hangs together.

Cut the dough in half and make two balls.

Wrap the dough in plastic wrap and refrigerate.

Peel the apples.

Core and quarter the apples and cut into 1/4″ slices.

Mix the apples with sugar, lemon juice, cinnamon, and a small amount of flour.

Roll out one of the pieces of pie dough into a circle slightly larger than your pie pan.

Fold the pie dough in half and lift it into the pie pan.

Press the dough into the pan.

Fill the pie dough with the apple mixture.

Roll the other piece of dough into a circle.

Place the dough on top of the pie and crimp the edges.

Cut steam holes in the top crust.

Bake the pie for 45 min in a 350° oven.

That's a lot of steps, right? A bit much for someone to process. If they know a lot about baking, they'll be able to parse that information in a way that makes sense, but if the learner doesn't have a lot of context for pie-making, then this list is likely to overwhelm them quickly.

There's no cue to tell them when to stop reading the new information for a moment, and process the existing information. There's also no higher-level organization for the material—it's just a long list of steps. Which is why you want to look for opportunities to chunk that information:

Prepare the dough

Mix together the flour and the salt.

Chill the butter and water.

Add the butter to the flour and cut it with a pastry blender until it resembles coarse crumbs.

Add enough water until the dough barely hangs together.

Cut the dough in half and make two balls.

Wrap the dough in plastic wrap and refrigerate.

Prepare the filling

Peel the apples.

Core and quarter the apples and cut into 1/4″ slices.

Mix the apples with sugar, lemon juice, cinnamon, and a small amount of flour.

Assemble the pie

Roll out one of the pieces of pie dough into a circle slightly larger than your pie pan.

Fold the pie dough in half and lift it into the pie pan.

Press the dough into the pan.

Fill the pie dough with the apple mixture.

Roll the other piece of dough into a circle.

Place the dough on top of the pie and crimp the edges.

Bake the pie

Cut steam holes in the top crust.

Bake the pie for 45 min in a 350° oven.

Even just chunking the steps into four categories makes the whole procedure much easier for people to process and remember. Chunking isn't magically going to allow the learner to remember the whole recipe, but it will help them to focus on a single section at any one time, and the steps in an individual chunk are a more realistic quantity of information to hold in working memory.

Working memory acts as a gatekeeper for long-term memory, so if the initial information overloads working memory, it's unlikely to make the transition to long-term memory.

LONG-TERM MEMORY, OR IS IT IN YOUR CLOSET?

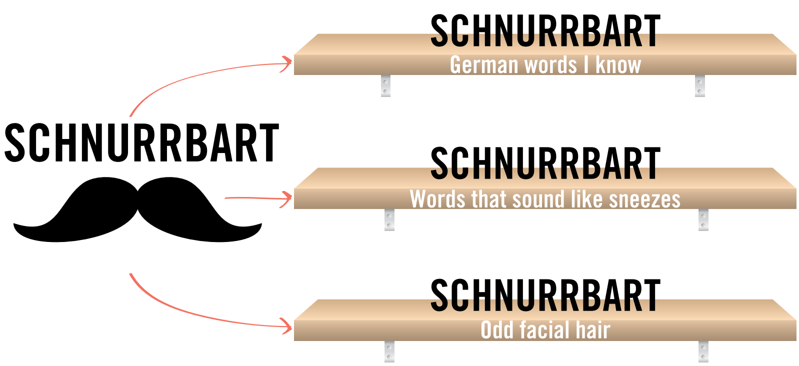
Ultimately, when we are teaching or learning something, what we really want is for the information to reach long-term memory—firmly situated in the closet, in a place where we can find it again easily.

WHERE DO YOU PUT IT?

Anything that you do remember becomes part of a series of associations—you don't learn anything in isolation.

For example, say you've just learned that the German word for *mustache* is *Schnurrbart*. Now, in all likelihood, you don't care about this information, and you will let it wash out of your short-term memory without a ripple.

But suppose there is some reason you need to retain this information (a German vocabulary test, a fascination with words that sound like sneezes, an interest in European facial hair trends). How will you encode it? Well, of course, that depends on the shape of your closet, and the types of shelves that you have for that information. Fortunately, you don't have to choose a single association—you can store this item on all of those shelves simultaneously.



More (and better) associations will make it easier to retrieve the information. If you don't have a good shelving system for this word, you can create a mnemonic for it (tell yourself a story about sitting across from a German man with an elaborate mustache while riding the Bay Area Rapid Transit (BART) system, for example).

If you already speak German, you probably wouldn't need a mnemonic, as you'd already have a much more sophisticated shelving system for this word, involving the root meanings of the parts of the word ("bart" means beard in German), or other associations.

Your ability to retrieve information depends on the condition and contents of the shelves it's stored on in your mental closet.

MULTIPLE SHELVES

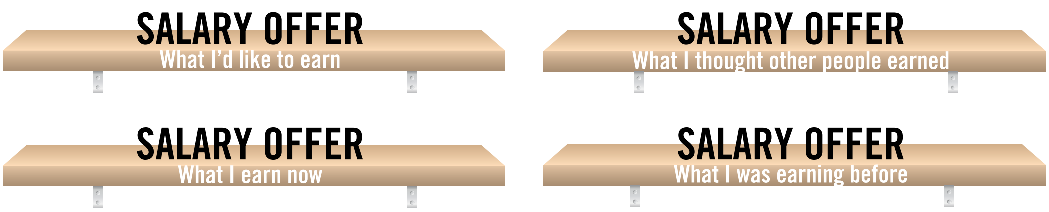
The more ways you have to find a piece of information, the easier it is to retrieve, so an item that goes on only one or two shelves is going to be harder to retrieve than an item that goes on many shelves.

For example, let's take two five-digit numbers: My mother's zip code and the salary offer I had for my first job after graduate school.

I don't have many shelves for the first number:

I don't use this number very often, and I don't have very many ways to access the information (I either remember it or I don't). In fact, these days I don't actually remember it, and have to get it from one of the external resources I use to supplement my memory (like an address book or a contact file on my phone). Basically, I have only one place to look for that number, and if that doesn't work, I don't have any other way to retrieve that information.

The salary offer, however, was a number with a lot more significance (sorry, Mom), and could be put on quite a few more shelves.



As a result, I have multiple ways to access that information. I know it was almost twice what I was making before I went to graduate school, it was 10% less than a friend of mine made with the same degree (she was a much better negotiator), and I know how it compares to my current salary.

The more shelves you can put an item on, the more likely that you'll be able to retrieve it in the future. This is the problem with pure memorization tasks, such as flash cards—things you've learned that way tend to be on only one shelf (the "things you've memorized" shelf), which makes them harder to retrieve.

POORLY CONSTRUCTED SHELVES

Some of my shelves are pretty weak, and allow information to slip through. For example, I was trying to learn some Japanese before a trip a few years ago. Instead of a sturdy wooden shelf, my shelf for Japanese vocabulary was more like a rickety wire rack—I would carefully balance a few words and phrases there, but they'd frequently slip through, and I wouldn't find them when I went back to retrieve something.

Part of the reason my shelf for Japanese was so rickety was because I had so little context for Japanese. If I was trying to learn Spanish, I would have a sturdier shelf for that language despite being a novice it. My Spanish shelf would be strengthened by all the context I have for Spanish (things like similar Latin roots to some words in English, a close relationship to Italian, which I do know a little, and years of watching Spanish language vocabulary cartoons on Sesame Street as a child).

CROWDED SHELVES

A shelf that is crowded may not be specific enough. That can happen when you have a lot of information but not a very sophisticated structure for organizing that information. It makes it much more difficult to retrieve items accurately.

For example, my shelf for jazz music is pretty crowded—not because I know a lot about jazz (I don't), but rather because everything I do know about jazz—a specific artist name, that one piece that always makes me smile, the time period in which a certain style of jazz was born—all pretty much gets crammed on a single shelf labeled "Jazz." This means I have a really hard time retrieving specific information about jazz.

My shelves for '80s popular music, on the other hand, are embarrassingly well-developed. There are shelves for different genres, for American groups, British groups, hair bands, Americana, MTV, music videos, stuff I owned on LP, stuff I owned on cassette, bands I saw in concert, and so on (too bad you can't just deliberately choose to "unlearn" things).

UNINTENDED SHELVES

Sometimes associations are unintended. For example, a few years ago I was in Washington DC, staying a few blocks away from the Fannie Mae building while the mortgage association was being heavily discussed in the news. There was a lush bed of lavender plants in front of the building, and you couldn't walk by without smelling lavender.

Now, the Federal National Mortgage Association is forever on my lavender shelf (and vice versa).

This happens far more often than we realize. Our brain creates numerous associations that we may or may not be aware of, utilizing all our senses (sight, sound, touch, taste, and smell).

While these associations are somewhat random, they are still part of the associations we use to retrieve information. Let's take a look at how those associations can actually be used.

IN-CONTEXT LEARNING

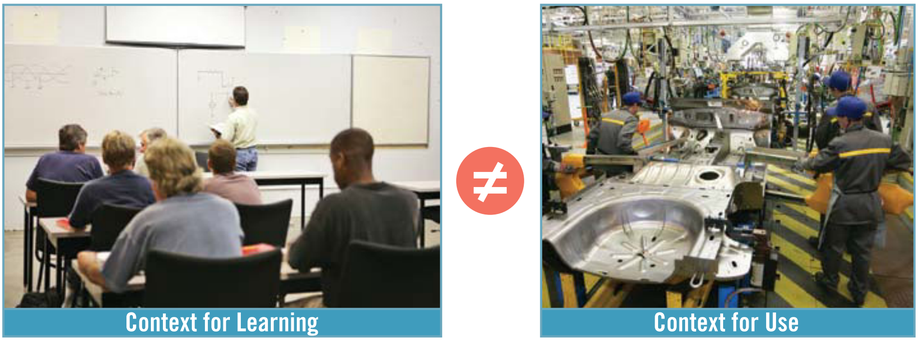
Pop quiz: You're taking a class at the local university and have an in-class exam the next week. Where is the best place to study for a test?

A. Outside under a tree in peaceful sunshine
B. In your grey windowless classroom with a noisy air conditioning system
C. In a quiet, well-lit library
D. In a noisy coffee shop

The answer may be surprising: it's B, the grey windowless classroom. Yes, the one with the noisy air conditioning system. Why? Because the environment in which you study will become part of your association with the material you are studying. When possible, you want to encode the information in the same type of environment where you will also be retrieving that information.

The same is true for information that needs to be retrieved in a particular context, such as on the job. The further the learning is from the context of use, the fewer shelves are being utilized to store the information.

The context of the classroom is only helping you remember if you need to retrieve that information in a classroom. But we learn all sorts of information in classrooms that we need to apply later. Topics like plumbing and journalism and geology and hazardous materials handling are all taught in environments that are very different from the environments where those subjects will be used.



We have a tendency to hold classes in bare rooms far away from the place that use is going to happen, and that is a disservice to learners.

Deep down, we know this is true. Whenever lives are at stake, training almost always involves in-context learning. Even if the context is simulated—for the safety of the students or those around them—it's a rich, realistic context. Examples of in-context learning include flight simulators, teaching hospitals, and actual driving practice during driver's education.

If possible, you want to encode the information in the same type of environment where you will also be retrieving that information.

Isn't it inconceivable that drivers' education wouldn't involve actually road time? We wouldn't ever think someone could be a safe driver until they had actual experience driving in real traffic. Eventually simulators may be good enough and cheap enough to replace road practice, but for now, we take it for granted that learning to drive involves practice in the real context.

So why is out-of-context training acceptable in other circumstances? Frequently, it's a matter of convenience or cost or practicality. These can be very real constraints. For example, it might be nice to teach a server administration class in your actual server room, but you just can't get 30 people into a room the size of a large closet.

When practical constraints require that the learning can't happen in the physical space, there are still ways to increase the context. For example, if the class is about the physical setup of computer servers, it should involve hands-on contact with the equipment, even if it can't take place in the server room.

Many times, though, learning happens in an out-of-context environment like a bare, featureless classroom because of habit, tradition, or lack of awareness.

There are a variety of ways to make learning more in-context, despite practical constraints.

Think about ways you might improve or increase the context for learning experiences in the following scenarios:

Scenario 1: You need to teach consumers about the features of a new cell phone.

How would you make this a high-context experience? Consider how you might do it before reading the answer below.

> **Some possible design solutions →** Ideally, the learner would be interacting with those features on the actual phone as part of the learning experience, and would be trying them out. Additionally, anything that could be done to make the features part of actual use scenarios tailored to the audience would enhance context. So the learning experience would be real tasks that someone would do (texting a friend, entering a work contact), rather than just a guided tour of the features.

Scenario 2: You've been given the task of teaching college students how to make nutritionally balanced meals. What can you do to increase the context for this learning experience?

> **Some possible design solutions →** The learning experience should match the final setting as much as possible, which could mean operating in a cruddy dorm kitchen, using cheap cooking equipment from the local chain store, and reflecting the actual food scenarios. Another option would be to use photos of actual student refrigerators and challenge your learners to identify ways to make a healthy meal from the contents.

Scenario 3: You are creating a course to teach fast-food restaurant managers how to give employees constructive feedback. How would you make this learning experience high context?

> **Some possible design solutions →** Consider in what setting the feedback would take place, and use role-playing to practice. You could have managers create triggers for themselves by doing a mental tour of the restaurant, and thinking about what behaviors they would praise at each station. They could create a checklist for themselves of what to look for, where to look for it, and what to do if they see it.

EMOTIONAL CONTEXT

One of the most difficult types of context to create for learning situations is emotional context.

Let's take the employee feedback example. Let's say you are in a class with other students, and you are learning the principles of giving difficult feedback. What's the mood like in the classroom? Everybody is probably calm, nobody is upset. People are being serious and thoughtful as befits a classroom environment.

Now, think about the environment when you have to use what you learned. There's a good chance you are nervous, maybe anxious. The person you are talking to is probably unhappy, upset, or even hostile.

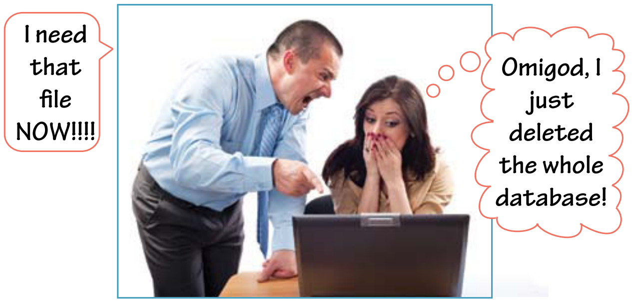
In this instance, the emotional context while learning about the material and then while applying it are very different. Many things seem reasonable when we are learning about them, like, when dealing with a hostile employee, staying calm, using "I" statements, validating the other person's point of view, etc.

But then you are actually confronted with a really angry person, and all that good advice flies out of your head, and fight-or-flight reactions surge to the front and you couldn't compose a validating "I" statement if your life depended on it.

We may be prepared with the knowledge and the protocols, but unable to implement them in the unfamiliar emotional context.

I believe this is why a lot of learning fails. Have you ever said to yourself "I *knew* the right thing to do, but..." The difference between knowing and doing can be a huge gap when the context of encoding and the context of retrieval are significantly different.

There are many things we learn where the emotional context for use is drastically different than the emotional context for learning. We can be trying to retrieve the information when we are in a stressed or otherwise heightened emotional state:



Stressful or emotionally heightened circumstances can cause us to rely less on our intellectual knowledge and more on our automatic responses. This makes it more difficult to transfer something learned in a placid emotional context to a fraught emotional context.

So how can you create proper and effective emotional contexts? There are several ways:

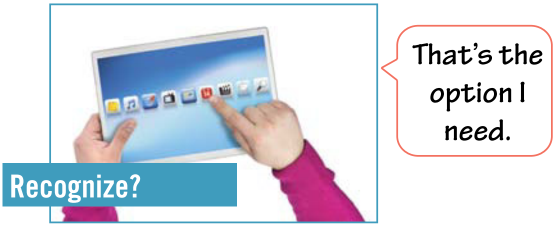
Use role-playing. Even though we know it's not real, role-playing can be an effective way to create the feel of the emotional context, especially if you have someone effective playing the part. Even though it won't be exactly the same, just having practiced saying the words out loud make them easier to recall in real-life situations.

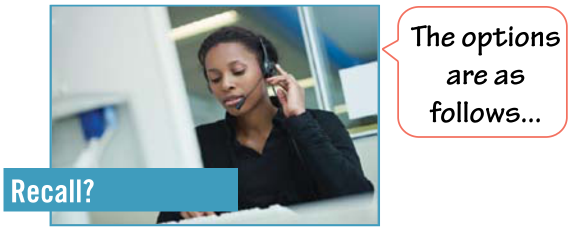
Create pressure. Even if the pressure is different, sometimes adding elements of similar pressure can create similar feelings. For example, a tight time limit on responses can create time pressure, which can approximate the emotional context of other types of pressure.

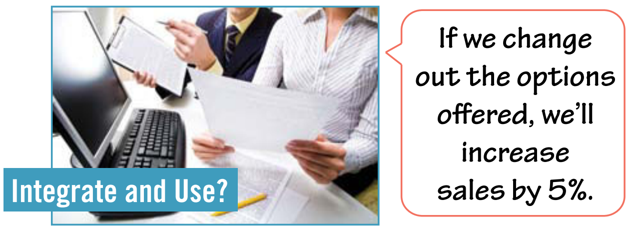
Invest in high-quality stories, acting, and performance. If it's critical material, get good actors or voice actors, and establish a strong emotional setup.

ENCODING FOR RETRIEVAL, OR HOW WILL IT NEED TO BE USED?

One of the things you will also want to consider is how the information will need to be used when it's retrieved. Will the learners only need to recognize the information, will they need to recall it outright, or will they need to be able to use it to actually do something?







You want the information encoding to align with assessment and use.

If someone is just going to need to recognize the right answer, then recognition activities are good ways to learn and practice. If someone needs to recall something unprompted, then they will need to learn and practice by recalling, not just by recognizing.

Which question is easier to answer?

Question 1: The French word for pool is __________. (fill in the blank)

Question 2: The French word for pool is:

a) Roman b) Piscine c) Plage d) Plume

The second question is easier, right? *Recognizing* the right answer from a set of options almost always involves less effort than *recalling* the answer.

Learning experiences frequently rely heavily on recognition activities such as multiple-choice questions. This is particularly true in e-learning, where the computer is used to evaluate the correctness of student answers. This is primarily a practical choice. Recognition activities are easier to grade—computers can do it for us. Recall activities usually require a person to evaluate.

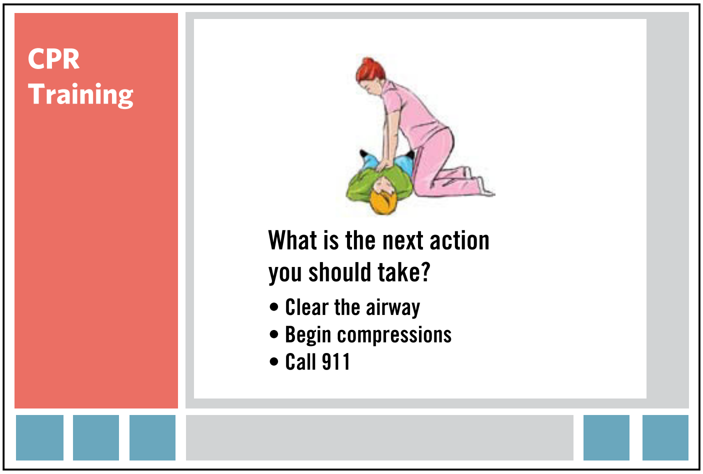
A PRACTICAL EXAMPLE

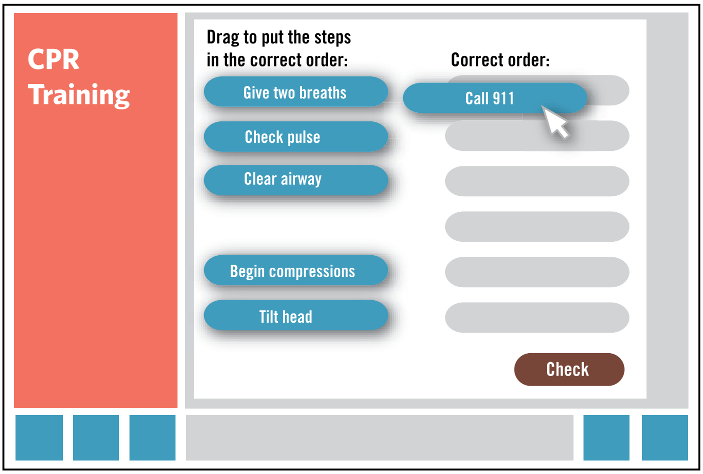
Look at the examples on the facing page for practicing and assessing a learner's CPR proficiency. Are they good examples? Why or why not? Stop and decide which one is the best before reading further.

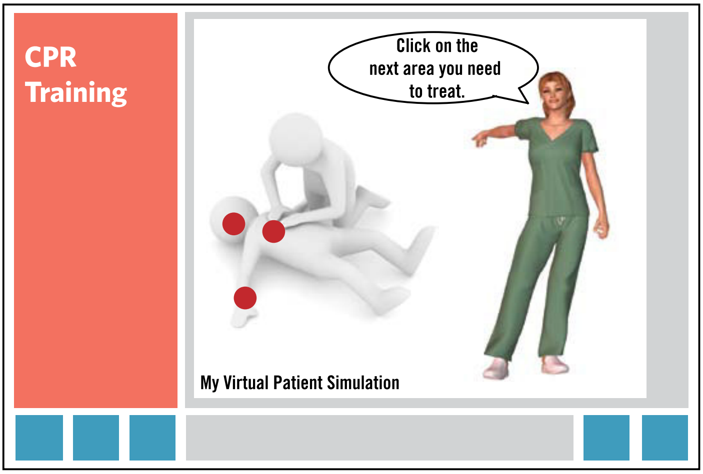
CPR requires *recall*—remembering the right steps and how to do them properly. None of the activities you see here are really recall activities. They are mostly recognition activities.

The simulation comes the closest, but you can still simply guess. Also, the context is problematic—it's very different to click on the virtual chest of a patient on a computer screen rather than to apply pressure to an actual patient.

These learning activities might be *part* of a good learning experience, but they don't actually allow the learner to practice recalling the steps in the way that they will need to in a real-life situation.

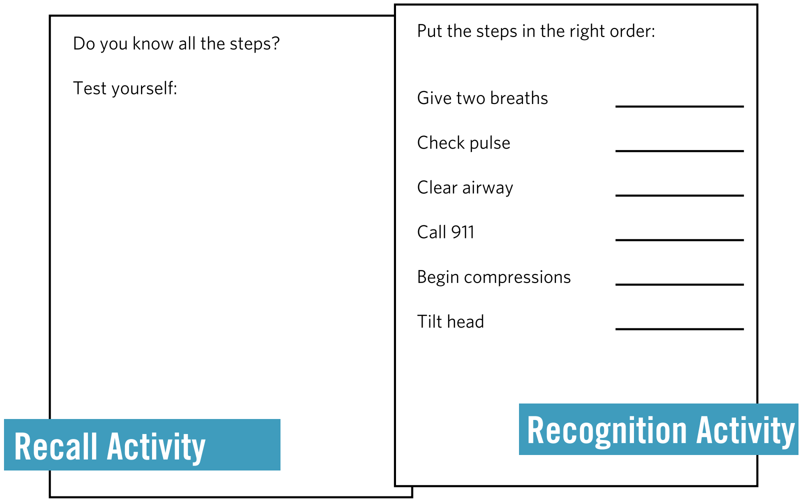

CPR
Training
What is the next action
you should take?
• Clear the airway
• Begin compressions
• Call 911


CPR
Training
Drag to put the steps
in the correct order:
Correct order:
Give two breaths
Call 911
Check pulse
Clear airway
Begin compressions
Tilt head
Check


CPR
Training
Click on the
next area you need
to treat.
My Virtual Patient Simulation

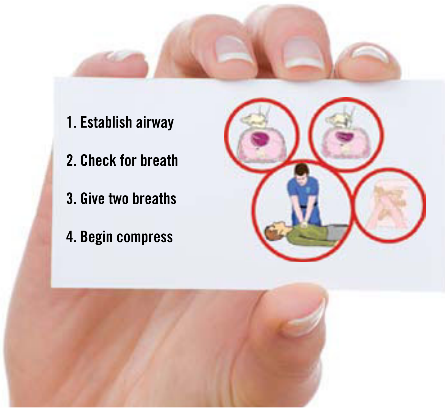
So how can you create learning activities that are a better match for the real-world application?

- Ensure that the practice involves recall or application.



- Ensure that the practice and assessment are high-context.

- Use job aids to change something from a recall to a recognition task. Job aids change the task from "recall the steps" to "follow these steps," reducing the need to rely on memory. If you do use job aids, give your learners a chance to practice with the job aid as part of the learning. We'll talk more about this in later chapters.

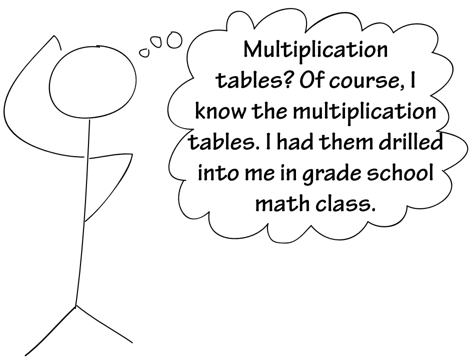


In the end, the practice needs to match the eventual use. If the learner just needs enough familiarity to recognize the right option, then practicing with recognition activities will be sufficient. If the learner needs to recall the material, or to do something more sophisticated like integrate the material, then the practice activities need to reflect that eventual use.

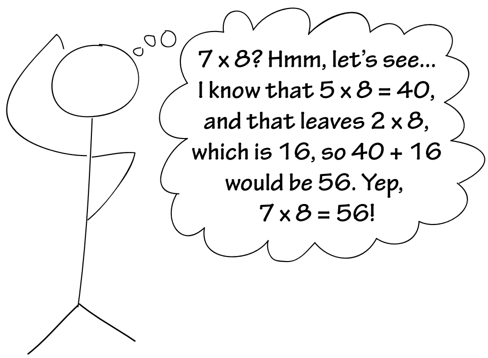
REAL VS PERCEIVED KNOWLEDGE

Frequently we think we know something because we recognize it—we *think* we know more than we actually *do* know.

What I think I know:



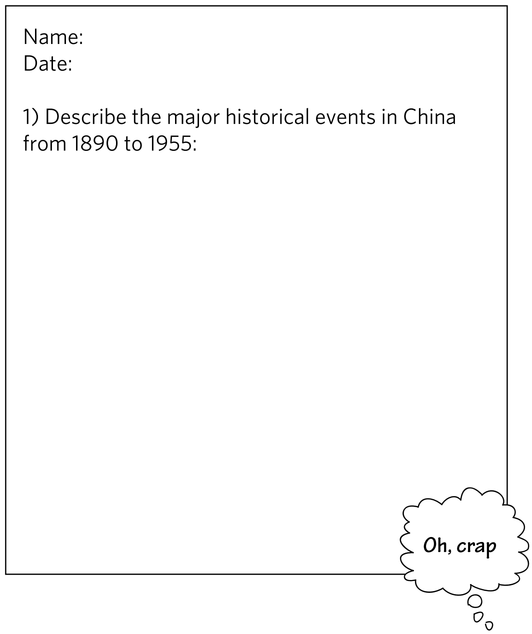
What I actually know:



So my conviction that I know the multiplication tables is a little suspect. I apparently know some parts of the multiplication tables, and I know some strategies for extending that knowledge (which is fortunate, because I would apparently be multiplication-illiterate without those strategies).

Let's say you are studying for an exam. You are chewing your pencil, reading your textbook, and nodding—it all looks pretty familiar. You've been studying like that for a while, and you are feeling pretty good about the whole thing.

Then you get to class, and you see this:



Recognition knowledge—the kind that might have gotten you through a multiple-choice test—is suddenly inadequate in the face of a mostly blank sheet of paper.

If you want to eventually retrieve information from your memory, you need to *practice* retrieving it when you study. (Karpicke 2011)

When you are teaching, you need to make sure that your learning activities allow your learners to practice in the same way that they will need to perform.

TYPES OF MEMORY

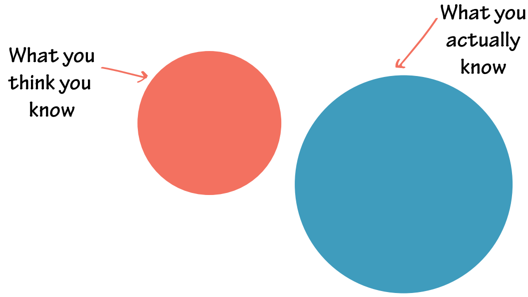
So far, we've been talking generally about the way a stimulus gets encoded into long-term memory, but there isn't just one general type of memory. There are actually several different types of memory that are encoded and retrieved in distinct ways. Some types of memory will be more appropriate to focus on depending on your subject matter, and learning design can often benefit from taking advantage of different types of memory.

There's a well-known story in psychology about an amnesia patient who did not have the ability to form new explicit memories. Her doctor had to reintroduce himself to her every time they met, because she couldn't remember him from day to day.

One day, as an experiment, the doctor hid a small sharp object in his hand when he shook the patient's hand in greeting.

When he followed up with her later, she had no explicit memory of meeting him, and needed to be introduced to him yet again, but when he offered his hand, she didn't want to shake it, even though, when asked, she couldn't give any reason for her reluctance.

This suggests that memories are processed in different ways, and that people are not consciously aware of all their memories.



What you know you know—The overlapping area (above) is your explicit memory. You know it and you know you know it, and can talk about it, if needed.

What you don't know you know—The rest of the blue area is your *tacit* memory. You know it, but couldn't describe it in any detail, or talk about it in a meaningful way. Sometimes it is things you forgot you knew, and other times it is things that are encoded in memory without your conscious awareness. You don't need to be an amnesiac to have tacit knowledge.

What you only *think* you know—The yellow area is made up of things you only think you know, but when you try to use those bits, your knowledge is incomplete or reconstructed incorrectly. Everybody has this—it's part of the messy human cognition process.

Within these categories, there are many different types of memory. While we are still very much in the process of understanding how different types of memory work in the brain, some of the types of memory include:

- **Declarative or semantic memory.** This is stuff you can talk about—facts, principles or ideas, like WWII ending in 1945, or your zip code.
- **Episodic memory.** This is also a form of declarative memory, but it's specific to stories or recollections from your own experience, like what happened at your graduation, or when you started your first job.
- **Conditioned memory.** Like Pavlov's dog, we all have conditioned reactions to certain triggers, whether we realize it or not, like when a pet gets excited about the sound of the can opener which precedes getting fed.
- **Procedural memory.** This is memory for how to perform procedures, like driving a car or playing the piano.
- **Flashbulb memories.** We seem to have a special type of memory for highly emotionally charged events, like national catastrophes.

Each of the different types of memory has different characteristics and different applications.

DECLARATIVE OR SEMANTIC MEMORY

Declarative memory is mostly the stuff you know you know, and can state explicitly, like facts, principles, or ideas.

Sometimes it's stuff you put into your closet deliberately (multiplication tables, for example), and sometimes it's material that you know despite not having made any conscious effort to retain (everything I know about Britney Spears, for example).

EPISODIC MEMORY

Episodic memory is also a form of declarative memory, in that you can talk about it, but it's related to specific events or experiences you've had.

For example, you may be able to remember a lot of things about dogs—they are pets, they have four legs, they are furry, they eat dog food, Scooby-doo is a dog, etc.

But you also probably have episodic memories about specific dogs that you've known—your childhood dog, the neighbor's dog, or the scary dog that followed you to school when you were little.

STORYTELLING

Episodic memory refers specifically to our memory for things that have happened to us in our lives, but even when a particular story didn't happen to us personally, we seem to have a singular ability to remember stories.

At the beginning of their book *Made to Stick*, Chip and Dan Heath compare two passages. The first is an urban legend (a man meets a woman in a bar and wakes up later in a bathtub full of ice with a kidney missing) and the second is a paragraph about the return-on-investment rationale for non-profit organizations (or something like that).

A few years after reading the book, I can still remember several salient details from the urban legend and nothing at all about the second passage. There are multiple reasons why that's the case, but a big part of it is because the first passage is a *story*.

There are a few reasons why stories seem to stick in our memories:

We have a framework for stories. There's a common framework for stories that we've all learned from the first stories we heard in childhood. Whether we realize it or not, in each culture there are common elements that we expect to hear when someone tells us a story. There's a beginning, middle, and end. There's the setup, the introduction of the players, and the environment. There's The Point of the story, which is usually pretty easy to recognize when it comes along. These are all shelves in our "how storytelling works" closet that give us places to store the information as we encounter it.

Stories are sequential. If I tell you 10 random facts about tennis, you need to expend mental energy trying to organize those facts somehow, possibly grouping like items or using some other strategy. If I tell you the story of a particularly gripping tennis match with 10 significant events, then the sequence of events provides a lot of the organization for you. Additionally, there's an internal logic to events in stories (logically, dropping the carton of eggs can't happen *before* the trip to the grocery store in the story of having a bad day).

Stories have characters. We have a lot of shelves to store information about people, their personalities, and their characteristics. If the story is about people we know, then we have all that background information to make remembering easier, and we have expectations about how they will behave. And if the character confounds your expectations by acting in a way that conflicts with your assumptions, that is surprising and novel and subsequently more memorable.

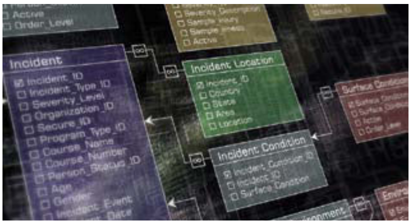
Which of the following would you be more interested in learning more about?

THIS? / **OR THIS?**

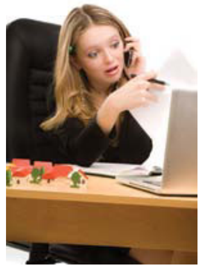
Insurance procedures

A story about Jim, a teen who was injured in a car accident, and how his family dealt with the aftermath

Steps to query a database



A story about Carla, the new employee who is the only one left in the office when the vice president calls down with an emergency request for updated reports



Human resources hiring best practices

A story about Marco, the replacement hiring manager in a company currently being sued for discriminatory hiring practices

CONDITIONED MEMORY

So you are cruising down the highway, and you glance in your rear view mirror and see a police car right behind you. Pop quiz—what do you do?

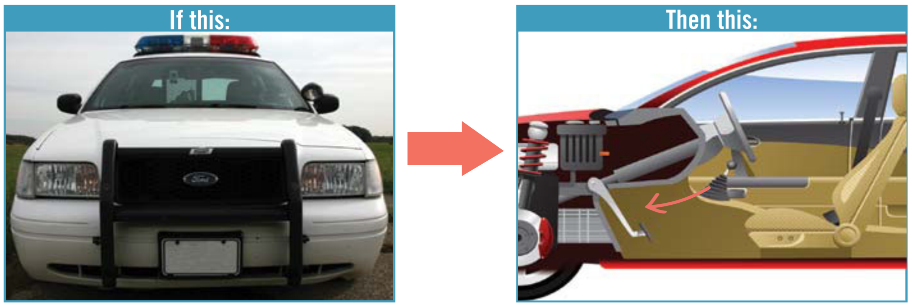
You slow down, right? Even if it becomes immediately apparent that the cop isn't the least bit interested in you, you've already dropped your speed, even if you weren't speeding in the first place.

What's happening there? Probably you didn't think to yourself, "Hmm, there seems to be a police officer behind me. Perhaps I should reduce my speed! I think I'll just gently let up on the gas pedal…easy does it…"

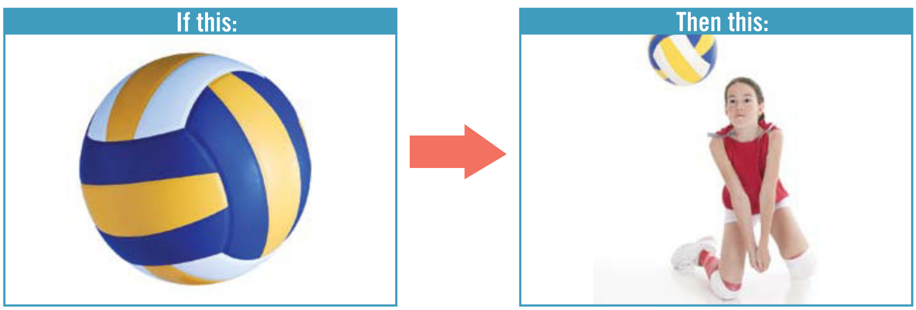
No, it was probably something more like, "WHOA!!" and you stomped your foot on the brake.

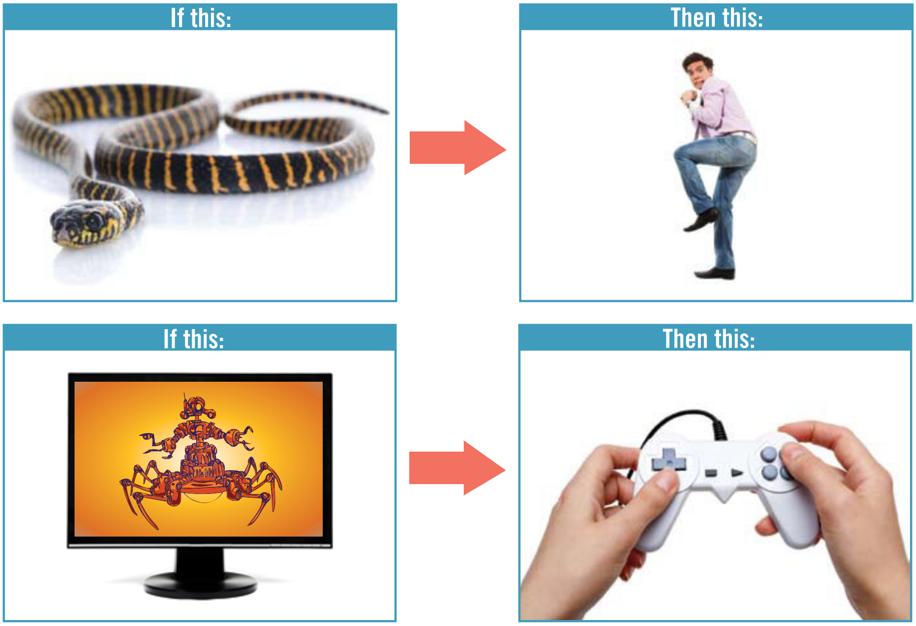
You see the stimulus of the police car, and you have what is a pretty much automatic reaction to what you see. This is what is referred to as a *conditioned response*.

Our conditioned responses are a form of implicit memory. Somewhere, stored in a part of your brain that you don't necessarily have explicit access to, there's a formula like this:



Everyone has reactions ingrained in their memory. Many are useful reactions acquired either through unconscious association or through deliberate practice:





Some actions didn't need much effort to encode (like recoiling from a snake). We acquire others deliberately, through practice and repetition.

PROCEDURAL MEMORY

Procedural memory is our memory for how to *do* things. Specifically, it's our memory for how to do things that require a step-by-step process.

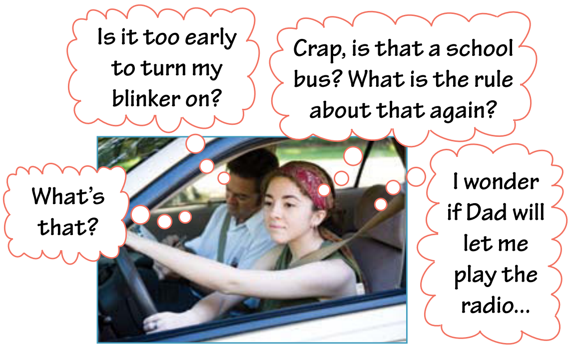
Some of the procedures you know are consciously learned, and you can explicitly state each step, but a lot of procedural memory is implicit.

Have you ever:

- Known how to get somewhere, but been unable to give somebody directions to that place?
- Gotten all the way home on your daily drive from work and realized that you have no memory of the drive itself?
- Been unable to remember a phone number or a PIN without tapping it out on the actual keypad?
- Thought you explained all the steps for a task to someone and then realized after it didn't work that you had neglected to mention some crucial details?

Those are all examples of utilizing something in your unconscious procedural memory. You use repeated practice of a procedure to make it become an unconscious habit. This is pretty important because it frees up your conscious attention to do other things.

Do you remember when you were first learning to drive? Everything required effort and attention.



Even if you were a pretty good student driver, you were still a bad driver, because you had to pay so much attention to everything, until you acquired enough practice to start automating some of the steps. Attention is a finite resource, and new drivers spread it pretty thin. Fortunately they start automating functions pretty quickly, and can then allocate a bigger chunk of their attention to things like not crashing, or avoiding pedestrians.

When you've been driving for a while, you (presumably) have freed up a lot of your attention for other things besides the basic mechanics of driving, so you can then, for example, change the radio station while switching lanes, and sing along at the same time. Of course, you may still be a bad driver years later, but that's probably due to other issues.

Automated procedural memory is related to the idea of **muscle memory** which, despite the name, is still really a brain function. Muscle memory refers to your procedural memory for certain tasks where you have learned something through practice so well that you don't have to put *any* noticeable conscious effort toward the task.

You get muscle memory through practice, and more practice, and even more practice (a process called *overlearning*). The biggest benefit of this is that you can perform the task without using up your conscious brain resources, freeing up those resources for other things.

It's frequently difficult to talk to others about these kinds of tasks, because you didn't learn them in a verbal, explicit way. You may know how to exactly adjust your golf swing to account for wind conditions, but you may not be able to explain it clearly to someone else. You can probably explain the overall motions, but not the subtleties (timing, how much pressure, the feel when you know it's correct).

FLASHBULB MEMORY

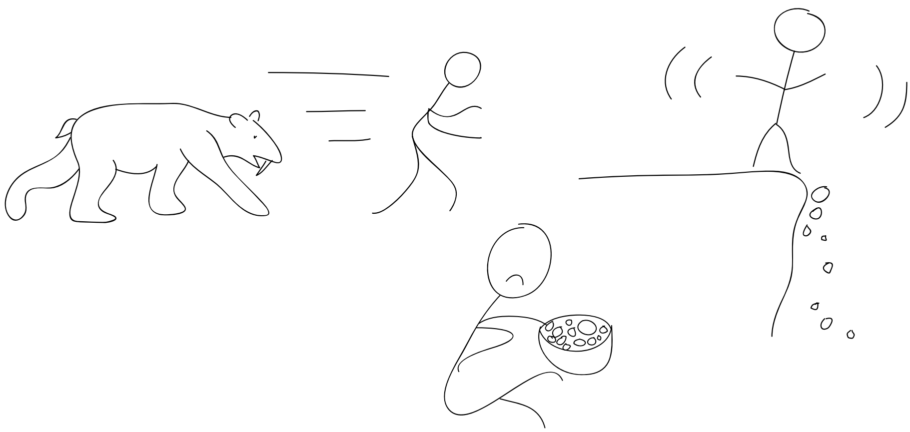
A few years ago, a freeway bridge near my home collapsed during rush hour, causing the death of about a dozen people, and injuring over a hundred more. It was widely reported in the national media at the time.

I vividly remember where I was when I heard about it. I was in a meeting room at the office working on a conference proposal. The lights were dim, and one of the cleaning people came in and told me about the bridge. I remember what chair I was sitting in, all the details of the proposal I was working on, and which website I used to get more information about the incident.

This type of vivid memory for emotionally charged events is call **flashbulb memory**. It's common for people to be able to recollect exactly where they were when they heard about the September 11th terrorist attacks, for example.

So what is the cause of this type of memory, and what does it have to do with learning? (Not that staging a major newsworthy event is a practical way to encourage retention.)

Many believe that flashbulb memory developed as part of our brain's attempt to keep us alive.

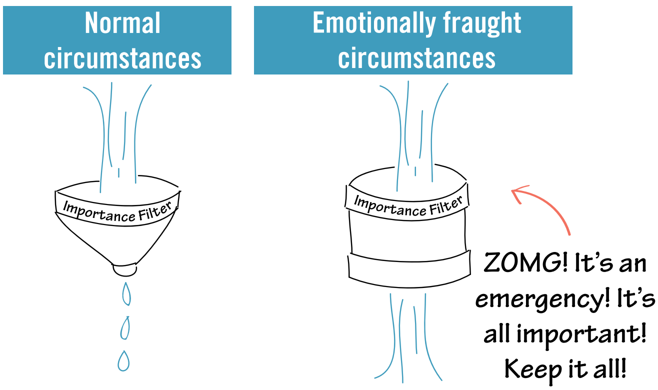


If you survive a death-defying encounter, **you want to remember how you did it**. Remembering how you got away from the bear is a much higher survival priority than remembering where you left that rock. You can forget all sorts of day-to-day things without dying, but if you bump into a bear a second time, forgetting key information from your first encounter may get you killed.

Things you can forget and not die

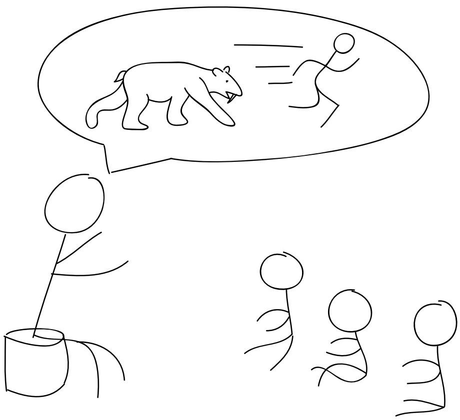
Things that can kill you

Ordinarily, it takes time, effort, and repetition to get things into your long-term memory, but in emotionally charged circumstances, the floodgates open and take in everything in the timeframe around the event. Sometimes it seems like time stands still.



One theory about why time seems to slow in an emergency is that you just remember so much more from those harrowing seconds than you do from the same amount of time in a normal circumstance. (Stetson 2007)

Even though I have never been personally harmed or threatened by an event like a bridge collapse or a terrorist attack, the heightened emotional charge of just hearing about the event seems to be enough to enhance my memory.



Even in less dire circumstances, emotion seems to have an impact on how much we remember. We will revisit this idea in later chapters and look at specific methods for using emotion to enhance retention.

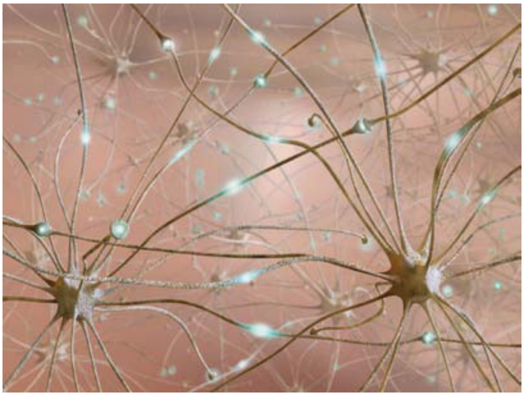
REPETITION AND MEMORY

With a few exceptions, learning almost always requires practice and repetition. For some reason, these are some of the most neglected aspects of learning design. Ever heard a variation on this conversation?

First supervisor: The staff is still throwing away the empty cartridges.

Second supervisor: But I *know* we told them not to. See, it's the third bullet point on slide 22 of the training presentation.

When you learn something new, connections are formed between neurons in your brain.



Like the paths that gradually develop when people repeatedly walk over the same ground, the connections that form in the brain are strengthened and reinforced whenever a learner re-encounters the material.

Connections that are reinforced become stronger and more durable. And, like a path that sees dwindling traffic, connections that aren't reinforced will usually fade or become irretrievable. Repetition and practice are necessary to successfully retain most learning for the long term.

Also, it's important for a learning designer to figure out how to have reinforcement without resorting to monotonous repetition. We know that multiple exposures to an idea improve the likelihood that the idea will be retained (well and good). BUT (and this is a big but) habituation tells us that people also tune out repetitive, unchanging things.

In the later design chapters, we look at how to reinforce an idea while avoiding tedious repetition.

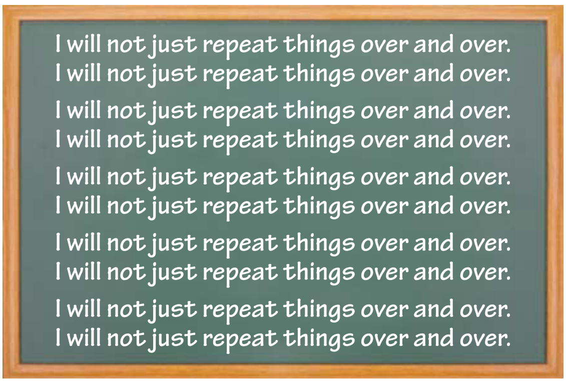
MEMORIZATION: THE BLUNT FORCE SOLUTION

So if repetition is so critical, why is memorizing stuff such a pain in the ass? Should we just get tough and use lots and lots or repetition to grind that information into people's heads?

When I was in college, I took an architecture class. The professor was explaining about early church buildings. She explained the people building the churches wanted to make the buildings as tall as possible, because they believed high ceilings enhanced churchgoers' religious feeling.

There were two different ways, the professor said, to make a building really tall: Use clever engineering to support the walls, or just make the walls really thick.

Using pure memorization to grind something into a learner's brain is the equivalent of building really thick walls—yes, it works, but it takes a lot of resources, and it's a clunky solution.



The biggest problem with memorization through repetition is that it frequently puts the information on just one shelf:

When you learn something by using it in context, you put it on multiple shelves, and learn how to use that information in multiple contexts.

So basically, if you repeat something over and over, eventually you will wear a groove into your long-term memory, but there are some limitations to that approach.

- It's only on one shelf (basically the "stuff I memorized" shelf), which gives you only one place to look when you are trying to retrieve the information.
- You don't have experience using it in multiple contexts, so it's more difficult to take that information and transfer it to a variety of situations.
- You likely have sequential rather than random access to the information. If you learn something in a memorized sequence, then the context for that information is in that sequence, and your ability to retrieve it is also in that sequence. You probably have to tick through the list every time you need to retrieve something, which is much slower than being able to get directly to that item.

SUMMARY

- Memory relies on encoding and retrieval, so learning designers need to think about how the material gets into long-term memory, and also what the learner can do to retrieve it later.
- Learners are besieged with a constant flow of input, and things need to be significant to the learner to attract their attention.
- People habituate to monotonous stimuli, so learning design needs to not fall into a repetitive drone.
- Working memory has its limits, and it's easy to overwhelm a new learner. Limit or chunk the flow of new information to make it more manageable.
- People hold items in working memory only as long as they need them for some purpose. Once that purpose is satisfied, they frequently forget the items. Asking your learners to do something with the information causes them to retain it longer and increases the likelihood that that information will be encoded into long-term memory.
- The organization of long-term memory has an impact on a learner's ability to retrieve material. The material will be easier to retrieve if it is grounded in a rich context and accessible in multiple ways (i.e., on multiple shelves).

- Matching the emotional context of learning to the emotional context of retrieval improves the likelihood that the learner will be able to successfully use the material.
- Storytelling leverages an existing mental framework, and therefore information given in story forms can be easier to retain than other types.
- Repetition and memorization will work to encode information into long-term memory, but it's a limited strategy. This process can be tedious for learners and doesn't provide very many pathways for retrieval.
- There are many different types of memory, and utilizing multiple types can improve the likelihood material is retained.

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INDEX

C

D

E

K

L

M

Q

R

S