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Why Do Students Remember Everything That's on Television and Forget Everything I Say?

Question: Memory is mysterious. You may lose a memory created fifteen seconds earlier, such as when you find yourself standing in your kitchen trying to remember what you came there to fetch. Other seemingly trivial memories (for example, advertisements) may last a lifetime. What makes something stick in memory, and what is likely to slip away?

Answer: We can't store everything we experience in memory. Too much happens. So what should the memory system tuck away? Things that are repeated again and again? But what about a really important one-time event such as a wedding? Things that cause emotion? But then you wouldn't remember important yet neutral things (for example, most schoolwork). How can the memory system know what you'll need to remember later? Your memory system lays its bets this way: if you think about something carefully, you'll probably have to think about it again, so it should be stored. Thus your memory is not a product of what you want to remember or what you try to remember; it's a product of what you think about. A teacher once told me that for a fourth-grade unit on the Underground Railroad he had his students bake biscuits, because this was a staple food for runaway slaves. He asked what I thought about the assignment. I pointed out that his students probably thought for forty seconds about the relationship of biscuits to the Underground Railroad, and for forty minutes about measuring flour, mixing shortening, and so on. Whatever students think about is what they will remember. The cognitive principle that guides this chapter is:

> Memory is the residue of thought.

To teach well, you should pay careful attention to what an assignment will actually make students think about (not what you hope they will think about), because that is what they will remember.

The Importance of Memory

Every teacher has had the following experience: you teach what you think is a terrific lesson, full of lively examples, deep content, engaging problems to solve, and a clear message, but the next day students remember nothing of it except a joke you told and an off-the-subject aside about your family[1]—or worse, when you say, struggling to keep your voice calm, "The point of yesterday's lesson was that one plus one equals two," they look at you incredulously and say, "One plus one equals *two?*" Obviously, if the message of Chapter Two is "background knowledge matters," then we must closely consider how we can make sure that students acquire this background knowledge. So why do students remember some things and forget other things?

Let's start by considering why you fail to remember something. Suppose I said to you, "Can you summarize the last professional development seminar you attended?" Let's further suppose that you brightly answer, "Nope, I sure can't." Why don't you remember?

One of four things has happened, all of which are illustrated in Figure 1, a slightly elaborated version of the diagram of the mind that we've used before. You will recall that working memory is where you keep things "in mind," the location of consciousness. There is lots of information in the environment, most of which we are not aware of. For example, as I write this, the refrigerator is humming, birds are chirping outside, and there is pressure on my backside from the chair I'm sitting on—but none of

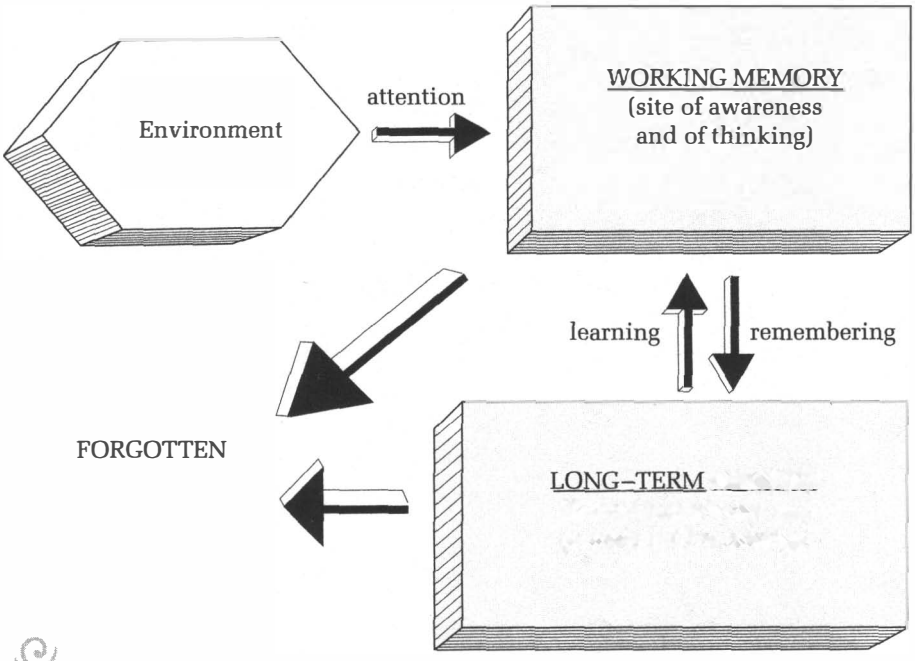

FIGURE 1: A slightly modified version of our simple diagram of the mind.

that was in my working memory (that is, my awareness) until I paid attention to it. As you can see in Figure 1, things can't get into long-term memory unless they have first been in working memory. So this is a somewhat complex way of explaining the familiar phenomenon: *If you don't pay attention to something, you can't learn it!* You won't remember much of the seminar if you were thinking about something else.

Information can enter working memory not only from the environment but also from long-term memory; that's what I mean when I refer to remembering, as shown by the labeled arrow. So another possible reason you don't remember is that the process by which things are drawn from long-term memory has failed. I discuss why that happens in Chapter Four.

A third possibility is that the information no longer resides in long-term memory—that it has been forgotten. I'm not going to discuss forgetting, but it's worth taking a moment to dispel a common myth. You sometimes hear that the mind records in exquisite detail everything that happens to you, like a video camera, but you just can't get at most of it—that is, memory failures are a problem of access. If you were given the right cue, the theory goes, anything that ever happened to you would be recoverable. For example, you may think you remember almost nothing of your childhood home, but when you revisit it the smell of the camellia blooms in the yard wipes away the years, and the memories that you thought were lost can be pulled out, like charms on a fine chain. Such experiences raise the possibility that *any* memory that you believe is lost can in principle be recovered again. Successful memory under hypnosis is often raised as evidence to support this theory. If the right cue (camellia blossoms or whatever it might be) can't be found, hypnosis allows you to probe the vault directly.

Although this idea is appealing, it's wrong. We know that hypnosis doesn't aid memory. That's easy to test in the laboratory. Simply give people some stuff to remember, then later hypnotize half of them and compare their recall to that of the people who were not hypnotized. This sort of experiment has been done dozens of times, and typical results are shown in Figure 2.[2] Hypnosis doesn't help. It does make you more confident that your memory is right, but it doesn't actually make your memory more accurate.

The other bit of evidence—that a good cue such as the odor of camellia can bring back long-lost memories—is much more difficult to test in a laboratory experiment, although most memory researchers believe that such recoveries are possible. But even if we allow that lost memories can be recovered in this way, it doesn't mean that *all* seemingly forgotten memories are recoverable—it just means that a few are. In sum, memory researchers see no reason to believe that all memories are recorded forever.

Now, let's return to our discussion of forgetting. Sometimes you *do* pay attention, so the material rattles around working memory for a while, but it never makes it to long-term memory. An example of a few such bits of information from my own experience are shown in Figure 3. *Lateral line* is a term I have looked up more than once, but I couldn't tell you now what it means. You doubtless have your own examples of things you are certain you *ought* to know, because you've looked them up or heard them (and thus they have been in working memory), yet they have never stuck in long-term memory.

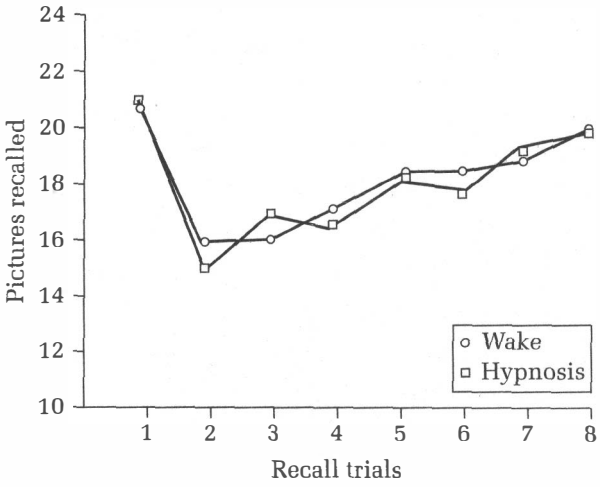

FIGURE 2: Subjects were shown forty drawings of common objects and then had to try to recall them. Session 1 happened right away; sessions 2 through 8 occurred a week later. Naturally there was significant forgetting during the week, and with each attempt to remember, subjects on average did recall more. Also, the hypnotized subjects didn't remember any more than the nonhypnotized subjects.

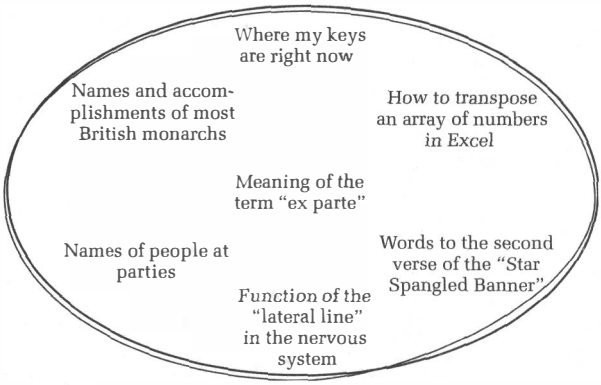

FIGURE 3: Bits of information that I am certain I have paid attention to and that thus have resided in my working memory but that have never made it into my long-term memory.

Just as odd is that some things have remained in your long-term memory for years although you had no intention of learning them; indeed, they held no special interest for you. For example, why do I know the jingle from the 1970s Bumble Bee tuna advertisement (Figure 4)?

You could make a good argument that understanding the difference between Figure 3 and Figure 4 is one of the core problems in education. We all know that students won't learn if they aren't paying attention. What's more mysterious is why, when they *are* paying attention, they sometimes learn and sometimes don't. What else is needed besides attention?

A reasonable guess is that we remember things that bring about some emotional reaction. Aren't you likely to remember really happy moments, such as a wedding, or really sad ones, such as hearing the news of the attacks on 9/11? You are, and in fact if you ask people to name their most vivid memories, they often relate events that probably had some emotional content, such as a first date or a birthday celebration (Figure 5).

Naturally we pay more attention to emotional events, and we are likely to talk about them later, so scientists have had to conduct very careful studies to show that it's really the emotion and not the repeated thought about these events that provides the boost to memory. The effect of emotion on memory is indeed real, and researchers have actually worked out some of the biochemistry behind it, but the emotion needs to be reasonably strong to have much impact on memory. If memory *depended* on emotion,

we would remember little of what we encounter in school. So the answer *Things go into long-term memory if they create an emotional reaction* is not quite right. It's more accurate to say, *Things that create an emotional reaction will be better remembered, but emotion is not necessary for learning.*

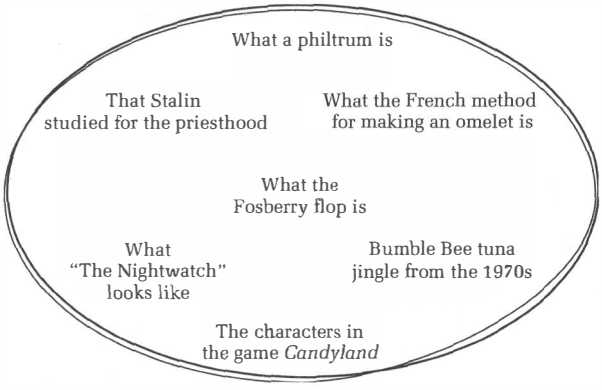

FIGURE 4: Material that is in the author's long-term memory even though the author didn't want to learn it and was in fact not all that interested in it.

Repetition is another obvious candidate for what makes learning work. Maybe the reason I remember the Bumble Bee tuna jingle (Figure 4) from thirty years ago is that I heard it a lot. Repetition is very important, and I discuss it in Chapter Five, but it turns out that not just any repetition will do. Material may be repeated

FIGURE 5: Emotional events tend to be well remembered, whether they are happy, such as a birthday party, or sad, such as a visit to the Holocaust Memorial in Berlin.

almost indefinitely and still not stick in your memory. For example, have a look at Figure 6. Can you spot the real penny among the counterfeits?

You have seen thousands of pennies in your lifetime—a huge number of repetitions. Yet, if you're like most people, you don't know much about what a penny looks like.[3] (The real penny is choice *A,* by the way.)

So repetition alone won't do it. It's equally clear that *wanting* to remember something is not the magic ingredient. How marvelous it would be if memory did work that way. Students would sit down with a book, say to themselves, "I want to remember this," and they would! You'd remember the names of people you've met, and you'd always know where your car keys are. Sadly, memory doesn't work that way, as demonstrated in a classic laboratory experiment.[4] Subjects were shown words on a screen one at a time and were asked to make a simple judgment about each word. (Some subjects had to say whether the word contained either an *A* or a ●; others had to say whether the word made them think of pleasant things or unpleasant things.) An important part of the experiment was that half of the subjects were told that their memory for the words would be tested later, after they had seen the whole list. The other subjects were not warned about the test. One of the remarkable findings was that knowing about the future test didn't improve subjects' memories. Other experiments have shown that telling subjects they'll be paid for each remembered word doesn't help much. So *wanting* to remember has little or no effect.

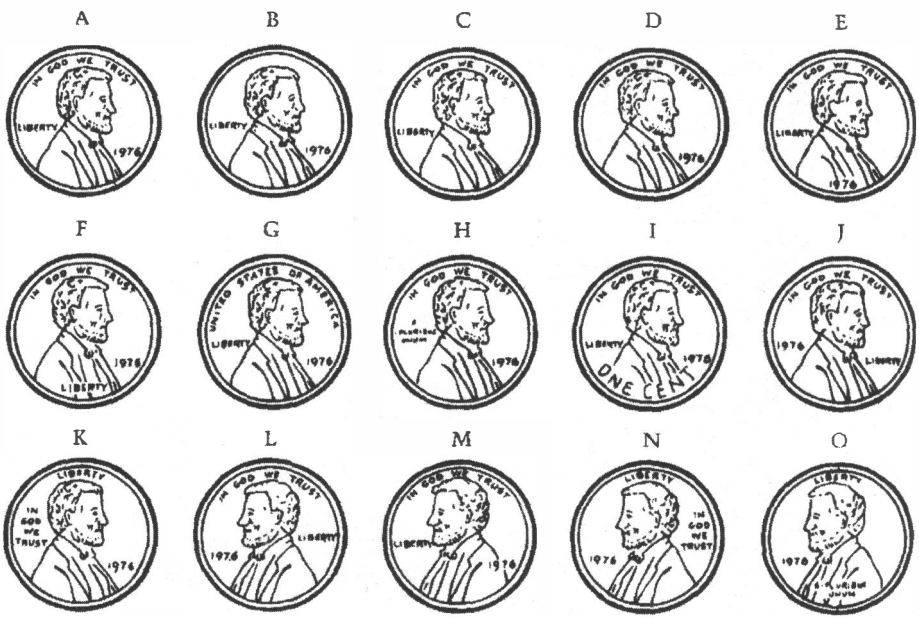

FIGURE 6: Can you find the real penny among the counterfeits? People are terrible at this task even though they have seen a penny thousands of times.

But there's another finding from this experiment that's still more important. Remember that when subjects saw each word they had to make a judgment about it—either about whether it contained an *A* or a *Q*, or about whether it made them think of pleasant or unpleasant things. The people who made the second type of judgment remembered nearly twice as many words as the people who made the first judgment. Now we seem to be getting somewhere. We've found a situation in which memory gets a big boost. But why would it help to think about whether a word is pleasant or not?

In this case it matters because judging pleasantness makes you think about what the word *means* and about other words that are related to that meaning. Thus, if you saw the word *oven,* you might think about cakes and roasts and about your kitchen oven, which doesn't work well, and so on. But if you were asked to judge whether *oven* contained an *A* or a *Q,* you wouldn't have to think about the meaning at all.

So it seems we're poised to say that *thinking about meaning is good for memory.* That's close, but not quite right. The penny example doesn't fit that generalization. In fact, the penny example shows just the opposite. I said that you've been exposed to a penny thousands of times (at least), and most of those times you were thinking about the penny's meaning—that is, you were thinking about its function, about the fact that it has monetary value, even if that value is modest. But having thought about the meaning of a penny doesn't help when you're trying to remember what the penny looks like, which is what the test in Figure 6 requires.

Here's another way to think about it. Suppose you are walking the halls of your school and you see a student muttering to himself in front of his open locker. You can't hear what he's saying, but you can tell from his tone that he's angry. There are several things you could focus on. You could think about the *sound* of the student's voice, you could focus on how he *looks,* or you could think about the *meaning* of the incident (why the student might be angry, whether you should speak to him, and so on). These thoughts will lead to different memories of the event the next day. If you thought only about the sound of the student's voice, the next day you'd probably remember that sound quite well but not his appearance. If you focused on visual details, then that's what you'd remember the next day, not what the student's voice sounded like. In the same way, if you think about the meaning of a penny but never about the visual details, you won't remember the visual details, even if they have been in front of your eyes ten thousand times.

Whatever you think about, that's what you remember. *Memory is the residue of thought.* Once stated, this conclusion seems impossibly obvious. Indeed, it's a very sensible way to set up a memory system. Given that you can't store everything away, how should you pick what to store and what to drop? Your brain lays its bets this way: If you don't think about something very much, then you probably won't want to think about it again, so it need not be stored. If you do think about something, then it's likely that you'll want to think about it *in the same way* in the future. If I think about what the student looks like when I see him, then his appearance is probably what I'll want to know about when I think about that student later.

There are a couple of subtleties to this obvious conclusion that we need to draw out. First, when we're talking about school, we usually want students to remember what things mean. Sometimes what things look like is important—for example, the

beautiful facade of the Parthenon, or the shape of Benin—but much more often we want students to think about meaning. Ninety-five percent of what students learn in school concerns meaning, not what things look like or what they sound like.★ Therefore, a teacher's goal should almost always be to get students to think about meaning.

The second subtlety (again, obvious once it's made explicit) is that there can be different aspects of meaning for the same material. For example, the word *piano* has lots of meaning-based characteristics (Figure 7). You could think about the fact that it makes music, or about the fact that it's expensive, or that it's really heavy, or that it's made from fine-quality wood, and so on. In one of my all-time favorite experiments, the researchers led subjects to think of one or another characteristic of words by placing them in sentences—for example, "The moving men lugged the PIANO up the flight of stairs" or "The professional played the PIANO with a lush, rich sound."[5] The subjects knew that they needed to remember only the word in capitals. Later, experimenters administered a memory test for the words, with some hints. For *piano,* the hint was either "something heavy" or "something that makes music." The results showed that the subjects' memories were really good if the hint matched the way they had thought about *piano,* but poor if it didn't. That is, if the subjects read the moving men version of the sentence, hearing the cue "something that makes music" didn't help them remember *piano.* So it's not even enough to say, "You should think about meaning." You have to think about the right aspect of meaning.

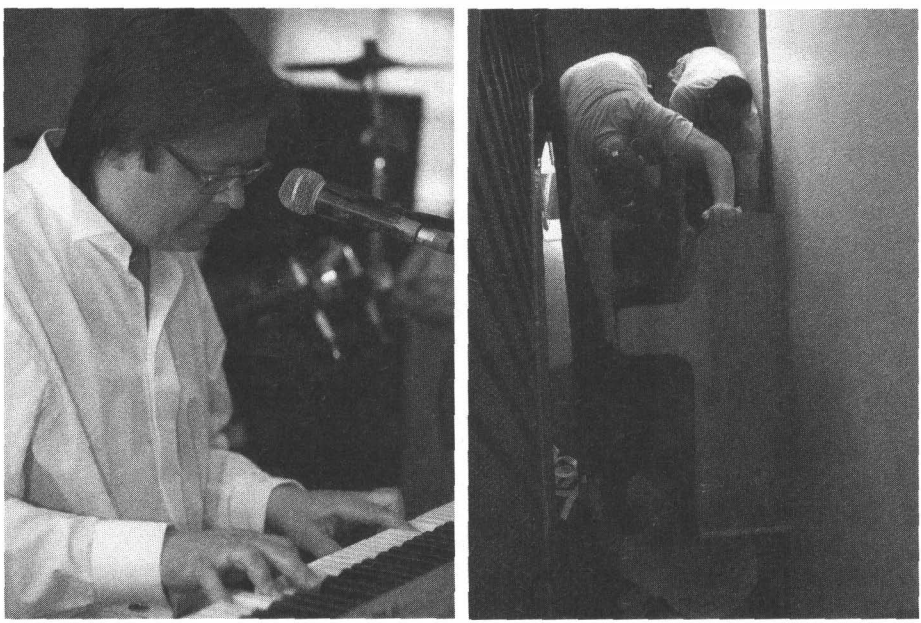

FIGURE 7: Two pictures of a piano, each emphasizing a different characteristic.

Let me summarize what I've said about learning so far. For material to be learned (that is, to end up in long-term memory), it must reside for some period in working memory—that is, a student must pay attention to it. Further, *how* the student thinks of the experience completely determines what will end up in long-term memory.

The obvious implication for teachers is that they must design lessons that will ensure that students are thinking about the meaning of the material. A striking example of an assignment that didn't work for this reason came from my nephew's sixth-grade teacher. He was to draw a plot diagram of a book he had recently finished. The point of the plot diagram was to get him to think about the story elements and how they related to one another. The teacher's goal, I believe, was to encourage her students to think of novels as having *structure,* but the teacher thought that it would be useful to integrate art into this project, so she asked her students to draw pictures to represent the plot elements. That meant that my nephew thought very little about the relation between different plot elements and a great deal about how to draw a good castle. My daughter had completed a similar assignment some years earlier, but her teacher had asked students to use words or phrases rather than pictures. I think that assignment more effectively fulfilled the intended goal because my daughter thought more about how ideas in the book were related.

Now you may be thinking, "OK, so cognitive psychologists can explain why students have to think about what material means—but I really already knew they should think about that. Can you tell me *how* to make sure that students think about meaning?" Glad you asked.

What Good Teachers Have in Common

If you read Chapter One, you can easily guess a common technique that I would *not* recommend for getting students to think about meaning: trying to make the subject matter relevant to the students' interests. I know that sounds odd, so let me elaborate.

Trying to make the material relevant to students' interests doesn't work. As I noted in Chapter One, content is seldom the decisive factor in whether or not our interest is maintained. For example, I love cognitive psychology, so you might think, "Well, to get Willingham to pay attention to this math problem, we'll wrap it up in a cognitive psychology example." But Willingham is quite capable of being bored by cognitive psychology, as has been proved repeatedly at professional conferences I've attended. Another problem with trying to use content to engage students is that it's sometimes very difficult to do and the whole enterprise comes off as artificial. How would a math instructor make algebra relevant to my sixteen-year-old daughter? With a "real-world" example using cell phone minutes? I just finished pointing out that any material has different aspects of meaning. If the instructor used a math problem with cell phone minutes, isn't there some chance that my daughter would think about cell phones rather than about the problem? And that thoughts about cell phones would lead to thoughts about the text message she received earlier, which would remind her