



Video

FULL DETAILS AND TRANSCRIPT

## Key Concepts in Spacing Learning Over Time

Mark McDaniel, Ph.D. • March 2008

Topic: How to Organize Your Teaching  
Practice: Spacing Learning Over Time

### Highlights

- “Spacing learning over time” means re-exposing students to material over the course of weeks and months to mitigate the problem of forgetting.
- Examples are provided to illustrate spacing learning and its effects.
- Suggested timeframes are offered for spacing learning.

### About the Interviewee

Mark McDaniel is a Professor of Psychology at Washington University in St. Louis, with a joint appointment in Education. He received his Ph.D. from University of Colorado in 1980. His research is in the general area of human learning and memory, with an emphasis on prospective memory, encoding and retrieval processes in episodic memory, and applications to educational contexts. His educationally relevant research includes a series of studies on elaborative study techniques and enhancing learning through testing (repeated retrieval), with much of this latter work being conducted in actual college and middle school classrooms. This research is

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McDaniel has served as Associate Editor of the *Journal of Experimental Psychology: Learning, Memory, and Cognition* and as president of the Rocky Mountain Psychological Association and is a fellow of Divisions 3 and 20 of the American Psychological Association. He has published over 170 journal articles, book chapters, and edited books on human learning and memory, and is the co-author, with Gilles Einstein, of two recent books: *Memory Fitness: A Guide for Successful Aging* (Yale University Press, 2004) and *Prospective Memory: An Overview and Synthesis of an Emerging Field* (Sage Press, 2007).

## Full Transcript

I am Mark McDaniel, Professor of Psychology and Education at Washington University in St. Louis. Spacing is a technique that's alternative to the common practice of presenting one particular topic or kind of content in one session. Spacing would take the same amount of time that you would spend on one lesson and divide that time into smaller chunks, and these smaller chunks would be distributed across several days or several weeks rather than presenting the material at once.

The research shows that spacing produces robust advantages in retention of material and sometimes in transfer of material. So an example would be an experiment that was done in a middle school biology classroom—I'm sorry, middle school science classroom—and the lessons involved some biology topics, one of which was mitosis. The researchers took the mitosis lesson, which generally was presented in one class and during the lesson, terms would be repeated and so on, and divided the amount of time that was generally spent on that lesson, took some portion of the time, and spent it on mitosis after an animal reproduction section. Then a little bit more of that time was spent after another lesson—plant reproduction. So the same amount of time spent on mitosis but in one case, it's presented in one lesson as it typically would be, in another case, that information is sectioned off into smaller units of time that are distributed among other kinds of topics.

And it turns out that three weeks after a presentation of these lessons, that these middle school kids were 50% better on average at answering questions about the particular terms, generating the terms to fill in the blank, and I think more impressive, in answering essay questions that ask the kids to describe what mitosis is and to illustrate the process. So, again, the same amount of time is spent on these terms in this unit, but in one case it's spaced over several different lessons, if you will, or reviewed—there are little reviews across other lessons—in the other case, it's the more traditional method of presenting everything in one session and then moving on to other topic.

I think in education we can distribute and space our instruction much more than we are doing now to really tremendous benefits. Now, it's going to be a little bit of a challenge for teachers because they are used to spending all their time on one topic and one lesson. But they don't need to spend anymore time, they just

have to think a little bit about saving—reserving some time for a particular content and bring it back about a week later, two weeks later, and so on throughout the semester, and this is going to promote much better retention and learning.

You can even see the effects in motor learning/skill learning type of situations. For example, practicing an instrument—it's better to practice in a spaced fashion 30 minutes a day for the week rather than two one-and-a-half-hour sessions throughout the week. In fact, college baseball teams have used this principle to help improve the batting proficiency of their hitters. At Cal Poly Tech, a study was done in which hitters practiced hitting 15 fastballs all at once, 15 curveballs, and 15 change-ups three times a week over a five-week practice session, and that was compared to a spaced or distributed practice situation where the hitter would hit a fastball, then maybe a curve ball, then maybe a change-up, then maybe another change-up, then a curve ball. So the practice on 15 of each kind of pitch is spaced over the whole session and these hitters were much better—who got the spaced practice—than the hitters who got the mass practice. So in virtually every kind of content you can think about, spacing the presentation or practice of material produces much better retention than massing the practice.

Now, some teachers are going to ask—it's a good question, too—"Well, what are the timeframes in which I should space the material?" The optimal spacing, more or less, for promoting retention at 30 days is about a review every six days. So you can see if you want to retain things for about a year, really, we ought to be spacing and reviewing content every couple of months in our classrooms.

There are some interesting reasons why spacing is going to promote retention. Spacing the information now is presented once you have forgotten and once the original lesson has left awareness. So on the next presentation, you have to retrieve the information, you have to get it out of long-term memory, and that, then, creates a more focused, a more attentive, a more engaged interaction with the material on the second and the third presentations. Moreover, these second and third presentations are coming in a different context. They are coming in a context in which additional information has been learned, and so these spaced presentations allow what we would call "variable encoding"—chances to encode the information in different ways, get different perspectives on it, understand it a little bit differently, relate it to prior knowledge. All of these things are instrumental in learning and good retention. Spacing fosters that.

If our goal in education is for long-term retention of material—that is, if our goal is that the kids learn information that they can retrieve and use a year later or two years later or three years later—we really ought to be spacing our practice.