

Overlearning, Choking, the Einstellung Effect, and Interleaving

By Barbara Oakley, PhD



Overlearning

The benefit of interleaved mathematics practice is not limited to superficially similar kinds of problems

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Abstract Most mathematics assignments consist of a group of problems requiring the same strategy. For example, a lesson on the quadratic formula is typically followed by a block of problems requiring students to use that formula, which means that students know the appropriate strategy before they read each problem. In an alternative approach, different kinds of problems appear in an interleaved order, which requires students to choose the strategy on the basis of the problem itself. In the classroom-based experiment reported here, grade 7 students ($n = 140$) received blocked or interleaved practice over a nine-week period, followed two weeks later by an unannounced test. The mean test scores were greater for material learned by interleaved practice rather than by blocked practice (72 % vs. 38 %, $d = 1.05$). This interleaving effect was observed even though the different kinds of problems were superficially dissimilar from each other, whereas previous interleaved mathematics studies had required students to learn nearly identical kinds of problems. We conclude that interleaving improves mathematics learning not only by improving discrimination between different kinds of problems, but also by strengthening the association between each kind of problem and its corresponding strategy.

Roediger & Pyc, 2012). In the study reported here, a simple intervention designed to improve mathematics learning was assessed in a classroom-based experiment. We first describe the intervention and the relevant research.

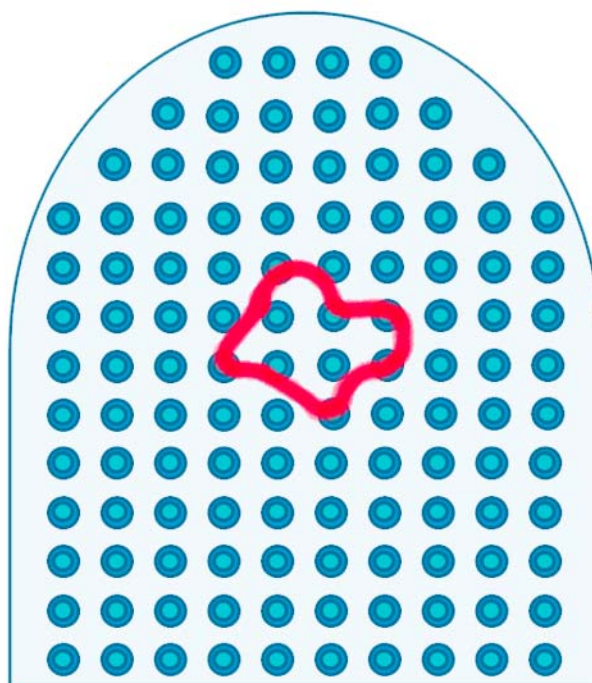
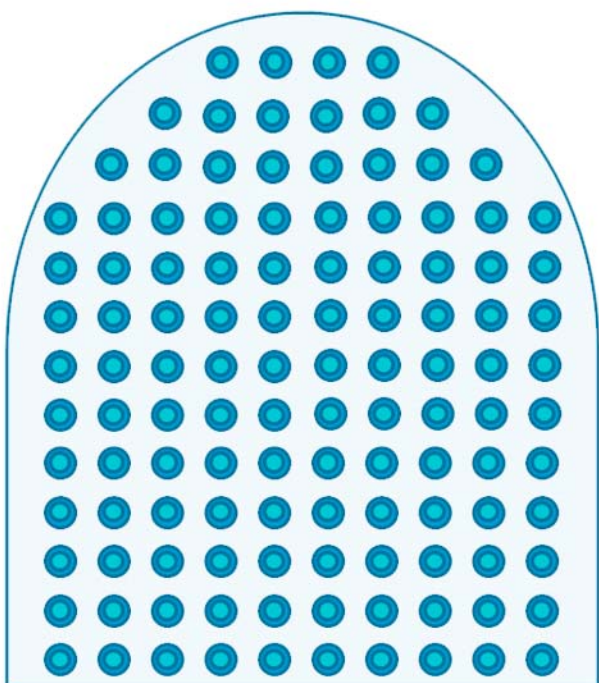
Interleaved practice

The solution of a mathematics problem requires two steps, as is illustrated by the following example:

A bug flies 48 m east and then flies 14 m north. How far is the bug from where it started?

This problem is solved by using the Pythagorean theorem to find the length of a hypotenuse ($\sqrt{48^2 + 14^2} = 50$). In other words, students first choose a strategy (Pythagorean theorem) and then execute the strategy. The term *strategy* is used loosely here to refer to a theorem, formula, concept, or procedure. Learning to choose an appropriate strategy is difficult, partly because the superficial features of a problem do not always point to an obvious strategy (e.g., Chi, Feltovich, &

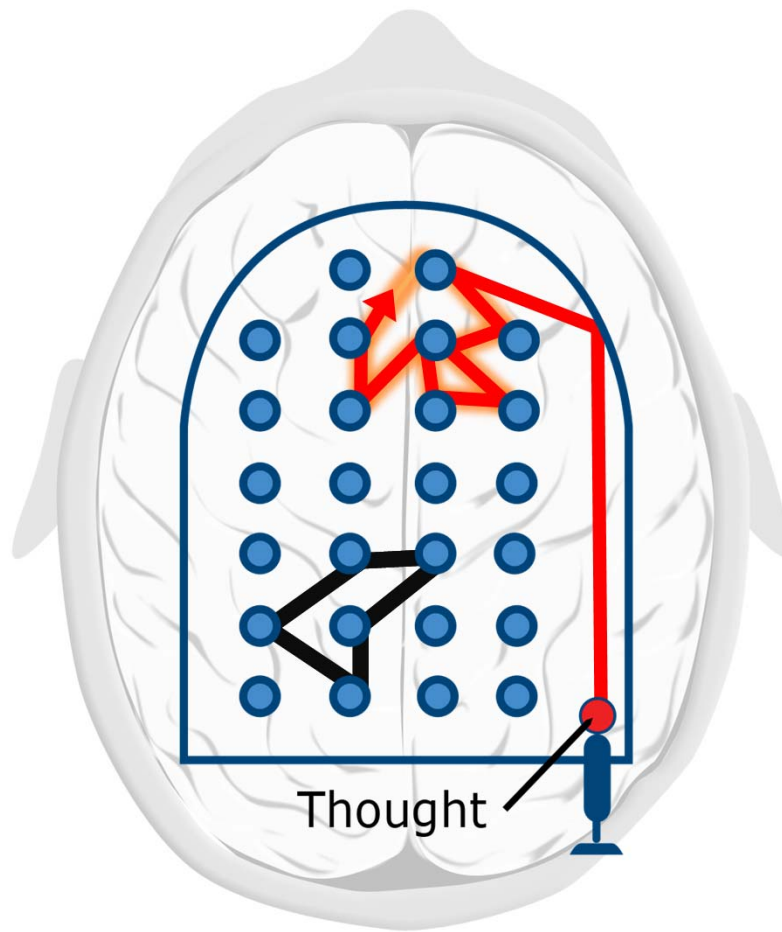




Illusion of competence

(versus)

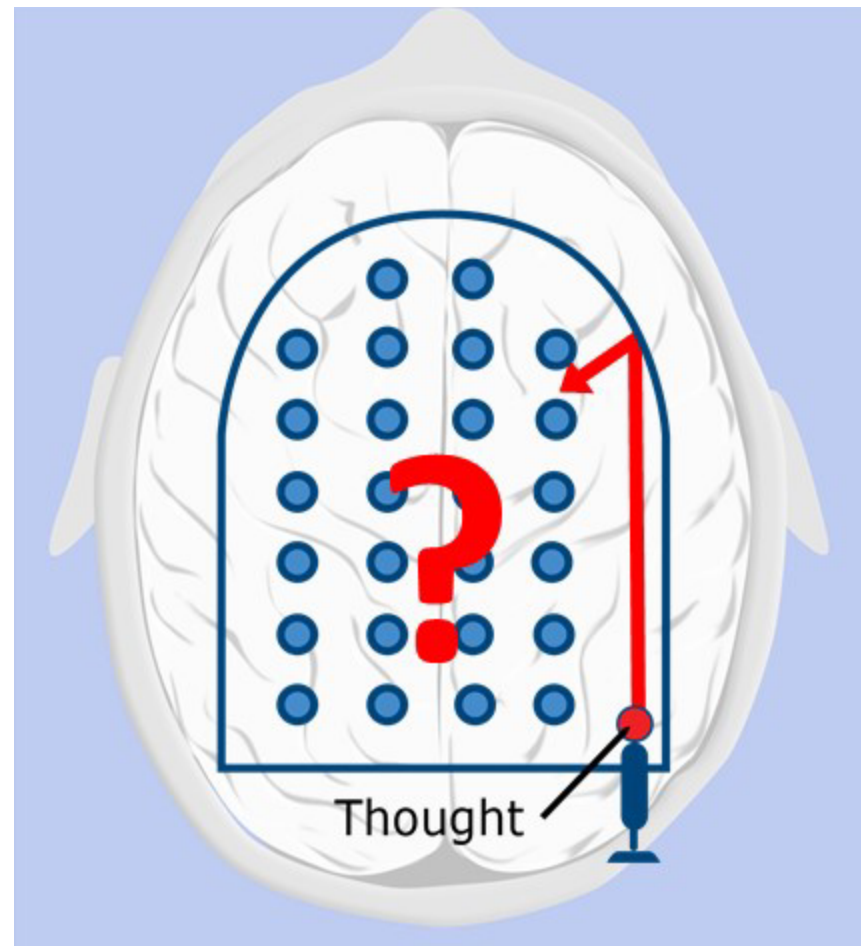
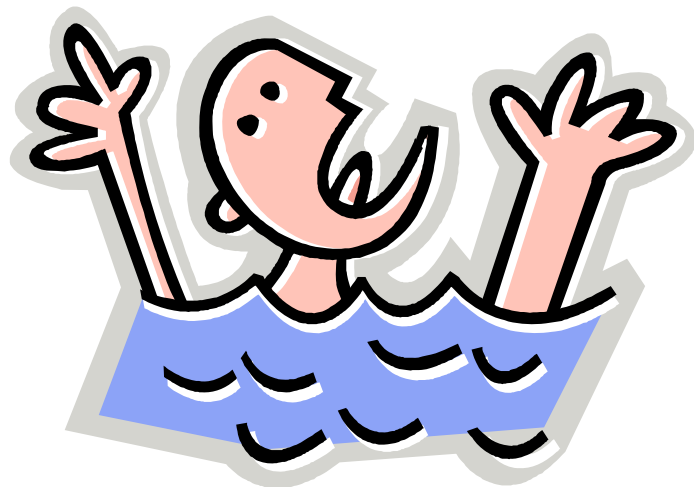
Deliberate practice

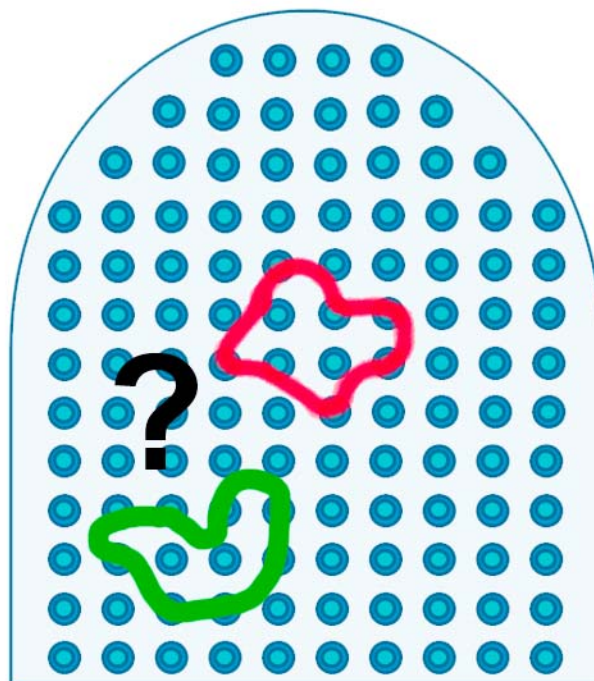
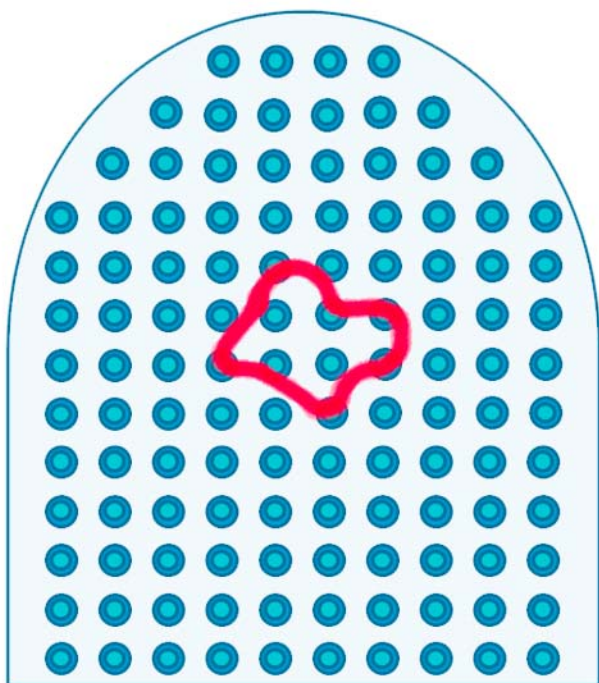


Einstellung
= Installation



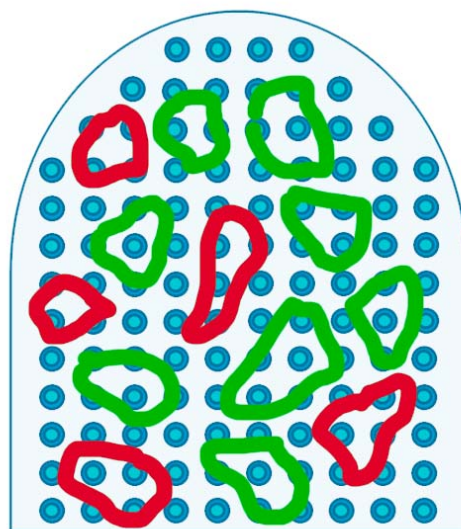
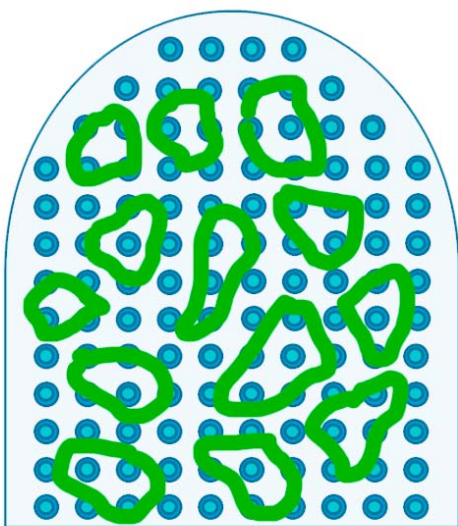








Interleaving

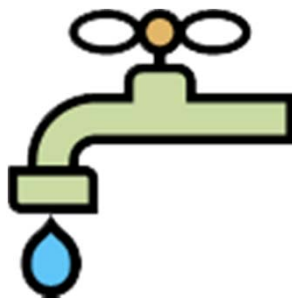


The Structure of Scientific Revolutions



Thomas S. Kuhn







Relevant Readings

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