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This Week's Citation Classic

Schmidt R A. A schema theory of discrete motor skill learning.
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A theory of motor skill learning is presented, based on the idea that learners acquire abstractions (or schemas) about a class of actions rather than individual movements. Assumptions, constructs, and supporting evidence are discussed. [The *Science Citation Index*® (*SCI*®) and the *Social Sciences Citation Index*® (*SSCI*®) indicate that this paper has been cited in over 155 publications since 1975.]

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"During my years at the University of Michigan in the early-1970s, I was influenced strongly by the work and theorizing of a former mentor at Illinois, Jack Adams. His 1971 theory[1] of the acquisition of motor responses, emphasizing feedback processes and the detection of one's own errors after a movement, motivated a great deal of my initial research and thinking. But, by 1973, I had decided that a number of aspects of his theory were wrong, particularly with respect to the learning of more rapid actions.

"At about the same time at Michigan, Dick Pew became impressed with some incidental findings of his graduate student Armstrong,[2] as well as Posner and Keele's[3] notions about abstraction processes in cognitive tasks. He began to discuss with me and others the idea that movements might be based on schemas—i.e., abstract representations of knowledge about actions. The idea, mentioned 40 years earlier by Bartlett,[4] was that the basis for action was not individual movements, but rather some abstract schema about a class of similar movements.

"The combination of my dissatisfaction with certain aspects of Adams's theory, together with the suggestions from Bartlett and Pew that actions may be represented by schemas, led me to consider how such schemas might be learned with practice. I borrowed heavily from Adams, but added extant concepts about motor programs, schemas, and recognition and recall memory to generate a different view of the processes in motor acquisition. In our recent review, Shapiro and I[5] argued that the theory still has a number of appealing features, but it is now clear that it must be modified in various ways to accommodate a number of recent findings.

"In viewing the reactions to the schema theory since 1975, I think that the idea was popular because it suggested a very different view of learning than had been present at the time, one which emphasized the acquisition of schemas rather than individual actions; and a variety of lines of evidence supported this view. Also, it seemed to help in the solution of some long-standing problems in motor behavior: how a nearly inconceivable number of possible movements might be represented, and how novel actions can occur. And many workers were attracted to its testable predictions, particularly those involved in practice variability and motor learning."

1. **Adams J A.** A closed-loop theory of motor learning. *J. Motor Behav.* 3:111-50, 1971.
2. **Armstrong T R.** *Training for the production of memorized movement patterns.* Ann Arbor, MI: University of Michigan, Human Performance Center, August 1970. Technical Report No. 26.
3. **Posner M I & Keele S W.** On the genesis of abstract ideas. *J. Exp. Psychol.* 77:353-63, 1968.
4. **Bartlett F C.** *Remembering*. Cambridge, England: Cambridge University Press, 1932. 317 p.
5. **Shapiro D C & Schmidt R A.** Schema theory: recent evidence and developmental implications. (Kelso J A S & Clark J E, eds.) *The development of movement control and coordination*. New York: Wiley, 1982. p. 113-50.