

This Week's Citation Classic

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Groves P M & Thompson R F. Habituation: a dual-process theory. *Psychol. Rev.* 77:419-50, 1970. (Dept. Psychobiology, Univ. California, Irvine, CA)

A series of experiments characterizes neurons in the spinal cord that could produce the simple forms of learning, habituation, and sensitization. A dual-process theory is developed in which the plasticity of a behavioral response to an iterated sensory stimulus may be accounted for by interacting populations of interneurons in the spinal cord and brain. [*The Science Citation Index*[®] (*SCI*[®]) and the *Social Sciences Citation Index*[®] (*SSCI*[™]) indicate that this paper has been cited over 275 times since 1970.]

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" Graduate studies in psychobiology at the University of California at Irvine were just beginning in the late 1960s, where the experimental work described in this publication was carried out I feel very fortunate to have been one of the early students in the psychobiology program there I had tried several areas of research in psychobiology before settling on studies of the cat spinal cord, in part because it was exhilarating to work on a classic problem in the study of behavior with a preparation of such significance in the history of the neuro-sciences You thought that you could actually experience the feelings of Sherrington and the many other historical figures who had studied the spinal cord and used it to discover and to solve important issues of the day in brain research This work fit into the scheme of things and seemed to be contributing to a line of conceptual and empirical development with a rich history and a

certainty that others who followed you would be equally rewarded

"Of course, the reasons that this publication has been cited frequently do not have much to do with the experimental work, and I think that the experiments that I do now are probably a lot better One certainly hopes that one's experimental work will get better after being at it for more than a decade But this paper provided an experimental and conceptual framework for understanding the neural substrates of these simple forms of learning which seems to have applicability across particular experimental preparations and different levels of analysis It represented a simple model and theoretical scheme for understanding how changes in the activity of certain nerve cells could lead to similar changes in behavior It also accounted for a wider domain of behavioral plasticity than had been the case in previous attempts But most importantly, it fit into the history of work on the phenomena of habituation and sensitization In fact, a frequently cited paper by Richard F. Thompson and the late W. Alden Spencer published in 1966,¹ had already predicted such an account, based upon experimental work published by Spencer, Thompson, and Nielson that same year^{2,4} Indeed, the theoretical and experimental setting for my thesis work, and the formal direction given the field by this publication in 1970, were more the work of Thompson, with whom I took my degree, than myself. A remarkably similar experimental and theoretical analysis of the neural mechanisms underlying these simple forms of learning was developed at about the same time by Eric Kandel and his associates using an invertebrate model system, as described elegantly in his recent text.⁵ I am pleased to have been a contributor to a problem of longstanding interest in biological psychology and the neurosciences."

1. **Thompson R F and Spencer W A.** Habituation: a model phenomenon for the study of neuronal substrates of behavior. *Psychol. Rev.* 173:16-43, 1966.
2. **Spencer W A, Thompson R F & Nielson D R, Jr.** Response decrement of flexion reflex in the acute spinal cat and transient restoration by strong stimuli. *J. Neurophysiology* 29:221-39, 1966.
3. Alterations in responsiveness of ascending and reflex path ways activated by iterated cutaneous afferent volleys. *J. Neurophysiology* 29:240-52, 1966
4. Decrement in ventral root electrotonus and intracellularly recorded post-synaptic potentials produced by iterated cutaneous afferent volleys. *J. Neurophysiology* 29:253-74, 1966.
5. **Kandel E R.** *Cellular basis of behavior: an introduction to behavioral neurobiology.* San Francisco: W. H. Freeman, 1976. 727 p.