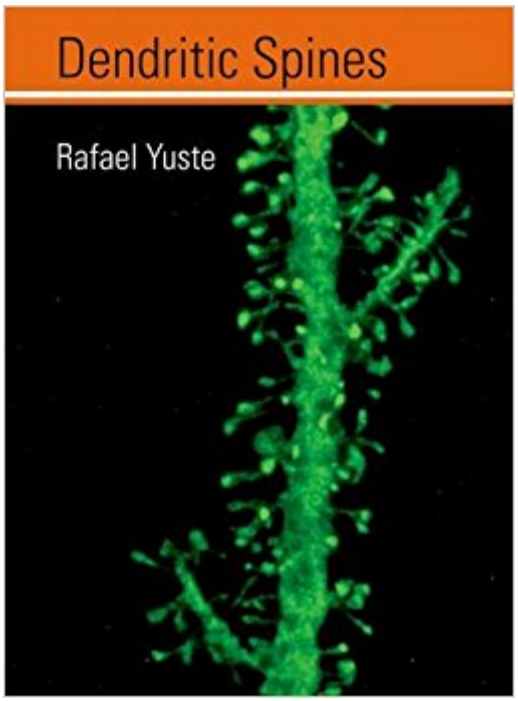
Dendritic Spines (MIT Press)



Synopsis

Most neurons in the brain are covered by dendritic spines, small protrusions that arise from dendrites, covering them like leaves on a tree. But a hundred and twenty years after spines were first described by RamÃƒÂ n y Cajal, their function is still unclear. Dozens of different functions have been proposed, from Cajal's idea that they enhance neuronal interconnectivity to hypotheses that spines serve as plasticity machines, neuroprotective devices, or even digital logic elements. In Dendritic Spines, leading neurobiologist Rafael Yuste attempts to solve the "spine problem," searching for the fundamental function of spines. He does this by examining many aspects of spine biology that have fascinated him over the years, including their structure, development, motility, plasticity, biophysical properties, and calcium compartmentalization. Yuste argues that we may never understand how the brain works without understanding the specific function of spines. In this book, he offers a synthesis of the information that has been gathered on spines (much of which comes from his own studies of the mammalian cortex), linking their function with the computational logic of the neuronal circuits that use them. He argues that once viewed from the circuit perspective, all the pieces of the spine puzzle fit together nicely into a single, overarching function. Yuste connects these two topics, integrating current knowledge of spines with that of key features of the circuits in which they operate. He concludes with a speculative chapter on the computational function of spines, searching for the ultimate logic of their existence in the brain and offering a proposal that is sure to stimulate discussions and drive future research.

Book Information

Series: MIT Press
Hardcover: 280 pages
Publisher: The MIT Press; 1 edition (September 24, 2010)
Language: English
ISBN-10: 0262013509
ISBN-13: 978-0262013505
Product Dimensions: 7 x 0.6 x 9 inches
Shipping Weight: 1.5 pounds (View shipping rates and policies)
Average Customer Review: 3.8 out of 5 stars 5 customer reviews
Best Sellers Rank: #697,332 in Books (See Top 100 in Books) #246 inÃ Â Books > Medical Books > Basic Sciences > Immunology #373 inÃ Â Books > Health, Fitness & Dieting > Psychology & Counseling > Reference #407 inÃ Â Books > Medical Books > Psychology > Reference

Customer Reviews

Rafael Yuste is Professor in the Department of Biological Sciences at Columbia University, where he is HHMI Investigator and Codirector of the Kavli Institute for Brain Circuits.Rafael Yuste is Professor in the Departments of Biological Sciences and Neuroscience at Columbia University, where he is HHMI Investigator and Codirector of the Kavli Institute for Brain Circuits.

I have to say that the book was a good read until the last part where the author gets it completely wrong. Since 2010, many studies came out showing the significance of in vivo dendritic spikes. However, the author claims that dendritic spikes are not important and dismiss them as not real in vivo. Non-linear integration of synaptic inputs have become the dominant model of synaptic integration and long term structural memories as opposed to linear integration and the author unfortunately failed to predict its importance. Overall, it’s a nice survey what what is known about spines in general, but the author fails to put forward an original theory or any novel ideas about the functional significance of spines. You can almost feel in the last chapter that the author is trying his best to sum up all the data to present a comprehensive theory that sheds new light into the workings of spines. And he fails.

As long as you are knowledgeable about the Neurosciences this book is a gold mine of information. Written in a clear, concise way, the material presented is thorough and up to date.

Excellent!! The results of a great team work

The spine is the backbone of the brain’s computational arsenal. Most synapses are formed on spines, and this key structure endows them with the seemingly incompatible virtues of promiscuity and fidelity. This beautiful book is a lucid, comprehensive and exciting survey of this minuscule enigma, which surely underpins that magnum mysterium we call the mind, much as DNA underpins life.Rafael Yuste, its lapidary and generous author, has himself contributed much of what we know about spines. He was one of the first to realize that spines compartmentalize calcium, the key messenger triggering synaptic learning, but also one of the first to show clear limits to this chemical isolation, and, by implication, to the ultimate power of the brain to understand the world. One is reminded of the earlier remarkable insight of Crick and Watson, who realized that the accurate, and now eponymous, pairing of nucleotides they discovered was the explanation of Darwinian evolution and molecular genetics.The calcium signal is caused (in an uncanny echo of DNA) by spike pairing,

and Yuste has pioneered the use of sophisticated techniques to show directly that spikes invade spines unfiltered, while the spine neck can filter the synaptic action that ultimately triggers these spikes. He also gives an absorbing account of the history, anatomy, cell biology and biochemistry of these neuronal prickles, on which thought itself depends. Spines seem to navigate the turbulent passage between the Scylla of chemical coupling and the Charybdis of electrical isolation, but even under Yuste's expert seamanship, they inevitably take on some water, and one is left doubting that even they can accomplish miracles. Resolution of this paradox must await another book. It will not be as elegant and enjoyable as this one.My only quibble is itself the highest praise: the author is unfailingly polite and diplomatic, so that contradictions and conundrums are sometimes elided. A very nice book by a worthy compatriot of Cajal.

This new monograph on the dendritic spine belongs on the shelves of all neuroscients--after having been at the bedside for reading because one can't put it down. An obvious scholar as well as researcher, Yuste synthesizes a very large amount of data into an orderly series of chapters that describes the spine from the dendritic shaft to the most distal point of the filopodium. Starting with history and an homage to Cajal, Yuste starts by clearly articulating his biases. He then proceeds to discuss in nicely compartmentalized chapters everything from the structure of the spine to spines as calcium compartments to computational aspects of spine function. Although each chapter can be throught of as appealing to morphologists or physiologists or pharmacologists, the clear exposition and fluid writing make reading chapters "outside" of ones area of expertise a pleasure, and one rapidlly begins to assemble a sense of the spine. The only shortcoming is that even Yuste doesn't yet formally approach the issue of global behavior and spines---although comments scattered through the book (particularly in early and late chapters) leaves the reader with impressions of possible spine contributions. In an era of escalating prices that often places books out of the hands of readers, this volume, even with glosy color plates, is so modestly priced that one would have no hesitation in assigning it as a text for a class, leaving plenty of money left over to to discuss the spine at a local bar.

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