



# Where Mathematics Comes From: How The Embodied Mind Brings Mathematics Into Being

By George Lakoff, Rafael E. Nunez

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When you think about it, it seems obvious: The only mathematical ideas that human beings can have are ideas that the human brain allows. We know a lot about what human ideas are like from research in Cognitive Science. Most ideas are unconscious, and that is no less true of the mathematical ones. Abstract ideas, for the most part, arise via conceptual metaphor—a mechanism for projecting embodied (that is, sensory-motor) reasoning to abstract reasoning. This book argues that conceptual metaphor plays a central, defining role in mathematical ideas within the cognitive unconscious—from arithmetic and algebra to sets and logic to infinity in all of its forms: transfinite numbers, points at infinity, infinitesimals, and so on. Even the real numbers, the imaginary numbers, trigonometry, and calculus are based on metaphorical ideas coming out of the way we function in the everyday physical world. This book is about mathematical ideas, about what mathematics means—and why. The authors believe that understanding the metaphors implicit in mathematics will make mathematics make more sense. Moreover, understanding mathematical ideas and how they arise from our bodies and brains will make it clear that the brain's mathematics is mathematics, the only mathematics we know or can know.

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### Editorial Review

#### Amazon.com Review

If Barbie thinks math class is tough, what could she possibly think about math as a class of metaphorical thought? Cognitive scientists George Lakoff and Rafael Nuñez explore that theme in great depth in *Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being*. This book is not for the faint of heart or those with an aversion to heavy abstraction--Lakoff and Nuñez pull no punches in their analysis of mathematical thinking. Their basic premise, that all of mathematics is derived from the metaphors we use to maneuver in the world around us, is easy enough to grasp, but following the reasoning requires a willingness to approach complex mathematical and linguistic concepts--a combination that is sure to alienate a fair number of readers.

Those willing to brave its rigors will find *Where Mathematics Comes From* rewarding and profoundly thought-provoking. The heart of the book wrestles with the important concept of infinity and tries to explain how our limited experience in a seemingly finite world can lead to such a crazy idea. The authors know their math and their cognitive theory. While those who want their abstractions to reflect the real world rather than merely the insides of their skulls will have trouble reading while rolling their eyes, most readers will take to the new conception of mathematical thinking as a satisfying, if challenging, solution. --*Rob Lightner*

#### From Publishers Weekly

This groundbreaking exploration by linguist Lakoff (co-author, with Mark Johnson, of *Metaphors We Live By*) and psychologist N#Sez (co-editor of *Reclaiming Cognition*) brings two decades of insights from cognitive science to bear on the nature of human mathematical thought, beginning with the basic, pre-verbal ability to do simple arithmetic on quantities of four or less, and encompassing set theory, multiple forms of infinity and the demystification of more enigmatic mathematical truths. Their purpose is to begin laying the foundations for a truly scientific understanding of human mathematical thought, grounded in processes common to all human cognition. They find that four distinct but related processes metaphorically structure basic arithmetic: object collection, object construction, using a measuring stick and moving along a path. By carefully unfolding these primitive examples and then building upon them, the authors take readers on a dazzling excursion without sacrificing the rigor of their exposition. Lakoff and N#Sez directly challenge the most cherished myths about the nature of mathematical truth, offering instead a fresh, profound, empirically grounded insight into the meaning of mathematical ideas. This revolutionary account is bound to garner major attention in the scientific pressDbut it remains a very challenging read that lends itself mostly to those with a strong interest in either math or cognitive science. (Nov. 15)

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#### From [Booklist](#)

With this ambitious book, Lakoff and Nunez hope to launch a whole new discipline: a cognitive science of mathematics. And they bid fair to bring it off, showing how all mathematical ideas--from simple counting to calculus--can be traced to the discrete workings of the human brain, and not to some transcendent realm of Platonic ideals. This approach to mathematics holds a number of surprises, as even ordinary arithmetic dissolves into conceptual metaphors grounded in the sensory-motor system. The entire panoply of mathematical symbols and calculations--precise and consistent--thus reflects the evolutionary history of brain neurons. Cognitive science can place even that most daunting of mathematical mysteries--infinity--within the observable human mind, explaining it as an aspect metaphor lodged deep in the unconscious. Similar reasoning can also account for the cultural plasticity of mathematics, which appears in one guise

among the Mayans and a quite different one among the Chinese. A pioneering work of singular importance for mathematicians and psychologists alike--and of definite appeal to general readers with interest in those subjects. *Bryce Christensen*

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