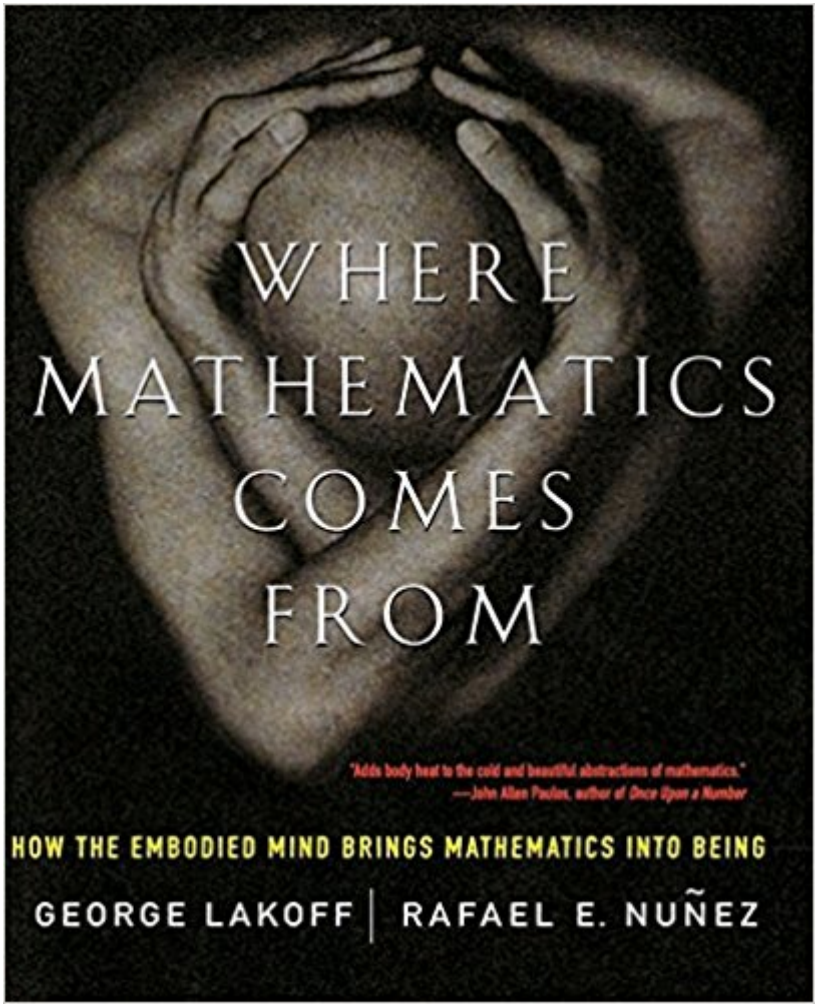
Where Mathematics Come From: How The Embodied Mind Brings Mathematics Into Being



Synopsis

This book is about mathematical ideas, about what mathematics means-and why. Abstract ideas, for the most part, arise via conceptual metaphor-metaphorical ideas projecting from the way we function in the everyday physical world. Where Mathematics Comes From argues that conceptual metaphor plays a central role in mathematical ideas within the cognitive unconscious-from arithmetic and algebra to sets and logic to infinity in all of its forms.

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Customer Reviews

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 NuÃ ez 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 NuÃ ez 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

This groundbreaking exploration by linguist Lakoff (co-author, with Mark Johnson, of Metaphors We Live By) and psychologist N#$ez (co-editor of Reclaiming Cognition) brings two decades of insights from cognitive science to bear on the nature of human mathematical thought, beginning with the basic, pre-verbal ability to do simple arithmetic on quantities of four or less, and encompassing set theory, multiple forms of infinity and the demystification of more enigmatic mathematical truths. Their purpose is to begin laying the foundations for a truly scientific understanding of human mathematical thought, grounded in processes common to all human cognition. They find that four distinct but related processes metaphorically structure basic arithmetic: object collection, object construction, using a measuring stick and moving along a path. By carefully unfolding these primitive examples and then building upon them, the authors take readers on a dazzling excursion without sacrificing the rigor of their exposition. Lakoff and N#$ez 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) --This text refers to an out of print or unavailable edition of this title.

Lakoff has pursued his thesis of cognitive metaphor as embodied structure that not only let’s science into the discussion of body/mind unity, but can be applied fruitfully in a variety of disciplines. Beginning by working cognitive science into linguistics research, he has expanded inquiries into literature, mathematics, and politics all with powerful effect.I first read this book hoping it might give me some insight into how to discuss a variety of things with my brother who’s study of math and physics has prevented him from imagining much value in poetry. The book marks a trail beginning with an inventory of cognitive science experiments that set the ground for basic math as cognitive metaphor, and leads to the heart warming jewel of mathematical beauty in Euler’s equation. Quite the ride! When I shared it with my brother he was hooked.Obviously, we don’t all think alike, but cognitive science has begun to shed light on the basic patterns of our variety and a shared mindfulness at the heart of being human. This book is an important indication of the power of that revelation which should be shared.

Although the book discusses well selected crucial topics in Mathematics, like the origins of the concept of number and sets, this is not a book about what Mathematics can do for human beings. Its main contention is that Mathematics is a human invention, not an inbuilt characteristic of Nature to be revealed by scientific research. Instead, it is a book about Cognitive Psychology that convicingly argues that the ideas we have about the world outside our brain reflects the organization of our neurons and experiences. That should be no surprise because our brain is the only instrument we have for the representation of reality, but some mathematicians and philosophers seem to resent it (not Wittgenstein, read "Tractatus Logicus Philosophicus"). Lakoff and NÃºÃ ez use metaphors for that purpose, a basis that may seem misleading to some people. It is not so, the basis of the discussion is in fact the concept of "structure" ("schemas" or "schemata" in Cognitive Psychology). The concept of identity of structures -metaphors only allege partial coincidence- is central to Mathematics where it appears as "isomorphism". Lakoff has already discussed the concept at large in the old but still enyoyable book "Metaphors we live by". The result is not the construction of Mathematics as it is known by its contemporary practitioners, only its basic psychological foundations, a problema that has been previously discussed by Piaget and other constructivists in relation to how we learn. From this basis grew the outstanding construction, layer upon layer, along many centuries, of the complex structure of modern math, which is mostly counterintuitive. All in all, a wonderful and thought provoking book that will delight all those attracted by the problem of how the human mind labours to grasp, to represent, the external world (is anything out there or am I just "seeing" my own ideas?). There may be errors, but that’s the price of faring in unknown territories.

I bought and read this book 4 years ago. The beginning of the book makes important statements about the "true nature" of mathematics. It is the perfect counterweight to the Platonic "universe of perfect forms" which some people think explains the source of mathematical meaning. Another philosophy of mathematics is the "mathematics in the universe" idea that the universe contains mathematics, and that’s where we discover it from.In the Platonic view, mathematics is essentially completely disconnected from the physical world, but can be perceived by the mind. In the "math in the universe" view, it’s "out there" outside the individual mind. The embodied mind viewpoint may be thought of as locating mathematics in the interface between individual minds and the universe around them. (Of course, there is no sharp boundary between individuals and their environments.)The essence of this book may be summarised by a single paragraph on page

9."Mathematics as we know it is human mathematics, a product of the human mind. Where does mathematics come from? It comes from us! We create it, but it is not arbitrary---not a mere historically contingent social construction. What makes mathematics nonarbitrary is that it uses the basic conceptual mechanisms of the embodied human mind as it has evolved in the real world. Mathematics is a product of the neural capacities of our brains, the nature of our bodies, our evolution, our environment, and our long social and cultural history."The rest of the book gives evidence for this claim and develops the consequences for some areas of mathematics. My favourite part of the book is the evidence for arithmetic in six-month-old human infants, using puppets, on pages 16-19. This shows clearly that some basic mathematics is not purely a matter of culture. It is innate.Chapters 2 to 11 present a series of "metaphors" and "schemas" for various mathematical concepts --- arithmetic, algebra, logic, sets, real numbers, infinity, transfinite numbers, infinitesimals. Initially it all seems quite plausible. Integers come from adding and removing objects from collections of objects. Real numbers come from measuring sticks. But the "metaphors" get less and less credible. My marginal notes pencilled in the margins changed from very positive to slightly positive, to lukewarm, to skeptical, to strong disagreement, to utter derision. My negative marginal notes started at page 91, concerning complex numbers interpreted as rotations. At page 108, my comments are "Huh?" and "infantile" and "Why not?". On pages 109 to 111, I commented "more nonsense", "unjustified conclusion", "nonsense", "total twaddle" and "nonsense".The metaphors are mostly like what are used to teach mathematics. In fact, a useful application of this book would be to mathematics teaching. That’s what it seems like really.I do think that this is a very good book, but the authors could have said everything much better in 150 pages instead of 493 pages. After the first couple of chapters, the rest may be considered "metaphors for teaching mathematics". The first 4 chapters are well worth reading as an antidote to the Platonic "universe of forms" philosophy of mathematics. Modern mathematics is taught as if it were "analytic" truth, i.e. as absolute, universal truth which even life-forms in other galaxies would agree with.The fact that the basic concepts of mathematics are wired into the brain is very important. However, that is only the launch point for mathematics. The detailed content of modern mathematics cannot be mapped one-to-one with the "embodied mind".Maybe each individual component of mathematical thinking may be identified with innate capabilities of the human mind. But all cooking uses pretty much the same set of ingredients and the same set of techniques, and yet the art of great cooks cannot be reduced to mere ingredients and techniques. Painters all use the same colours, tools, concepts of perspective and composition etc., but that does not explain all of the art in the art galleries.The basic components of mathematical activity are indubitably in-born in the sensory/motor system of the human mind, but it

is very doubtful that "cognitive science" (if it is indeed a science) can identify which mental process is being applied in each mathematical thinking-process. Probably each individual uses different innate brain functions to other individuals for the same mathematical concepts. For example, I use diagrams for almost all mathematics, whereas some mathematicians I have met say that they do all mathematics symbolically and algebraically without any visualisation.The "embodied mind" theory also does not explain how mathematicians at some points in history totally rejected concepts which at other times were accepted as self-evident. Examples are zero, negative numbers, irrational numbers, transcendental numbers, complex numbers, infinite sets, transfinite ordinal numbers and non-Euclidean geometry. The vicious debates between intuitionists and formalists in the late 19th and early 20th centuries show that even at one point in history, there can be strong disagreement on the most fundamental ideas of what constitutes mathematics. So it seems unlikely that the "embodied mind" theory can do explain anything more than the ingredients and utensils of mathematics. I cannot explain the recipes in the cookbooks.

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