Quantitative
Eco/evo/etho
Discussions

The Brain's Constraints on Human Number Concepts

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Prof. Andreas Nieder

Although animals can estimate numerical quantities, true counting and arithmetic abilities are unique to humans and are inextricably linked to symbolic competence. However, our unprecedented numerical skills are deeply rooted in our neuronal heritage as primates and vertebrates. In this article, I argue that numerical competence in humans is the result of three neural constraints. First, I propose that the neuronal mechanisms of quantity estimation are part of our evolutionary heritage and can be witnessed across primate and vertebrate phylogeny. Second, I suggest that a basic understanding of number, what numerical quantity means, is innately wired into the brain and gives rise to an intuitive number sense, or number instinct. Third and finally, I argue that symbolic counting and arithmetic in humans is rooted in an evolutionarily and ontogenetically primeval neural system for non-symbolic number representations. These three neural constraints jointly determine the basic processing of number concepts in the human mind.

Prof. Andreas Nieder is the Director of the Institute of Neurobiology at the University of Tübingen, Germany. He studied Biology/Zoology at the Technical University in Munich and received his PhD in Neurobiology from RWTH Aachen University. Afterwards, he was a postdoc at the Picower Center for Learning and Memory at MIT, and an independent junior research group leader at the Hertie Institute for Clinical Brain Research, University of Tübingen. His research takes an evolutionary-comparative approach to understand the brains and behaviors of crows, macaques, and humans, with a focus on number representations, categories and concepts, learning and memory, consciousness, and vocalization. In addition to numerous articles, Prof. Nieder authored the book "A Brain for Numbers: The Biology of the Number Instinct", and his work has been featured in Scientific American, The Guardian, Science Daily, and other media outlets.

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Contact: Irina Tolkova
Email: itolkova@g.harvard.edu

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