Rezension

Andreas Nieder: A brain for numbers. The biology of number instinct

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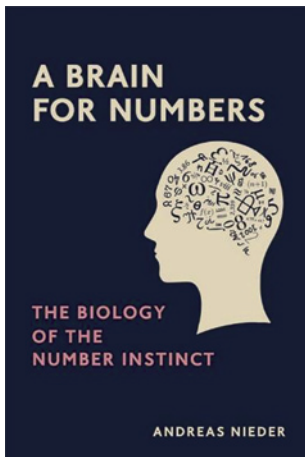
Figure: https://mitpress.mit.edu/books/brain-numbers

Have you ever thought that symbolic use of numbers is a cognitive achievement that discriminates us from animals as much or even more than our language? I certainly did not until I read *A Brain for numbers* by Andreas Nieder (chair of animal physiology at Tübingen University, Germany).

This book is special for two reasons. On the one hand, each of the 14 chapters starts from very basic knowledge and develops its contents step by step in a very clear language. On the other hand, it does not only include our human advanced number concepts but also the evolutionary basis of number competence and its adaptive value throughout the animal kingdom.

The book starts with the simple question "Where do numbers come from?". The answer is not easy, and the first two conceptualizing chapters spell out and define important basic terms and concepts. One of these important terms is "cardinality". Cardinality plays a central role in the understanding of number concepts in the animal kingdom. In Nieder's words, cardinality "refers to a quantitative assignment and thus applies to the empirical property 'number of elements in a set'." The next three chapters explain how numbers are rooted in the animal kingdom. Here, also methods are introduced on how to test numerical competence in behavior. The famous example of the horse "Clever Hans", who was erroneously thought to be able to count, reminds the reader on how difficult it may be to design, carry out and correctly interpret data obtained in animal studies. In the next part, the neuronal representation of numbers in the brain is introduced. An interim conclusion is – in the absence of symbols – animals and humans represent number in an approximate manner, consistent with the Weber quotient. In other words, numbers may be discriminated, if they are a certain percentage (the Weber quotient) apart: 3 may discriminated as well from 4 (Weber quotient: 0.33) as 30 from 40 (same Weber quotient). This holds for both behavior and the so-called 'number neurons' in the brain.

Humans, of course, have a higher numerical competence than animals, especially in that we are able to handle numbers in a symbolic way. Starting with part IV the books shifts to introducing more advanced numerical thinking. No animal is capable of representing numbers in a symbolic manner. Thus, advanced number competence discriminates us humans from animals as much as does our language of which also only rudimentary capacity exists in the animal kingdom. In the following chapters the book introduces, amongst others, brain areas dedicated to numerals, space and numbers in the brain, dissociated networks for calculation and language, the abstractness of number representation in the brain, the effect of developmental dyscalculia (a learning disability in math) on the life of the patients, and, finally, the special case of the number zero.

I very much enjoyed reading this book. The clear and plain language kept me going once I started to read. The different aspects of our number competence demonstrate an intriguing capacity rivaling that of language, but not as loved as the latter, especially if you are sitting in a mathematical exam. But this book is different. It invites you to use your language to understand what we can do with numbers. I recommend the book to everyone – from students via zoologists interested in animal behavior to cognitive scientists. Even the "educated layman" may profit from reading this book.