The representational space of symbolic numbers: from integers to fractions

Daniela Valerio
Univeristy Paris-Saclay, College de France, CEA, Paris, France

Samuel Debray
Université Paris-Saclay, Gif-sur-Yvette, France

Alireza Karami
NeuroSpin, Paris, France

Maxime Cauté
INSERM / CEA, Gif-sur-Yvette, France

Stanislas Dehaene
NeuroSpin Center, CEA DRF/I2BM, INSERM, Unicersité Paris-Sud, Université Paris-Saclay, 91191
Gif-Sur-Yvette, France

Abstract

Mathematics is a central tool for understanding the universe, yet how numbers are cognitively and neurally represented remains unclear. This is especially true when focusing on higher-level concepts, such as symbolic integers, including zero, and fractions. Twenty participants were scanned using a high-resolution 7T fMRI while performing a task in which they judged whether the current number was larger or smaller than the previous one. Behaviorally, we found that participants were slower and less accurate when two numbers were closer in distance on the number line. Neurally, our findings suggest that brain areas involved in mathematical processing – such as the intraparietal sulcus, inferior temporal gyrus, and prefrontal cortex - presented a graded neural BOLD response as a function of numerical distance on the number line. However, both behavioral and neural representations clearly distinguish between fractions and integers.

In D. Barner, N.R. Bramley, A. Ruggeri and C.M. Walker (Eds.), *Proceedings of the 47th Annual Conference of the Cognitive Science Society*