Neural Correlates of the Semantics of Mathematical Logic

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Mathematics as a higher cognitive function in humans is supported by parietal and prefrontal brain systems. Here we give an integrative account of the role of the different brain systems in processing semantics of mathematical logic. We show, based on fMRI experiments, that the fronto-parietal network is modulated by the semantic domain over which formulae are interpreted by comparing algebraic and arithmetic formulae of identical underlying structure. Within this network the prefrontal cortex represents a system with three major components, namely control, logic and short-term memory. This system operates and controls data provided by two other systems, which work in a top-down respectively bottom-up fashion. Whereas the first one is located bilaterally in the dorsal parietal cortex the second involves ventral parietal aspects of the cortex but also hippocampal structures. The division into a ventral and a dorsal interacting fronto-parietal network is closely related to the declarative/procedural model in language.