One of the things that makes us human is the ability to manipulate numbers. The ability to manipulate numerical concepts is one of the key abilities that make us human. Its proficient mastery of represents an indispensable cultural requirement in modern industrialized societies. Children can do additions, multiplications, use an multiplication table. Modern civilization is based on mathematics in thousands of disciplines: engineering, health, economics, education.

The question how the cardinal meaning of numerical information is perceived, represented and processed has received increasing attention during the last two decades. The key cortical region for numerical magnitude processing is the intraparietal sulcus (IPS) where numerical quantity information is represented as an analogue magnitude code. The nature of this number processing system is currently debated. It is controversial, in particular, whether the magnitude code in the IPS is truly abstract. An abstract magnitude representation should be commonly activated by numerical information in different modalities, for example number words and Arabic digits. Surprisingly little empirical evidence has been accumulated concerning this central notion.

A couple of years ago, our research team has conceived a course that teaches Braille, a tactile alphabet, to sighted adults. It is a unique course, since it was widely believed that only blind people can learn to read Braille. The graduates of this course can read in two sensory modalities, the tactile and the visual. Our recent work on in those subjects has brought important insights into the mechanisms of the reading system (Siuda-Krzywicka et al., eLife, 2016).

The graduates of this course can also read numbers in Braille. Therefore, in this project, we propose a detailed investigation of the cognitive architecture for number representation from an unique angle of two sensory inputs: the tactile one and the visual one. Our general hypothesis is thus that both Braille (tactile) and Arabic (visual) numbers will activate the same abstract representation across several behavioral and fMRI (functional Magnetic Resonance Imaging) paradigms. Our main research tool will be fMRI, which allows, in a non-invasive way, to “peek” inside the human brain.

The strategic objective of the research proposed here is to is to gain crucial insights on how the uniquely human cognitive architecture for number processing is shaped by sensory input and preexisting neuronal constraints. This should allow us to better understand what is constant, and what is malleable in the human brain. The proposed experiments can thus change our understanding of cerebral mechanisms number magnitude processing