

## Introduction

Main aim of this fMRI study is to better characterize the role of the parietal circuits in numerical and non-numerical ordinality processing and how it unfolds over developmental time. There is accumulating evidence that the parietal intraparietal sulcus (IPS) is a key region for number processing (Dehaene et al., 2003). So far, most studies have focused on magnitude processing (i.e., discrete set size), thus neglecting the ordinal aspect (i.e., the rank of an individual element in a given sequence) of numerical processing. Recent studies have found that numerical and non-numerical dimensions (such as letters of the alphabet) might share a common network for ordinality processing (Fias et al., 2007; Ischebeck et al., 2008). Moreover it is hypothesized that abstract ordinality processing (i.e. number or letters) is based on low-level ordinality processing such as physical size (Fias et al., 2007).

### Research Questions and Hypothesis:

We predict that IPS activation in response to ordinality processing is age dependent.

Specifically, we predict an increasing overlap of abstract (i.e. numbers) and low-level (i.e. physical size) ordered dimensions over developmental time.

## RESULTS

### Behavioral Results:

➤ Results revealed high accuracies (>90%) and comparable response latencies across tasks.

### Brain Imaging Results:

➤ **Baseline contrasts** revealed strong and circumscribed activation patterns in bilateral parietal cortex in response to both numerical and non-numerical order processing.

➤ **Significant group x task interaction** within the left supramarginal gyrus (SMG) extending to the left anterior IPS.

➤ **A Post-hoc ROI analysis** revealed a significant difference for the numerical and non-numerical task in children but not so in adults.

## Discussion

Our results support the hypothesis that abstract ordinality processing (i.e., number or letters) might be based on lower-level order processing (i.e., physical size order).

## METHOD

### Participants:

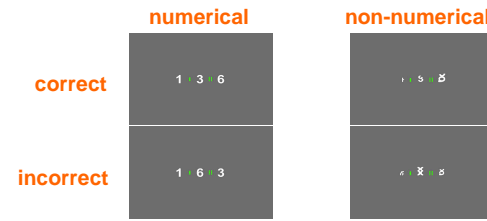
11 healthy adults: mean age 28.3 years, SD = 5.2

11 healthy children: mean age 12.9 years, SD = 2.3

### Tasks:

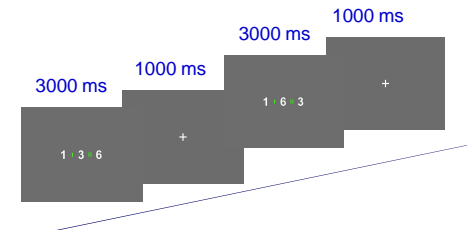
The numerical task required participants to judge whether the numerical magnitudes of three horizontally and simultaneous presented Arabic single-digit numerals follow an ordinal sequence.

The non-numerical task required participants to judge whether the font size (i.e., physical sizes) of three horizontally and simultaneous presented symbols gradually increases or not.

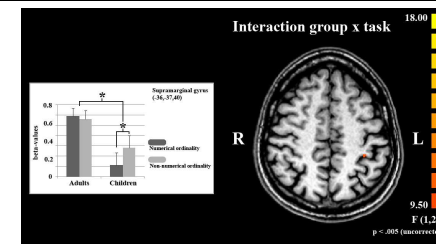
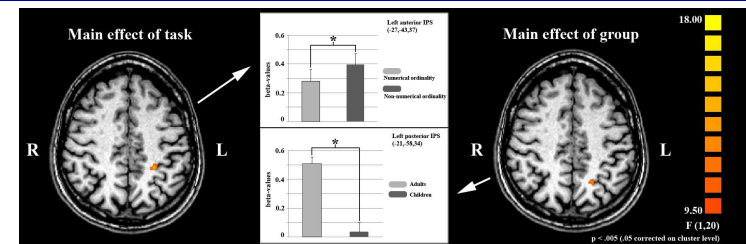


### Procedure and apparatus:

Block-design  
1.5 Tesla (Siemens)  
32 axial slices  
TR/TE 3050/50 ms,  
FOV 220 mm, 64x64 Matrix,  
3.4x3.4x3 voxelsize



## BRAIN IMAGING RESULTS



### References

Dehaene, S., Piazza, M., Pinel, P., Cohen, L., 2003. Three parietal circuits for number processing. *Cognitive Neuropsychology* 20, 487-506.

Fias, W., Lammertyn, J., Caessens, B., Orban, G.A., 2007. Processing of abstract ordinal knowledge in the horizontal segment of the intraparietal sulcus. *J Neurosci* 27, 8952-8956.

Ischebeck, A., Heim, S., Siedentopf, C., Zamarian, L., Schocke, M., Kremser, C., Egger, K., Strenge, H., Scheperjans, F., Delazer, M., 2008. Are numbers special? Comparing the generation of verbal materials from ordered categories (months) to numbers and other categories (animals) in an fMRI study. *Hum Brain Mapp* 29, 894-909.