

# The Abacus in the brain

Tea talk 23-05-17

# Abacus

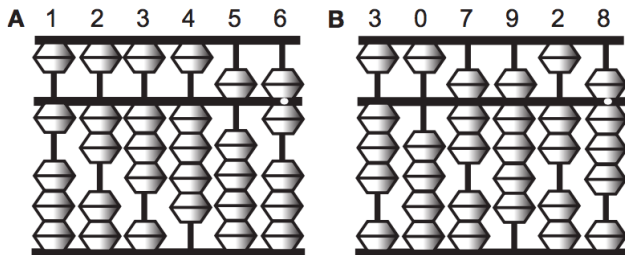
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- ▶ It is a simple device of beads and rods. Numbers are represented by the spatial locations of beads (4 plus 1 bead per decimal place)



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- ▶ Neuroimaging studies have reported activation in the bilateral dorsal premotor cortex (PMd) and inferior and superior parietal lobule (IPL and SPL, respectively) during mental calculation and digit memory tasks in abacus users.
- ▶ No neuropsychological studies reporting deficits in mental abacus ability after focal brain injury. Therefore, the causal relationship between mental abacus ability and region-specific brain structures remains unclear.



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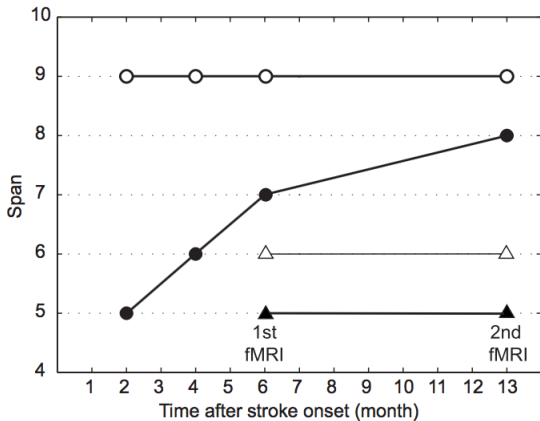
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- ▶ Right hemispheric lesion including the dorsal premotor cortex (PMd) and inferior parietal lobule (IPL).
- ▶ Functional magnetic resonance imaging experiments were conducted 6 and 13 months after her stroke.

# Behavioral performance



○ Digit forward

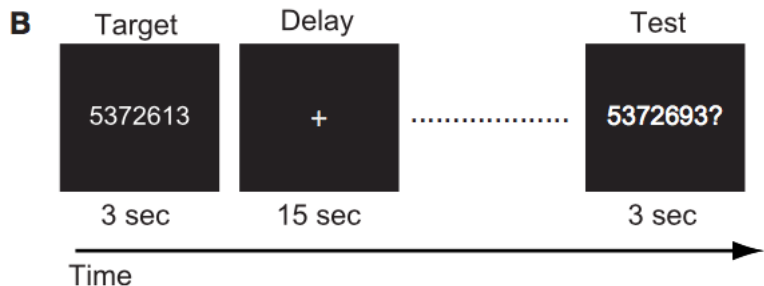
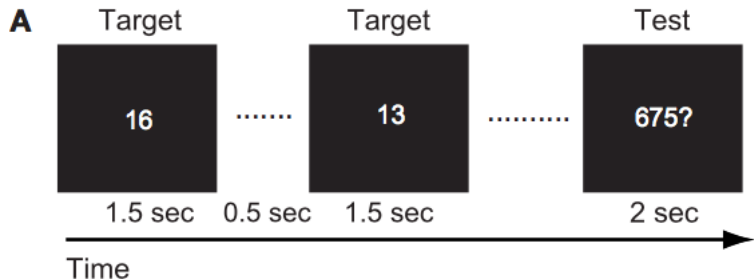
● Digit backward

△ Alphabet forward

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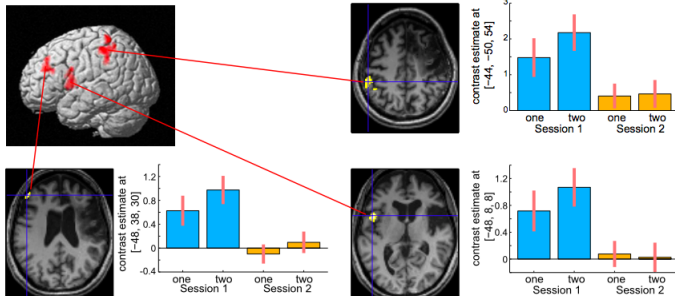


# A mental calculation and a digit memory task

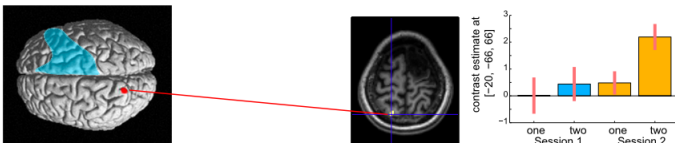


# fMRI study. Mental calculation task.

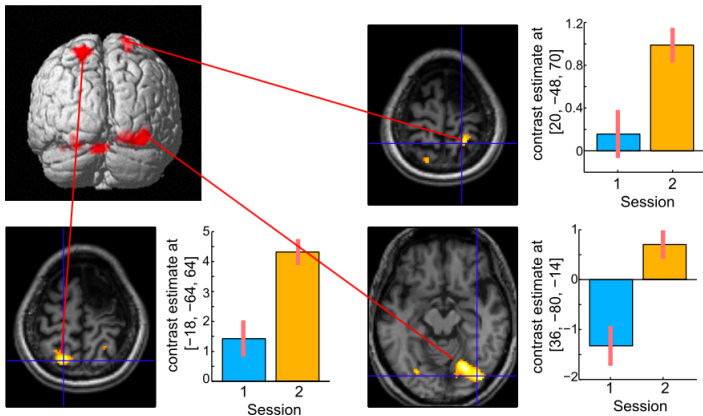
**A**



**B**



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- ▶ Right hemispheric lesion including the dorsal premotor cortex (PMd) and inferior parietal lobule (IPL).
- ▶ In the mental calculation task, her brain activity was shifted from the language-related areas, including Broca’s area and the left dlPFC and IPLs, to the visuospatial-related brain areas including the left SPL, according to the recovery of her arithmetic abilities.

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- ▶ In the digit memory task, activities in the bilateral SPL, and right visual association cortex were also observed after recovery.
- ▶ However, they do not show significant activation of PMd after recovery...
- ▶ The shift of brain activities was consistent with her subjective report that she was able to shift the calculation strategy from linguistic to visuospatial as her mental abacus became stable again.