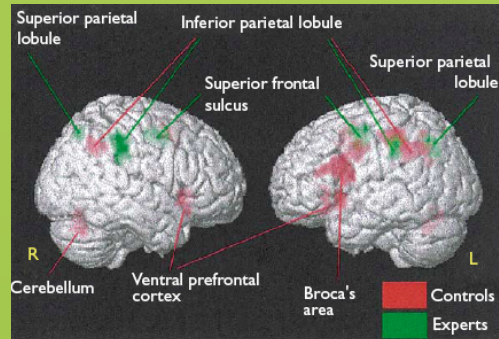


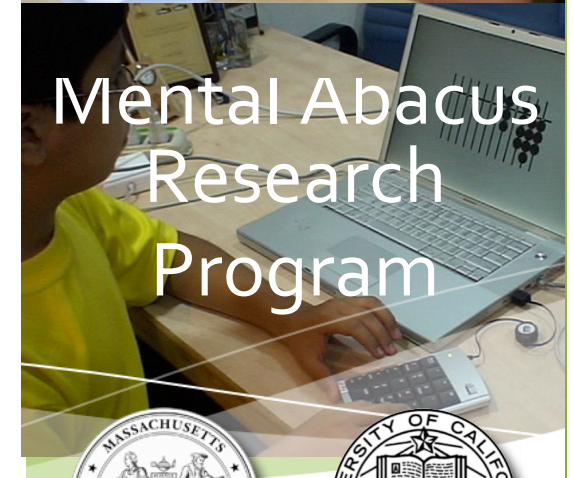
## Abacus and Cognition: Our Research Questions

- The average adult can keep 4-5 objects in their visual memory at one time. How are UCMAS students able to keep track as many as 20 mental abacus beads at once?
- How does learning mental abacus affect other cognitive abilities? Does it increase memory and attention on unrelated tasks?
- Does learning math through visual and spatial means help children develop a deeper conceptual understanding of mathematics?



### Differences in brain activation in mental abacus users.

Research by Satoshi Tanaka and colleagues has shown that abacus experts use different parts of their brain than control subjects when comparing pictures of abacuses. They relied less on areas of the brain associated with language, and more on areas associated with visual memory.



## The Researchers

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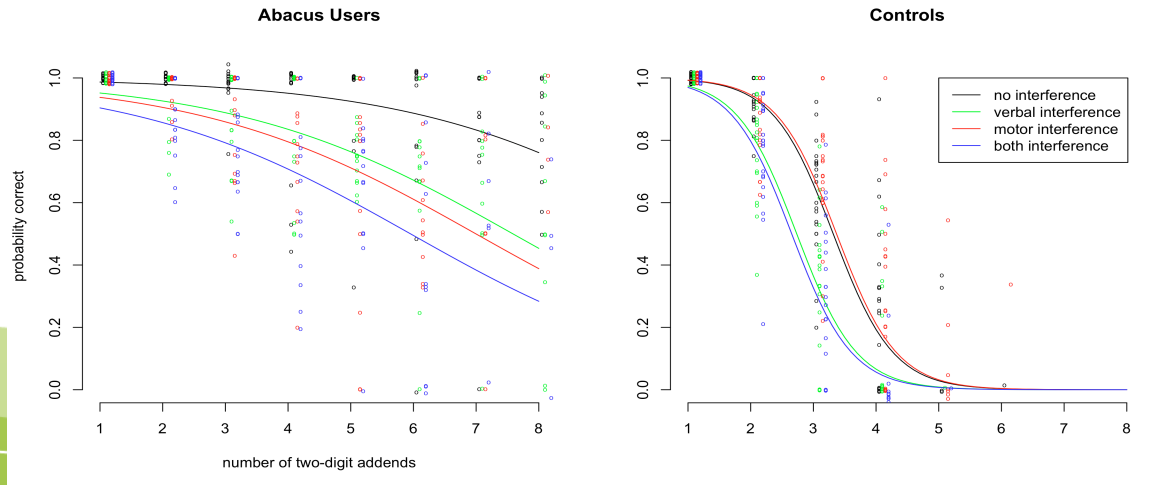
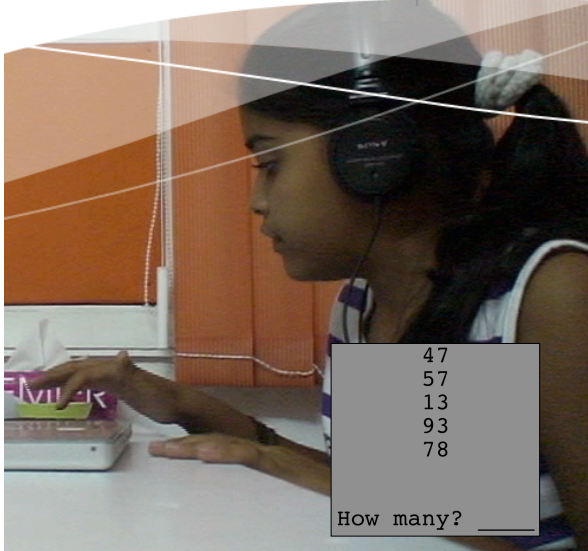
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# Our Findings

**Future Directions.** As we continue with this research program, we plan to explore the effects of learning abacus on visual and verbal memory, attention, mental imagery, and the ability to reason about approximate quantities. We will also investigate how learning abacus helps children understand mathematical concepts.



Probability of correct response for sums with 2 to 8 addends (time limit: 10s) in interference tasks.

## Preliminary Results: Children with mental abacus training showed advantages on addition and estimation tasks.

### Addition Task.

Abacus users were significantly more accurate than untrained participants at solving addition problems with multiple addends with a ten second time limit (see above). Abacus users also showed a different pattern of responses, suggesting that they are using different mental resources to think about number.

memory capacity by grouping the dots into abacus columns.

### Estimation Task.

Children were presented with images like those at right, and asked to estimate the number of dots in the display. The more the display resembled an abacus, the more accurate children were (see right). Children were able to increase their visual

