This has been an exciting fifth year for the Stanford MathBrain Project, led by Dr. Vinod Menon! In this newsletter, we would like to share some of the discoveries made possible by your participation. Please note that we are interested in discovering general trends and we encourage parents not to interpret the findings as an indication of their child’s ability. This newsletter provides an overview of ongoing studies and points to useful links and reading materials that provide additional information about our research. Additional details including scientific publications are available online at http://mathbrain.stanford.edu.

Our research is funded by the National Institute of Child and Human Development and the National Science Foundation.

### SMP By The Numbers...

<table>
<thead>
<tr>
<th>Brain Scans Complete</th>
<th>Over 200</th>
</tr>
</thead>
<tbody>
<tr>
<td># Children Returning</td>
<td>Over 55</td>
</tr>
<tr>
<td>Age Range</td>
<td>7 - 12 Years</td>
</tr>
<tr>
<td># of Girls to Boys</td>
<td>134 to 112</td>
</tr>
<tr>
<td># of Schools Represented</td>
<td>Over 54</td>
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</tbody>
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**CURRENT STUDIES**

- **Math Intervention:** This is an exciting new study designed to improve math skills in children with and without learning disabilities and to increase our understanding of how children learn math. Study provides free math tutoring. Currently recruiting 2nd and 3rd graders.
- **Multi-year Tracking of Math Skill Development:** This study will track math skill development in individual children over a 3 year period starting from grade 2. Currently recruiting 2nd graders.
- **Math Skills in Children and Adults:** This study examines maturation of math skills from childhood to adulthood. Currently recruiting children between ages 7 and 18.
- **Math Skills in Children with Autism:** This study will examine whether math skills are enhanced in children with autism. Currently recruiting children ages 7-12.

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How much difference does a year of schooling make in children’s problem solving abilities? In a recent study of ninety 2nd and 3rd grade children solving addition problems in the MRI scanner, we found differences in the following brain regions:

1. Occipital cortex: involved in visually processing the problems
2. Parietal cortex: involved in understanding the magnitude of numbers
3. Frontal areas: involved in decision making

We found that 3rd graders had improved math abilities and greater activity in the occipital and parietal cortices, reflecting increased specialization for processing quantity. Our study is the first to suggest that the narrow one year interval spanning grades 2 and 3 is characterized by significant changes in brain response and connectivity.

The figure below illustrates the regions that had activity for both 2nd and 3rd graders. However, 3rd graders had greater activity in the intra-parietal sulcus.
Do children with difficulties in math have specific deficits in brain anatomy? The anatomical basis of math disabilities (MD), a specific learning deficit with prevalence rates exceeding 5%, is poorly understood. We recently examined brain structure and wiring in 7-9 year old children with MD, compared to a group of typically developing (TD) children matched on age and cognitive abilities. We found that children with MD have deficits in white matter in the posterior part of the brain in the right hemisphere. Our study showed for the first time that deficits in math skills in young children can be related to the integrity of wiring that connects higher order visual areas with the parietal cortex. We believe that a detailed description of white and gray matter structural brain abnormalities is important for characterizing and remediating math and related learning disabilities.

The figure below shows the white matter pathways of a TD child.

The following figure reveals a brain region that has reduced connection in children with MD.

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Math Anxiety Score

Math Achievement

Researchers and educators alike have long recognized the role of mathematics in academic and professional success. One factor that influences the learning and mastery of mathematics is anxiety. Math anxiety, in particular, can negatively impact an individual’s initial learning of mathematics, leading over time to poor math skills which, in turn, can have an adverse effect on longer-term career choices and professional success.

Does math anxiety impact math abilities in children ages 7-9? We developed a new measure of Mathematics Anxiety that is more appropriate for children in the early stages of formal math learning. Data acquired from 162 2nd and 3rd grade children indicate that our measure has high reliability and validity, and further suggest that children in the early stages of math skill acquisition already begin to exhibit math anxiety in ways that can negatively impact math achievement.

In the figure below, greater math anxiety is correlated with lower math achievement.

In the figure below, greater math anxiety is correlated with lower math achievement.
1. Choose a number from 1 to 9. Add your number to the number right after it. (If I choose 4 then I would add 5). Now add 9. Divide by 2. Subtract 5. What do you get?

2. What is the name of a shape with six sides?

3. In the school parking lot there are two buses, five bicycles, and a tricycle. If the buses have four wheels each, how many wheels are in the parking lot in all?

4. How many different ways can you arrange three toys on a shelf? Hint: Here are two ways to get you started.

Solutions
1. The number you started with
2. Hexagon
3. 21
4. 6 different ways!

In Your Words:

What did you like most about being in our study?
Getting the socks.
Watching Spongebob!
It made me like math games more.

How did you feel about being in the scanner?
Curious and in the end FUN!

What was your favorite part of the study?
Seeing my brain and getting money!

Did the scanner remind you of anything?
A spaceship!

How did you feel about being in the study?
Thumbs up!

Online Math Adventures!

Math Cats!
http://www.mathcats.com/explore/mathcatsgames.html
Kaboose!
http://resources.kaboose.com/games/math2.html
Extra Fun!
http://www.coolmath4kids.com
Math Baseball!
http://www.funbrain.com/math/index.html