Who can participate in the study?

Adult healthy volunteers 20–30 years of age who are eligible for an MRI scan.

Criteria for participant selection

Participants in the current study need to fulfill the following criteria:

- ✓ 20–30 years of age;
- ✓ normal or corrected vision;
- ✓ not be claustrophobic;
- ✓ not have any metal parts in the body (e.g. cochlear implant); dental fillings are allowed;
- ✓ not have neurological or psychiatric history;
- ✓ not be on medication known to affect brain function.

How much of our time is required?

A total of 3 hours:

✓ A 90-minute **training session** in our laboratory at HSE:

Armyanskiy Pereulok 4c2,101000
Moscow, Russia

✓ A 90-minute scanner session at the MRI facility at Kurchatov Institutue:

1, Akademika Kurchatova pl., 123182
Moscow, Russia

Will our privacy be protected?

Yes, all information about your participation in this study and the exprerimental data will remain absolutely confidential.

Will I receive a picture of my brain?

Yes. A few days after the completion of the experiment, the researchers will send you an anatomical photo of your brain.

Will I receive reimbursement for my participation in the MRI study?

Yes. For participating in the MRI study you will receive the scan of your brain and 1000 rub.

For more information, please contact:

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Project within the framework of the Academic Fund Program at the National Research University Higher School of Economics HSE in 2018 grant № 18-05-0001 and by the Russian Academic Excellence Project "5-100".

fMRI and Math

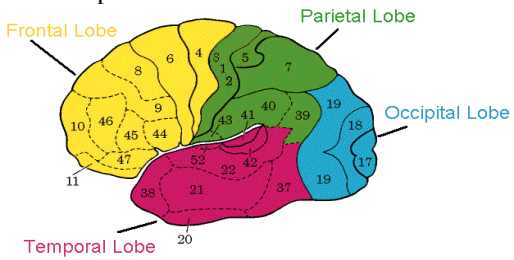
Let's do science together

NEUROPSY LAB

www.neuropsylab.com
https://social.hse.ru/en/psy/brainresponses/

A short introduction to Neuroanatomy

The brain is divided into two hemispheres. Each hemisphere is divided into lobes, and each lobe is divided into areas which are depicted in numbers in the picture below.



Areas 1, 2, 3 and 5 respond to the sensations of touch, position and temperature. Areas 4, 6, and 8 move the muscles of the body. Areas 17 to 19 are the vision areas and 41 and 42 are the hearing areas. Areas 44, 45 and 47 are involved in language and areas like 9, 10 and 46 are involved in executive functions such as planning and memory.

Everything we do, any sensation, thought, feeling or action is associated with activity in specific areas in the brain. For example, if you see a snake and you are scared, the cells located in the inner part of the brain activate. These cells need energy to activate and as a result more blood flows to that region.

Consequently, any activity in the brain creates an increase in blood flow to a region.

A very short introduction to MRI

Magnetic resonance imaging (MRI) uses radio waves and a magnetic field to provide clear and detailed pictures of the brain and other internal organs.

Functional magnetic resonance imaging (fMRI) measures tiny changes in blood flow that take place in an active part of the brain. MRI not only helps researchers look closely at the anatomy of the brain but can help them determine precisely which part of the brain is handling critical functions such as language, movement and sensation.

How is fMRI used in Research?

In fMRI research a task will be used with the MRI scanner. The participants will complete the task while the MRI is running. These tasks are carefully designed so that you use specific brain areas. When the MRI is running any activity in the brain is recorded as an image that depicts the activation. All these images are then collected and analyzed across participants so that we can understand brain function.

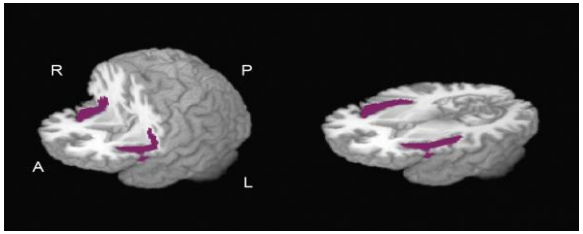
Is the MRI safe?

Yes. The MRI poses no risk to the participant if appropriate safety guidelines are followed. For example, it is essential that you remove any metallic belongings in advance, including watches, jewelry, and items of clothing that have metallic threads or fasteners. Also, in our MRI facility, all participants are carefully screened to ensure that no person/child enters the scanner if they have any metal implants. MRI is as safe for children as it is for adults.

Current Research: fMRI and Math

Sometimes we find math problems very easy, medium difficulty or very complex. For example, 9 + 4 is easy, 79 + 44 is medium difficulty, and 789 + 674 is more complex. Our study will examine vary difficulty of fundamental mathematical operations: addition, subtraction, multiplication and division to examine the brain areas that are related to math as a function of difficulty.

We are particularly interested in key brain regions in the parietal lobe (Areas 7 and 40) in the prefrontal cortex (Areas 9 and 46) and areas deeper in the brain called the insular cortex (which we show in purple in the figure below.



A= anterior; P =posterior; R=right; L=left

In-depth understanding of these processes will help to reveal the factors which affect the mathematical performance and other higher-order cognitive functions.

How does the brain –

solve mathematical operations such as addition, subtraction, multiplication and division? What happens in the brain when arithmetic calculations are easy, medium difficulty or complex? For instance, easy multiplications conform to the multiplication table rules, such as 2×4, whereas complex operations require more than one step of calculations – 49×7 (2-digit number multiplied by 1-digit number)?

Learning more about brain responses to easy and complex math will help us understand fundamental processes in problem solving. This knowledge may help improve existing educational approaches that may benefit students, researchers, clinicians and educators.