Guess first or second-guess: the neural signature of prediction-based learning in adolescents and young adults

Published: 16-06-2021
Last updated: 08-04-2024

The study will address two key questions:1. Which brain systems are involved during learning by making predictions versus receiving direct instruction on a numerical fact learning task? 2. Do adolescents and young adults differ in the recruitment of...

Ethical review	Approved WMO
Status	Recruiting
Health condition type	Other condition
Study type	Observational non invasive

Summary

ID

NL-OMON52132

Source
ToetsingOnline

Brief title
Guess first or second-guess

Condition

- Other condition

Synonym
n/a

Health condition

het onderzoek betreft gezonde vrijwilligers en heeft geen toepassing op klasse(n) van aandoeningen

Research involving
Human

Sponsors and support

Primary sponsor: Universiteit Leiden
Source(s) of monetary or material Support: Ministerie van OC&W,Jacobs Foundation Research Fellowship

Intervention

Keyword: Cognitive control, Development, fMRI, Learning

Outcome measures

Primary outcome

Performance and brain activation during learning by making predictions versus

receiving direct instruction, and the interaction with age group.

Secondary outcome

- Cognitive test performance and performance on questionnaires about executive

functioning and self-regulation.

- Resting-state functional connectivity between key regions involved in the

learning tasks.

Study description

Background summary

An alarming number of young adolescents fail in school for reasons not related to their intellectual capacities or their eagerness to learn. This discrepancy between students* school achievement and their learning potential suggests that the educational approach in early adolescence does not provide a good enough fit with students* learning skills. The goal of this project is to get a better understanding of the neurocognitive mechanisms underlying different instructional approaches and to investigate potential differences in learning mechanisms between young adolescents and young adults.

For this purpose, we will measure brain activation during a learning task with two conditions: direct instruction and prediction-based learning. We hypothesize that instruction-based learning draws more upon brain circuits

classically associated with declarative memory (medial temporal lobe system), whereas learning from predictions will rely more on feedback-based learning circuits (striatal system). The prefrontal cortex will likely play a role in modulating the interaction between medial temporal lobe and striatal systems. Critically, we expect to find differences the recruitment of these learning systems between adolescents and adults, which may provide important leads for the design of educational material that takes into account the relative strengths and weaknesses of adolescents* learning systems.

Study objective

The study will address two key questions:
1. Which brain systems are involved during learning by making predictions versus receiving direct instruction on a numerical fact learning task?
2. Do adolescents and young adults differ in the recruitment of these brain systems during numerical fact learning?

Besides the main research questions, we will also address two exploratory questions:
1. Can differences in learning be explained by differences in cognition and self-regulation?
2. Can differences in learning be explained by differences in the intrinsic network structure of the brain?

Study design

The current proposal involves experimental research, combining measures of neural activity with behavioural assessments. We will measure brain activation using functional Magnetic Resonance Imaging (fMRI) while participants are performing a computerized numerical fact learning task. The learning task involves two conditions: direct instruction and prediction-based learning. In addition, we will collect resting-state MRI to measure functional connectivity in the underlying brain networks that are relevant to the learning task. Outside the scanner, memory for the numerical facts will be assessed. Furthermore, we will measure cognitive functioning on a battery of tasks and participants will fill out a couple of questionnaires about executive functions and learning strategies. All measurements are non-invasive.

Study burden and risks

There are no known risks associated with participating in the proposed measurements. MRI is a noninvasive technique involving no catheterizations or introduction of exogenous tracers. Numerous children and adults have undergone MRI studies without apparent harmful consequences. Some people become claustrophobic while inside the magnet and in these cases the study will be terminated immediately at the subject's request. The only absolute

contraindications to MRI studies are the presence of intracranial or intraocular metal, or a pacemaker. Relative contraindications include pregnancy and claustrophobia. Subjects who may be pregnant, who may have metallic foreign bodies in the eyes or head, or who have cardiac pacemakers will be excluded because of potential contraindications of MRI in such subjects. Although there is no direct benefit to the participants from this proposed research, there are greater benefits to society. Not only are the insights gained by this study important for theory development, they can also be used to inform educational programs tailored to the abilities and needs of young adolescents. More generally, knowledge about normal development is critical to aid in the understanding of cases of abnormal development, as seen in children with Attention Deficit Hyperactivity Disorder, autism spectrum disorder, or traumatic brain injury.

Contacts

Public
Universiteit Leiden

Wassenaarseweg 52
Leiden 2333 AK
NL
Scientific
Universiteit Leiden

Wassenaarseweg 52
Leiden 2333 AK
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adolescents (12-15 years)
Adults (18-64 years)

Children (2-11 years)

Inclusion criteria

- Age 11-13 years old or 20-25 years old
- Native Dutch speaker
- Right-handed

Exclusion criteria

- Previously diagnosed intellectual disability (IQ < 70), developmental delay or severe learning disabilities
- History of neurological or psychiatric disorder/disease and/or use of psychotropic medications
- Left-handed
- Contraindications for MRI, including metal implants, heart arrhythmia, and claustrophobia.
- Pregnancy

Study design

Design

Study type: Observational non invasive

Masking:	Open (masking not used)
Control:	Uncontrolled
Primary purpose:	Other

Recruitment

NL

Recruitment status:	Recruiting
Start date (anticipated):	16-09-2021
Enrollment:	115
Type:	Actual

Ethics review

Approved WMO Date:	16-06-2021
Application type:	First submission
Review commission:	METC Leiden-Den Haag-Delft (Leiden)
	metc-ldd@lumc.nl

Approved WMO Date:	19-01-2022
Application type:	Amendment
Review commission:	METC Leiden-Den Haag-Delft (Leiden)
	metc-ldd@lumc.nl

Approved WMO Date:	25-07-2022
Application type:	Amendment
Review commission:	METC Leiden-Den Haag-Delft (Leiden)
	metc-ldd@lumc.nl

Approved WMO Date:	12-10-2022
Application type:	Amendment
Review commission:	METC Leiden-Den Haag-Delft (Leiden)
	metc-ldd@lumc.nl

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL76127.058.20