# Facilitation of human long-term memory with post-learning physical exercise

Published: 14-05-2013 Last updated: 24-04-2024

To examine the behavioural and neural effects of a single session of post-learning exercise on long-term memory retention in humans.

Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Other condition
Study type	Interventional

# **Summary**

## ID

NL-OMON39752

**Source** ToetsingOnline

**Brief title** Long-term memory retention and exercise

## Condition

• Other condition

**Synonym** Long-term memory, memory consolidation

## **Health condition**

Het betreft fundamenteel onderzoek naar de consolidatie van het langetermijngeheugen in gezonde vrijwilligers, met mogelijke therapeutische relevantie voor populaties met geheugenproblemen zoals ouderen en/of patienten met geheugenstoornissen

#### **Research involving**

Human

## **Sponsors and support**

**Primary sponsor:** Radboud Universiteit Nijmegen **Source(s) of monetary or material Support:** European Research Council;Grant 2010-AdG 268800[Neuroschema

## Intervention

Keyword: Exercise, Functional neuroimaging, Memory

## **Outcome measures**

#### **Primary outcome**

At the behavioural level, the primary study parameter is the memory performance on the associative memory task (number of correctly recalled associative memories). This is measured directly after learning and after a 2 day delay to check long-term memory retention. The main study parameter is the memory retention, i.e. the difference between memory performance before and after the physical exercise intervention. We aim to investigate how post-learning exercise modulates long-term memory performance.

## Secondary outcome

At the neural level, the secondary study parameters are the neural activation and functional connectivity of memory-related brain regions during memory retrieval after the intervention. Before and after both experimental conditions saliva will be obtained from all subjects. By measuring the concentration of cortisol and alpha-amylase in saliva, the physiological effects of exercise can be demonstrated in the subject population.

During the intervention subjects will repeatedly report on their subjective experience of the exercise intensity level. In addition, heart rate will be monitored continuously. Finally the participants' activity and sleep rhythm

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will be recorded with actigraphs in the period between the first and second

experimental day as a control measure.

# **Study description**

#### **Background summary**

Memory consolidation refers to the processes through which initially encoded memories are transformed into a more stable enduring form. The neural and behavioural processes that mediate consolidation, and thus ensure long-term memory retention, are poorly understood in humans. Recent animal research has led to the \*Synaptic Tagging and Capture\* hypothesis. This theory postulates that cellular processes of memory consolidation can be divided into an early and a late phase. In the early consolidation phase, a potential for long-lasting neural change is created by the initial experience of the to-be-remembered event. However, this potential is only realized as a persistent change in the late consolidation phase when it is accompanied by certain molecular events. Chief amongst those events is local dopaminergic and adrenergic activation, and the release of plasticity-related proteins. In the absence of these phenomena, initial potentiation decays within 2 hours after initial memory encoding, and long-term memory formation is not possible. However, it has been shown in animals that, within this critical time period, molecular and behavioural interventions that increase dopaminergic and adrenergic signalling can rescue memories that would have otherwise decayed. Interestingly, physical exercise has been associated with increased dopaminergic and B-adrenergic release as well as increased plasticity, mostly through upregulation of BDNF and other neurotrophins. The size of these physiological changes scales with exercise intensity. As such, current theory would predict that performance of intense exercise within 2 hours of learning is beneficial for long-term memory retention. In contrast, physical exercise more than 2 hr after learning (outside the critical time period for consolidation) is not predicted to be effective. The current exploratory study will test these predictions in the healthy human population.

## **Study objective**

To examine the behavioural and neural effects of a single session of post-learning exercise on long-term memory retention in humans.

## Study design

Single centre, exploratory, randomized open between-subject intervention study

in parallel groups with fMRI measurements during memory retrieval.

## Intervention

Two experimental groups participate in high intensity physical exercise and a control session after performing an associative memory task. Experimental groups differ only in the order of experimental conditions performed (control->exercise vs exercise->control) but experience both conditions over the course of the study. Exercise consists of one sub-maximal stationary bicycle interval training session of 35 minutes. The intensity level of the exercise will be based on the predicted maximum heartrate of each subject, and will therefore be adjusted on an individual-to-individual basis. The maximum heartrate is the highest heartrate that a subject can achieve without experiencing complications, and will be estimated using an age-corrected formula. These calculations do not require a physical exercise test. The "high intensity" exercise session will have a maximum intensity of 80% of the maximum heartrate.

## Study burden and risks

Sub-maximal bicycle exercise is associated with negligible safety risks in young healthy volunteers without hypertension, normal ECG and without a history of cardiovascular disease. MRI recordings are safe if conducted by qualified personnel and

proper precautions are taken.

# Contacts

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# **Trial sites**

# **Listed location countries**

Netherlands

# **Eligibility criteria**

#### Age

Adults (18-64 years) Elderly (65 years and older)

## **Inclusion criteria**

- Age: 18-28
- Normal or corrected-to-normal vision
- Willingness and ability to sign informed consent
- Healthy
- Performs regular exercise (1-5 times a week)
- Body Mass Index between 18.5 and 25 kg/m2

# **Exclusion criteria**

- Subjects that are or might be pregnant
- Subjects that use (prescribed) medication, except for paracetamol and oral contraceptives
- Subjects that are unable to perform bicycle exercise
- Subjects that suffered from recent illness (in past 2 weeks before the day of screening)
- Subjects with hypertension (systolic blood pressure > 140 mmHg or diastolic blood pressure > 90 mmHg)

- Subjects with any cardiovascular abnormality in current or past medical history or that show such abnormality during the ECG screening.

- Subjects with any neurological disorder in current or past medical history.
- Subjects with diagnosed diabetes mellitus
- Subjects with diagnosed hypercholesterolemia
- Subjects who smoke, or who quit smoking less than 2 years ago

- Subjects with parents, children and/or siblings who died at a young age (<50 years old) as the result of a cardiovascular disorder.

- Subjects with any personal characteristics that make him/her ineligible for MR scanning, such as:

- Non-removable metallic objects in the body
- Active implants (pacemaker, neurostimulator and so on)

- Epilepsy
- Claustrophobia
- Head surgery
- Metallic tattoos

# Study design

# Design

Study type:	Interventional
Intervention model:	Parallel
Allocation:	Randomized controlled trial
Masking:	Open (masking not used)
Control:	Active
Primary purpose:	Other

## Recruitment

NL	
Recruitment status:	Recruitment stopped
Start date (anticipated):	23-10-2013
Enrollment:	50
Туре:	Actual

# **Ethics review**

Approved WMO Date:	14-05-2013
Application type:	First submission
Review commission:	CMO regio Arnhem-Nijmegen (Nijmegen)
Approved WMO Date:	05-12-2013
Application type:	Amendment
Review commission:	CMO regio Arnhem-Nijmegen (Nijmegen)

# **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 CCMO **ID** NL42847.091.12