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fMRI neurofeedback training for improving cognitive control/attention in adults with attention deficit hyperactivity disorder

Submission date
19/06/2016

Recruitment status
No longer recruiting

Registration date
23/06/2016

Overall study status
Completed

Last Edited
20/10/2017

Condition category
Mental and Behavioural Disorders

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[X] Results
[ ] Individual participant data

Plain English summary of protocol

Background and study aims
Attention deficit hyperactivity disorder (ADHD) is a common disorder that affects behaviour. ADHD can present in a number of ways, but common symptoms include a short attention span, restlessness, hyperactivity and impulsiveness. It is a common disorder in children, with around 5-10% of European children being affected, and around a third of these cases are expected to continue into adulthood. Initial treatment for ADHD usually involves medication however this can lead to severe side effects and is not always effective. One proposed alternative treatment which doesn't cause these side effects is neurofeedback. Neurofeedback in general is defined as a procedure during which a participant learns self-control over brain functioning through getting feedback on it from MRI brain scanning. This aims to help eliminate patterns in the way the brain signals within itself leading to abnormal behavior. The goal in ADHD patients is to teach participants how to control certain brain signals that are an indicator of alertness. Recent reviews on EEG-neurofeedback have concluded that preliminary results are promising regarding the reduction of ADHD symptoms and improvement of genitive functioning (thought, memory and learning). The aim of this study is to investigate the effectiveness of neurofeedback treatment in patients with ADHD.

Who can participate?
Adults with ADHD who are not currently receiving drug treatment.

What does the study involve?
Before the training, participants are given a set of cognitive (thinking) strategies that they may use during the neurofeedback training (e for all participants). These cognitive strategies are taken from research looking into which mental tasks activate the get areas of the brain. During the neurofeeback, participants are in an MRI scanner and are able to see their brain activation on a screen. Participants are randomly allocated to two groups. Those in the first group are able to see the area of the brain responsible for their ADHD symptoms, and those in the second group see a "control area" (i.e. an area not responsible for the symptoms that is still activated). Participants in both groups are then instructed to increase and maintain activation levels to a set target level, in order to learn how to control their brain signalling. Before and after the training,

participants in both groups complete a number of tasks to measure their cognitive function and a questionnaire to measure their ADHD symptoms.

What are the possible benefits and risks of participating?
Participants may benefit from an improvement to their ADHD symptoms as a result of the treatment. There are no notable risks involved with participating

Where is the study run from?
Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre (Netherlands)

When is the study starting and how long is it expected to run for?
March 2012 to September 2014

Who is funding the study?
BrainGain Consortium (Netherlands)

Who is the main contact?
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Contact information

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Scientific

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Additional identifiers

EudraCT/CTIS number

IRAS number

ClinicalTrials.gov number

Secondary identifying numbers
Registratienummer: 2012/292 NL nr.: 40273.091.12

Study information

Scientific Title
Increasing anterior cingulate cortex activation in adult attention deficit hyperactivity disorder: a real-time fMRI neurofeedback feasibility study

Study objectives
Primary objective:
To investigate whether the modulation of the ACC activation level through fMRI-neurofeedback training reduces ADHD symptoms and improves cognitive functioning.

Secondary objective:
To investigate if abnormal activation levels of the ACC in ADHD patients play a causal role in ADHD pathophysiology.

Ethics approval required
Old ethics approval format

Ethics approval(s)
The Commissie Mensgebonden Onderzoek (Central Comittee on Research Involving Human Subjects) Regio Arnhem-Nijmegen, 27/09/2012, ref: 2012/292 and 40273.091.12

Study design
Single-center single-blind randomized controlled trial

Primary study design
Interventional

Secondary study design
Randomised controlled trial

Study setting(s)
Other

Study type(s)

Treatment

Participant information sheet
Not available in web format, please use the contact details to request a patient information sheet

Health condition(s) or problem(s) studied
Attention Deficit Hyperactivity Disorder

Interventions
Before the training the subjects will be suggested a set of cognitive strategies that they may use during the neurofeedback training (the same set of strategies in both groups). These cognitive strategies will be derived from research on which mental tasks activate the neurofeedback and the control region. Towards the patients it will be stressed that they are also always free to choose any other strategy that seems to work, and that they should be guided by the feedback in the selection of their strategy.

During the neurofeeback training the patients randomly allocated to either see their own current brain activation level (BOLD % signal change) from the individually defined feedback target region in the dorsal anterior cingulate cortex (experimental group), or the control region (control group). They will see the current activation level presented with a simple a visual thermometer display, which will be continuously updated (every 1.5 second). The thermometer will be individually scaled according to the activation level measured during the previous localizer task. Participants will be instructed to increase and maintain activation levels to a 50% or to a 100% level, depending on the target level indicated by the red box. The subjects will have no other task than to using mental strategies to manipulate their brain activation level and observe and reflect on the changes in the displayed activation level while they are doing this.

The training will last approximately 30 minutes and consist of 3x 8 “neurofeedback” blocks of 30 seconds during which they will manipulate their brain activation, each neurofeedback block being followed by a resting period of 20 seconds. After a series of 8 blocks there will be a self-paced break. Finally, 8 “transfer” blocks will follow, during which subjects will be asked to apply whatever strategy they have learned previously, but now without receiving neurofeedback. They will thus be asked to transfer what they have learned during the training to a situation without neurofeedback.

Intervention Type
Behavioural

Primary outcome measure
The severity of ADHD symptoms are measured using the ADHD-DSM-IV rating scale fully based on the DSM-IV before and after training.

Secondary outcome measures
1. Sustained attention is measured using both the Sustained Attention dots task (SA-DOTS) as well as the Sustained Attention to Response Task (SART) before and after training
2. Working memory is measured using the Digit Span subtest of the WAIS-III-NL to assess verbal working memory and the visuo-spatial Nback task to assess visuo-spatial working memory before and after training
3. Cognitive control during interference is measured using the Multi-Source Interference Task before and after training

Overall study start date
01/03/2012

Completion date
01/09/2014

Eligibility

Key inclusion criteria
1. Diagnosis of ADHD according to the DSM-IV TR criteria (American Psychiatric Association, 2000)
2. Aged 18 years and over
3. Psychopharmaca-naïve or –free, or being on a fixed dose of medication for the study period (patients may pro-actively opt for non-medical treatment)
4. Passing fMRI screening criteria, which consist of the following:
4.1. No previous brain operation
4.2. No epilepsy
4.3. No implants as for example pacemakers or an implanted insulin pump
4.4. No metal parts in the body (protheses, implants, clips on blood vessels, spiral, or other metal objects except teeth fillings and connectors)
4.5. No claustrophobia
4.6. No pregnancy
4.7. IQ > 100 according to block design and vocabulary test WAIS-III-NL (Uterwijk, 2005)

Participant type(s)
Patient

Age group
Adult

Lower age limit
18 Years

Sex
Both

Target number of participants
20

Key exclusion criteria
1. Participation in another clinical trial simultaneously
2. Previous participation in neurofeedback training
3. Other significant medical condition (e.g. neurological, heart or vascular diseases) or regular use of medication other than psychostimulants if the dosis of medication is not fixed for the study period
4. Current diagnosis of one or more Axis I diagnosis other than ADHD according to the DSM-IV TR criteria (American Psychiatric Association, 2000) (e.g. depression, psychosis, tics, autism, eating disorders or behavioural disorders)
5. Current alcohol or drug abuse according to the DSM-IV TR criteria (American Psychiatric Association, 2000)

Date of first enrolment
01/03/2013

Date of final enrolment
01/03/2014

Locations

Countries of recruitment
Netherlands

Study participating centre
Donders Institute for Brain, Cognition and Behaviour
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Sponsor information

Organisation
BrainGain Consortium

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Sponsor type
Research council

Funder(s)

Funder type
Research organisation

Funder Name
BrainGain Consortium

Results and Publications

Publication and dissemination plan
The results of this study will be submitted to peer-reviewed journals for publication.

Intention to publish date
30/06/2017

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article	results	26/01/2017		Yes	No