Brain Plasticity Related to Psycho-motor Skills in Catheter-based Interventions
Paul, Katja; Cnossen, Fokeltje; Taatgen, Niels; Lanzer, Peter; Sehm, Bernhard; Villringer, Arno

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2017

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):

Copyright
Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): http://www.rug.nl/research/portal. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Download date: 10-09-2020
Introduction

• A fascinating property of the human brain is its ability to reorganize as a result of experience.
• Experimental evidence of practice-related brain change has been shown as a result of simple and increasingly complex visuo-motor training tasks, even after brief training periods.

Previous studies examining brain plasticity related to complex visuo-motor skill training found:
• Increased grey matter volume in MT/V5 and (posterior) intraparietal sulcus.
• Increased fractional anisotropy of white matter underlying the right posterior intraparietal sulcus.
• Increased connectivity in fronto-parietal (and cerebellar networks)

Catheter-based interventions (CBIs):
• Minimal access procedures, where a catheter is used to diagnose and/or treat the target site.
• CBIs have many advantages over open procedures.
• However, patient outcomes heavily dependent on the catheter-handling skills of the operator and there are great performance differences.
• CBIs are complex procedures and cognitively challenging to execute. Therefore, they constitute an interesting real-life task to study brain plasticity related to acquiring complex skills and to explore whether expected changes are behaviourally relevant.

Research questions and hypotheses:

Are there specific functional & structural neural changes after overall learning and do specific neural changes correlate with performance gain?
• Hypothesis: Specific training-related changes in MT/V5 and/or hippocampus, intraparietal sulcus & fronto-parietal networks are expected, the correlation with performance gains will be explored.

Do structural and/or functional baseline MRI parameters predict learning of catheter-based interventions?
• Hypothesis: MT/V5 and intraparietal areas are expected to predict learning of CBIs.

Methods

Participants:
• 2 groups (n=40), healthy young medical students.
• Passed "Physikum", no experience with CBIs.
• Normal or corrected to normal vision, right-handed.
• No MRI contraindications.

Measures:

Cognitive:
• Accuracy & reaction time in cognitive tasks (cognitive control, task-switching and visuo-spatial ability).
• Average amount of pegs inserted with the right hand in the manual dexterity task.

Behavioural:
• Total time required to complete the task.
• Total fluoroscopy, cine time and contrast agent used to complete the task.
• Number of catheter handling and table movement errors.

Neuronal:
• Change in grey matter (T1-weighted scan).
• Change in white matter (diffusion weighted scan).
• Change in functional connectivity (resting-state fMRI).

Analysis:
• Region of interest analysis (MT/V5, hippocampus, intraparietal sulcus) as well as whole brain analysis.
• Eigenvector centrality analysis to examine network changes.
• Group*time-point interaction (controlled for multiple comparisons).
• Changes in experimental group > control group?
• Changes from pre to post scan > baseline to pre scan?
• Correlation between structural and functional changes (in %) with performance gains (% improvement day1+ day2+day3)/3.
• Correlation between certain baseline MRI parameters (before learning) and performance gains (%).

Procedure

MRI scanning protocol:
• T1-weighted scan: MP2RAGE sequence.
• Diffusion weighted imaging: multiband EPI sequence.
• Resting state fMRI, multiband BOLD EPI-sequence.

Training on the catheter-lab simulator:

Aim: Perform selective access to the right internal carotid artery.
• Individual training for 2 hours on three consecutive days.
• Motor proficiency questionnaire.
• Instruction video about the task & written instructions.
• During the first trial, participants are walked through the procedure.
• On each training day, catheter-handling tips are given until selective access to the target artery is successfully performed once.
• The training complexity advances as the training progresses.
• Training complexity is defined by patient anatomy and morphology.

Control group:
• Participants are age and gender matched to the experimental group.
• Simplified training task on the simulator.
• Participants also watch an instruction video, receive written instructions and perform the task under supervision.
• The simplified task does neither require table movements, spatial sense (converting 2D image into 3D environment) nor selective access with the catheter.
• The rest of the work-flow is exactly the same.

References