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The effects of an online piano training programme, PIANO-Cog, on cognition and brain microstructure in healthy older adults.

Submission date
13/11/2024

Recruitment status
No longer recruiting

Registration date
13/11/2024

Overall study status
Completed

Last Edited
17/12/2025

Condition category
Mental and Behavioural Disorders

[_] Prospectively registered
[X] Protocol
[_] Statistical analysis plan
[_] Results
[_] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
As we age, our cognitive abilities can decline. Research suggests that activities combining sensory and motor skills, like musical training, might help improve cognitive functions in older adults. This study aims to test a self-guided piano training program called PIANO-Cog, which participants can do at home. The goal is to see if this program is acceptable to participants and if a larger study would be feasible.

Who can participate?
Cognitively healthy volunteers over the age of 50, with little-to-no musical training, can take part in this study.

What does the study involve?
Participants will undergo 2 hours of cognitive testing and a 30-minute MRI scan before and after an 8-week intervention period. They will be randomly assigned to either the piano training group or a control group. The piano group will receive a 30-minute training video each week and are asked to practice for 30 minutes, 5 days a week. The control group will continue their usual activities and avoid any musical or cognitive training during the study.

What are the possible benefits and risks of participating?
Participants may not directly benefit from the study. Those in the piano training group will receive a keyboard for 8 weeks, but it must be returned after the study. Control group participants will get the piano training videos after the study ends. There are small risks associated with MRI scanning, such as discomfort in confined spaces and the need to remain still. Cognitive testing can be tiring, but breaks will be provided as needed.

Where is the study run from?
Cardiff University Brain Research Imaging Centre (CUBRIC), Maindy Road, Cardiff (UK)

When is the study starting and how long is it expected to run for?
March 2023 to July 2025

Who is funding the study?
School of Psychology, Cardiff University (UK)

Who is the main contact?
Fionnuala Rogers (RogersF2@cardiff.ac.uk)

Contact information

Type(s)
Public, Scientific, Principal investigator

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Study information

Scientific Title
The effects of Piano Instruction for Adult Novices as Online Cognitive intervention (PIANO-Cog) on executive function, fluid intelligence and white and grey matter microstructure compared to passive control in healthy older adults

Acronym
PIANO-Cog

Study objectives
Our primary hypotheses are:
1. PIANO-Cog will be a feasible online cognitive training intervention for healthy non-musicians over the age of 50 years old.
2. A future fully-powered RCT into the effects of 8-weeks of home-based PIANO-Cog training compared to no-training control will be feasible.

Our secondary hypotheses are that, in healthy non-musicians (>50 years), 8 weeks of piano training will:
1. Lead to improvements in processing speed, response inhibition and attention switching as measured by digit-symbol substitution test, a Stroop test, Go/No-go test and verbal fluency category switching tasks

2. Lead to grey and white matter microstructural changes in auditory, motor and somatosensory networks measured using DTI and metrics from the biophysical models, NODDI and SANDI. Specifically, we expect to see an increase in soma density and soma size metrics from SANDI model and increased orientation dispersion and intracellular density metrics from the NODDI model following piano training compared to the control group.
3. Underlying microstructural changes will be associated with changes in processing speed (digit-symbol task) and EF (N-back, Stroop and Go/No-go tasks).

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 20/06/2024, School of Psychology Research Ethics Committee, Cardiff University (70 Park Place, Cardiff, CF10 3AT, United Kingdom; +44(0)29 208 70707; psychethics@cardiff.ac.uk), ref: EC.23.05.16.6801GRA

Primary study design
Interventional

Study design
Two-arm single-blinded randomized controlled trial (pilot feasibility study)

Study type(s)
Prevention, Quality of life

Health condition(s) or problem(s) studied
Age-related cognitive decline and neurodegeneration.

Interventions
Cognitively healthy non-musicians over 50 years will be recruited and screened for cognitive impairment and < 4 years music experience. They will be assigned to either self-guided piano training or a passive control for 8 weeks. Piano training consists of video-guided tutorials which can be carried out in participant's homes. Cognitive assessments and diffusion MRI will take place before and after the intervention period.

The groups will be stratified by sex and by two age categories: 50-65 years and >65 years. Pseudo-random numbers will be used to generate randomised group allocation per stratum using R version 4.41, and implemented by the lead researcher. Neither participants nor the researcher conducting baseline testing will be informed of group allocation until after baseline testing is completed, as the algorithm determining group allocation will take place only at the end of testing.

Intervention Type
Behavioural

Primary outcome(s)
1. Recruitment rate = 100 x (number of participants who provided consent / number of participants eligible) %
2. Retention rate = 100 x (number of participants who complete follow-up testing / number of participants who provided consent)
3. Adherence rate (frequency) = 100 x (number of days' practice logged / 40 days) %

4. Adherence rate (duration) = 100 x (number of minutes practice logged / (40 days x 30 minutes average session duration = 1,200 minutes) %
5. Acceptability of the intervention is assessed using an evaluation survey consisting of 27 x 6-point Likert scale items on how participants perceived the quality, difficulty level and content of the training. Four qualitative questions are also included to ask participants for their individual feedback.

Key secondary outcome(s)
1. Processing speed measured as the number of correct responses within 90 seconds on the symbol-digit test from the WAIS-III.
2. Inhibitory control for motor responses measured as the rate of correct responses and latencies on the Go/No-go test.
3. Inhibitory control for distractor information measured as the number of correct responses and latencies on a computerised Stroop task for congruent versus incongruent trials.
4. Working memory capacity measured as the number of correct responses on the digit span task (forward and backward conditions) from the WAIS-III.
5. Updating of working memory measured as the error rates on the N-back.
6. Visual attention and attention-switching measured by completion times on the Trail-Making Task Parts A and B respectively.
7. Verbal fluency measured by the number of correct responses provided on the letter, category and category-switching subtests of the D-KEFS verbal fluency test.
8. Verbal memory measured as the total number of words recalled on the California Verbal Learning Test - II.
9. Musical abilities measured as score from the micro-PROMS which assess a participant's ability to detect changes in samples of music.
10. Piano performance measured as the number of correct notes and timing accuracy measured whilst playing 5-finger scales using a MIDI-keyboard and Reaper, compared with a reference.
11. Changes in grey matter microstructure assessed by the soma size and soma density metrics from the Soma And Neurite Density Imaging (SANDI) model which will be applied to multi-shell high angular resolution diffusion imaging data (msHARDI) collected using ultra-high gradients of the Siemens Connectom.
12. Changes in white matter microstructure assessed using the Neurite Orientation Dispersion and Density Imaging (NODDI) model which provides the isotropic signal fraction (ISOSF) as an estimate of free water, intracellular signal fraction as an estimate of axon density, and the orientation dispersion index (ODI) as an estimate of axon orientation and dispersion.

Completion date
30/07/2025

Eligibility

Key inclusion criteria
1. >50 years old
2. Fluent English speakers
3. Have normal/corrected-to-normal vision and hearing
4. Have less than 4 years of formal musical or dance training
5. Are not involved in any musical activities
6. Have no neurological or psychiatric history that could affect learning (e.g., dementia, stroke or traumatic brain injury, depression requiring hospitalisation)
7. No self-reported difficulty with hand movement
8. No self-reported learning disabilities

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Mixed

Lower age limit
50 Years

Upper age limit
99 Years

Sex
All

Total final enrolment
0

Key exclusion criteria
1. Impaired hearing or vision
2. Neurological diagnosis
3. Current involvement in other cognitive training or musical activities (e.g., choir singing, dance or exercise to music classes)
4. More than 4 years of formal music or dance lessons
5. Currently taking psycho-reactive medications which affect memory performance
6. Participants with MRI contra-indications (e.g., pacemakers, stents, cochlear implants, or other metal in the body such as metallic plates, screws or clips) will not be scanned, but will still be eligible for training and cognitive and motor testing

Date of first enrolment
15/08/2024

Date of final enrolment
01/06/2025

Locations

Countries of recruitment
United Kingdom

Wales

Study participating centre
CUBRIC
Maindy Road

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Sponsor information

Organisation
Cardiff University

ROR
https://ror.org/03kk7td41

Funder(s)

Funder type
University/education

Funder Name
School of Psychology, Cardiff University

Alternative Name(s)

Funding Body Type
Private sector organisation

Funding Body Subtype
Universities (academic only)

Location
United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study will be stored in a publicly available repository. Cognitive and MRI data will be made openly available on OSF.

IPD sharing plan summary
Stored in publicly available repository

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?

Protocol article	version 3	17/12/2025	17/12/2025	Yes	No
Participant information sheet		14/06/2024	13/11/2024	No	Yes