DATA NOTE

Attention Network Test fMRI data for participants with Parkinson's disease and healthy elderly [version 1; peer review: 2 approved]

Trevor K. M. Day [1], Tara M. Madhyastha[1,2], Mary K. Askren[1], Peter Boord[1], Thomas J. Montine[3], Thomas J. Grabowski[1,4]

[1]Department of Radiology, University of Washington, Seattle, WA, 98195, USA
[2]Department of Psychology, University of Washington, Seattle, WA, 98195, USA
[3]Department of Pathology, Stanford University, Stanford, CA, 94305, USA
[4]Department of Neurology, University of Washington, Seattle, WA, 98195, USA

v1 **First published:** 04 Jun 2019, **8**:780
https://doi.org/10.12688/f1000research.19288.1
Latest published: 04 Jun 2019, **8**:780
https://doi.org/10.12688/f1000research.19288.1

Abstract

Here, we present unprocessed and preprocessed Attention Network Test data from 25 adults with Parkinson's disease and 21 healthy adults, along with the associated defaced structural scans. The preprocessed data has been processed with a provided Analysis of Functional NeuroImages *afni_proc.py* script and includes structural scans that were skull-stripped before defacing. All acquired demographic and neuropsychological data are included.

Keywords

Attention Network Task, ANT, fMRI, Parkinson's disease, attention

This article is included in the INCF gateway.

Open Peer Review

Reviewer Status ✓ ✓

	Invited Reviewers	
	1	**2**
version 1 04 Jun 2019	✓ report	✓ report

1 **Brian Berman**, University of Colorado Anschutz Medical Campus, Aurora, USA

2 **Yong Jeong**, Korea Advanced Institute of Science and Technology, Daejeon, South Korea

Any reports and responses or comments on the article can be found at the end of the article.

Corresponding author: Trevor K. M. Day (tkmday@uw.edu)

Author roles: Day TKM: Data Curation, Software, Writing – Original Draft Preparation, Writing – Review & Editing; **Madhyastha TM**: Formal Analysis, Project Administration, Software, Supervision, Writing – Review & Editing; **Askren MK**: Conceptualization, Data Curation, Formal Analysis, Investigation, Project Administration, Software, Writing – Review & Editing; **Boord P**: Data Curation, Formal Analysis, Investigation, Project Administration, Writing – Review & Editing; **Montine TJ**: Conceptualization, Funding Acquisition, Writing – Review & Editing; **Grabowski TJ**: Conceptualization, Funding Acquisition, Resources, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This research was supported by NIH RC4 NS073008 (PI: Grabowski), P50 NS062684 (PI: Montine). Peter Boord received postdoctoral support under the Ruth L. Kirschstein National Research Service Award, T32AG0000258.
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

How to cite this article: Day TKM, Madhyastha TM, Askren MK *et al.* **Attention Network Test fMRI data for participants with Parkinson's disease and healthy elderly [version 1; peer review: 2 approved]** F1000Research 2019, **8**:780
https://doi.org/10.12688/f1000research.19288.1

First published: 04 Jun 2019, **8**:780 https://doi.org/10.12688/f1000research.19288.1

Introduction

Attention dysfunction is a common symptom of Parkinson's disease (PD) and has a significant impact on quality of life. Approximately half of all people with PD suffer from attention and/or memory symptoms (Barone *et al.*, 2009).

The data included here is a subset of data from a study (Cholerton *et al.*, 2013) that used the Attention Network Test (ANT) (Fan *et al.*, 2005) to measure three aspects of attention: alerting (achieving and maintaining an alert state), orienting (selecting the spatial location of sensory input), and executive control (resolving conflict). We acquired structural and functional MRI images at two occasions in participants with and without PD, with six randomly ordered repetitions of the ANT task (labeled 1–6) at each occasion. Each numbered run represents the same stimulus list between subjects, although the six runs were presented to each subject in a different order.

Data described in this paper have previously been analyzed in Boord *et al.* (2017) and Madhyastha *et al.* (2015), wherein the runs were labeled A-F rather than 1–6.

Materials and methods

Ethical statement

Procedures were approved by the University of Washington Institutional Review Board (#41304) and subjects provided written informed consent.

Participants

The sample of subjects includes 25 participants with PD and 21 healthy controls (HC) who participated in two scanning sessions, which were one to three weeks apart. PD participants were recruited from a larger parent study where they underwent extensive clinical examination and neuropsychological assessment (Cholerton *et al.*, 2013).

Demographic information is provided in Table 1. PD and HC participants did not differ on age ($t(40) = 1$; $p = 0.2$) or years of education ($t(40) = 0.6$, $p = 0.6$), but did differ on the Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS; Goetz *et al.*, 2007) part III ($t(30) = 10$; $p < .001$). Participants also underwent a battery of neuropsychological tests (Cholerton *et al.*, 2013). Neuropsychological test results are provided in Table 2. PD and HC participants did not differ on any of the cognitive tests that were administered to both groups. HC participants obtained only a subset of the measurements.

One subject (RC4206) had an acquisition error during their second session structural scan. Correspondingly, their structural scan from their first session has been copied for their second session to create a valid Brain Imaging Data Structure (BIDS) directory.

Table 1. Demographics of sample. Participants with PD and healthy controls did not differ on age, UPDRS III, or years of education.

	Parkinson Disease	Healthy Controls
N	25	21
Age (years)	66.1 (10.0)	62.1 (9.9)
Sex (number of males)	18	9
Hoehn & Yahr	2.0 (0.3)	
UPDRS I	10.0 (5.7)	
UPDRS II	8.8 (5.3)	
UDPRS III	23.6 (8.7)	0.8 (1.4)
UPDRS IV	2.0 (3.7)	
Years since disease onset	8.4 (4.8)	
Education (years)	16.2 (2.1)	15.9 (2.4)
Handedness (# right)	21	20

Table 2. Summary statistics for cognitive variables. Controls are included where they were administered the exam.

	Parkinson Disease	Healthy Controls
BVRT total correct (delayed)	1 (1.35)	
Copy of Cube	0.78 (0.42)	0.81 (0.4)
Backward digit span	7.46 (2.45)	
Forward digit span	9.5 (1.59)	
Digit span total score	17.08 (3.49)	
Clock drawing (total)	12.44 (1.34)	12.62 (0.86)
Stroop total correct	189.26 (24.99)	
JLO total correct	12.69 (1.89)	
Letter number sequencing total	10.15 (2.51)	
Logical Memory Test (total delay story units recalled)	9.75 (4.55)	
Logical Memory Test (total immediate story units recalled)	11.92 (3.78)	
Logical Memory Test (recognition total score for Story A)	11.69 (2.06)	
Mattis Dementia Rating Scale	138.81 (3.76)	
MMSE score	28.69 (1.19)	
MoCA score	26.44 (2.06)	27.29 (1.95)
Shipley-2 Vocabulary	34.85 (3.86)	
Tower of London total correct	4.7 (3.15)	
Tower of London total time	349.25 (163.78)	
Trail Making Test A-B (s)	-44.69 (29.32)	
Trail Making Test A (s)	29.73 (10.53)	
Trail Making Test B (s)	74.42 (31.53)	
WAIS Digit Symbol score	47.73 (7.94)	

Abbreviations: Boston Visual Retention Test (BVRT); Judgment of Line Orientation (JLO); Mini-Mental State Examination (MMSE); Montreal Cognitive Assessment (MoCA); Weschler Adult Intelligence Scale (WAIS)

MRI acquisition

At each of the two sessions, we acquired six repetitions of the task and T1-weighted structural images from each subject. Data were acquired using a Philips 3.0T X-Series Achieva MR System (Philips Medical Systems, software version R2.6.3) with a 32-channel SENSE head coil. Each session included functional and structural scans. For task scans, whole-brain axial echo-planar images (43 sequential ascending slices, 3 mm isotropic voxels, field of view = 240 x 240 x 129 mm, repetition time = 2400 ms, echo time = 25 ms, flip angle = 79°, SENSE acceleration factor = 2) were collected parallel to the AC-PC line. Each functional scan was 149 volumes (5.96 min). A sagittal T1-weighted 3D MPRAGE (176 slices, matrix size = 256 x 256, inversion time = 1100 ms, turbo-field echo factor = 225, repetition time = 7.46 ms, echo time = 3.49 ms, flip angle = 7°, shot interval = 2530 ms) with 1 mm isotropic voxels was also acquired for registration and tissue analyses.

In total, 45 subjects completed all six task scans in both sessions. One subject did not complete the second session; and one subject is missing task data for the first four task scans (out of six) at the second session.

Most scans were available in the Digital Imaging and Communications in Medicine (DICOM) file format; and were converted to the Neuroimaging Informatics Technology Initiative (NIfTI) file format using the Analysis of Functional NeuroImages (AFNI) program *dcm2niix_afni*. Subjects with missing DICOMs had Philips format PAR/RECs available and were also converted to NIfTI format using AFNI *dcm2niix_afni* (Day *et al.*, 2019).

ANT

We used the ANT (Fan *et al.*, 2005; Fan *et al.*, 2002), which combines cues and targets within a single reaction time task to measure the efficiency of the alerting, orienting, and executive attention networks. Each session included six separate task runs. Each run included two buffer trials followed by 36 reaction time trials (a total of 432 trials per subject).

A full description of the ANT can be found in Fan *et al.* (2005). Briefly, in the ANT, subjects are asked to determine the direction of an arrow (left or right); which is flanked by four other arrows. These flanker arrows either point the same direction as the probe arrow ("congruent") or the opposite direction ("incongruent"). The row of arrows appears either above or below the center of the screen, and prior to displaying the arrows, the participants are presented with a) no cue; b) a spatial cue that reflects where the arrows will appear; or c) a center cue. A fixation cross appeared throughout the trial.

fMRI preprocessing

fMRI data were preprocessed using AFNI (Cox, 1996), version AFNI_17.3.00 (Oct. 12, 2017). Processing steps were generated with *afni_proc.py* (version 5.18, Sept. 12, 2017), treating each repetition of the ANT task as a single scan (i.e. no concatenation).

afni_proc.py call

First four parameters are set on a per-subject basis and represented here with asterisks (*).

```
afni_proc.py \
      -subj_id                  *                                    \
      -dsets                    *                               \
      -outdir                   *                                    \
      -script                   *                                    \
      -copy_anat                T1.nii.gz                            \
      -blocks despike tshift align tlrc volreg blur mask regress    \
      -align_opts_aea           -cost    lpc+ZZ                      \
      -tlrc_base                MNI152_T1_2009c+tlrc                 \
      -tlrc_NL_warp                                                  \
      -volreg_warp_dxyz         2                                    \
      -volreg_align_e2a                                              \
      -volreg_tlrc_warp                                              \
      -volreg_align_to          MIN_OUTLIER                          \
      -regress_anaticor                                              \
      -regress_est_blur_epits                                        \
      -regress_est_blur_errts
```

We used the following blocks: despike, tshift (default), align, tlrc, volreg (default), blur (default), regress (default). Frames were despiked and slice-timing corrected (tshift). During the align stage, we aligned the functional to the structural using the *lpc+ZZ* cost function. Following structural alignment, we aligned the data to the Montreal Neurological Institute (MNI) 152 standard space (2009c) template, and the data was blurred with a 4 mm full-width half-max filter and masked using *3dAutomask* algorithms. Frames were registered to the minimum outlier and then aligned to standard space. We used *anaticor* (Jo *et al.*, 2010) to regress out the white matter signal and remove the effects of motion. The final result of the AFNI processing was converted to NIFTI using AFNI *3dAFNIto NIFTI.* All scans completed AFNI processing.

The anatomical scans were defaced using *pydeface* before organizing in BIDS format. Skull-stripping and registration were performed on the undefaced anatomical scans.

All code is available on GitHub (Day, 2019).

Organization

Data are organized according to the Brain Imaging Data Structure (BIDS) (Gorgolewski *et al.*, 2016). All 47 subjects have two sessions, with corresponding `func/` and `anat/` directories.

The AFNI-processed data are included in `derivatives`, matching the format of `Nifti/`. Also included for convenience are skull-stripped anatomical images, as skull-stripping is known to occasionally fail on defaced images.

Finally, individual scans have matching JSON files in both datasets, created by *dcm2niix_afni*. Supplementing these files are higher level JSON files (following the naming convention `task-ANT?_bold.json`) that supply the "TaskName" and "SliceTiming" parameters. Slice timing information is required by the BIDS format, and as the pre-processed ("derivatives") data has been slice-timing corrected, an array of zeros is provided for this field.

Task timing data are included on the scan level. The "onset" and "duration" columns are in seconds, and the "trial_type" column includes cue events ("CenterCue," "SpatialCue," "NoCue"), target events ("Congruent," "Incongruent"), and cue/target errors ("CueErr," "TargetErr"). Only correct-response trials are included. Errors are also generated when the subject responded too early or not at all.

The processing script (`afniscript.sh`) and demographic information (`demographics.csv`) are included at the top level.

Data availability

Underlying data

OpenNeuro: ANT: Healthy aging and Parkinson's disease. https://doi.org/10.18112/openneuro.ds001907.v2.0.3 (Day *et al.*, 2019)

This project contains the following underlying data:

- sub-RC4101/ – sub-RC4227/ (scans of the 46 participants at two sessions each)

These folders each contain the following underlying data:

- ses-1/anat (T1w.json and defaced T1w.nii.gz files for session 1)
- ses-1/func (bold.json, bold.nii.gz and events.tsv files for runs 1–6 of session 1)
- ses-2/anat (T1w.json and defaced T1w.nii.gz files for session 2)
- ses-2/func (bold.json, bold.nii.gz and events.tsv files for runs 1–6 of session 2)

Extended data

OpenNeuro: ANT: Healthy aging and Parkinson's disease. https://doi.org/10.18112/openneuro.ds001907.v2.0.3 (Day *et al.*, 2019)

This project contains the following extended data:

- . bidsignore (file to suppress BIDS naming warning messages)
- afniscript.sh (processing script)
- dataset_description.json (BIDS dataset parameters)
- demographics.csv (demographic information for participants)
- README (README file, including changelog)
- task-ANT_bold.json (acquisition parameters for task scan)
- derivatives/ (AFNI-processed functional images within func/ directories; skull-stripped anatomical images within anat/)

Software availability

- Source code available from: https://github.com/IBIC/UdallANT
- Archived source code at time of publication: https://doi.org/10.5281/zenodo.2847832 (Day, 2019)
- License: MIT

Grant information

This research was supported by NIH RC4 NS073008 (PI: Grabowski), P50 NS062684 (PI: Montine). Peter Boord received postdoctoral support under the Ruth L. Kirschstein National Research Service Award, T32AG0000258.

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Acknowledgements

We are grateful to the participants of the Pacific Udall Center for contributing their time and data to advance Parkinson's research.

References

Barone P, Antonini A, Colosimo C, *et al.*: **The PRIAMO study: A multicenter assessment of nonmotor symptoms and their impact on quality of life in Parkinson's disease.** *Mov Disord.* 2009; **24**(11): 1641–1649.
PubMed Abstract | Publisher Full Text

Boord P, Madhyastha TM, Askren MK, *et al.*: **Executive attention networks show altered relationship with default mode network in PD.** *Neuroimage Clin.* 2017; **13**: 1–8.
PubMed Abstract | Publisher Full Text | Free Full Text

Cholerton BA, Zabetian CP, Quinn JF, *et al.*: **Pacific Northwest Udall Center of excellence clinical consortium: study design and baseline cohort characteristics.** *J Parkinsons Dis.* 2013; **3**(2): 205–214.
PubMed Abstract | Publisher Full Text | Free Full Text

Cox RW: **AFNI: software for analysis and visualization of functional magnetic resonance neuroimages.** *Comput Biomed Res.* 1996; **29**(3): 162–173.
PubMed Abstract | Publisher Full Text

Day TKM, Madyastha TM, Boord P, *et al.*: **Udall Pilot (ANT).** *OpenNeuro.* 2019.
http://www.doi.org/10.18112/openneuro.ds001907.v2.0.3

Day TKM: **'ANT: Healthy aging and Parkinson's disease' processing script (Version 1.0.0).** *Zenodo.* 2019.
http://www.doi.org/10.5281/zenodo.2847832

Fan J, McCandliss BD, Fossella J, *et al.*: **The activation of attentional networks.** *NeuroImage.* 2005; **26**(2): 471–479.
PubMed Abstract | Publisher Full Text

Fan J, McCandliss BD, Sommer T, *et al.*: **Testing the efficiency and independence of attentional networks.** *J Cogn Neurosci.* 2002; **14**(3): 340–347.
PubMed Abstract | Publisher Full Text

Goetz CG, Fahn S, Martinez-Martin P, *et al.*: **Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS): Process, format, and clinimetric testing plan.** *Mov Disord.* 2007; **22**(1): 41–47.
PubMed Abstract | Publisher Full Text

Gorgolewski KJ, Auer T, Calhoun VD, *et al.*: **The brain imaging data structure, a format for organizing and describing outputs of neuroimaging experiments.** *Sci Data.* 2016; **3**: 160044.
PubMed Abstract | Publisher Full Text | Free Full Text

Jo HJ, Saad ZS, Simmons WK, *et al.*: **Mapping sources of correlation in resting state FMRI, with artifact detection and removal.** *NeuroImage.* 2010; **52**(2): 571–582.
PubMed Abstract | Publisher Full Text | Free Full Text

Madhyastha TM, Askren MK, Boord P, *et al.*: **Dynamic connectivity at rest predicts attention task performance.** *Brain Connect.* 2015; **5**(1): 45–59.
PubMed Abstract | Publisher Full Text | Free Full Text

Open Peer Review

Current Peer Review Status: ✔ ✔

Version 1

Reviewer Report 11 May 2020

https://doi.org/10.5256/f1000research.21144.r62815

✔ **Yong Jeong**
Department of Bio and Brain Engineering, Korea Advanced Institute of Science and Technology, Daejeon, South Korea

This data note is on the brain fMRI data of patients with Parkinson's disease in Openneuro.

They provide unprocessed and also preprocessed fMRI data from 25 patients and 21 healthy controls acquired during the attention network test tasks along with T1 structural MRI. The MRI acquisition parameters and preprocessing codes are also provided thus other researchers can replicate the results or use them for other purposes such as machine learning-based classification. They also provide the basic demographics and the performance of cognitive tests.

Given increased activities of neuroimage data sharing, the data has values of providing unique fMRI data from patients. There are available task fMRI data from normal controls, however, limited data from patients with neurological diseases or psychiatric disorders. Furthermore, patients with Parkinson's disease showing motor problems have difficulties in performing task in the scanner and commonly have motion artifacts.

There are some items needed for the wide use of the data. First, the authors need to provide the medication history of the patients, at least the levodopa dose equivalency. Since, the medication influence a lot on the motor and cognitive performance in the patients and also on brain activities, one may use them as covariates depending on their interests. Second, they need to provide the performance of ANT task corresponding task scan. One can separate sessions into correct or fail, omit, or commit. This approach is popular in the attention fMRI experiment. Third, it will be great if they can provide resting fMRI and/or DTI data. These data can be used for investigating the functional/structural connectivity or network change in the disease.

Is the rationale for creating the dataset(s) clearly described?
Yes

Are the protocols appropriate and is the work technically sound?
Yes

Are sufficient details of methods and materials provided to allow replication by others?
Partly

Are the datasets clearly presented in a useable and accessible format?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Neuroimaging in neurological diseases

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 19 June 2019

https://doi.org/10.5256/f1000research.21144.r49476

Brian Berman
Department of Neurology, University of Colorado Anschutz Medical Campus, Aurora, CO, USA

The authors have done a nice job presenting their imaging data that are being made available for public download. The article is well written and concise and provides background information necessary to enable the utilization of these data by other investigators. A sampling of imaging data provided online was looked at and appears to be appropriate and of good quality. The accompanying demographics file was reviewed and contains pertinent data. One issue I noticed on quick review is that there are MoCA and MMSE scores that exceed 30. Otherwise I have largely minor suggestions in order to improve the accessibility and utilization of these data by others:

- Please state reason for repeating scanning sessions. If time between two sessions may be relevant for analysis, then please provide timing log for each subject.
- Would include sex difference comparison between groups. They look like they may be different.
- BIDS in Materials section could be referenced as is done later under “Organization”.
- Would use “MDS-UPDRS” in Table 1 to distinguish values from the “UPDRS” scale.
- Tables should note if parentheses represent standard deviations. (Parentheses are incorrectly used to note units.)
- There were 149 volumes resulting in 357.6 sec of scanning time. Were the scans actually 6 min long? Were there any dummy scans at begging for T1 equilibration and if so have these been removed?
- Would explicitly state matrix size and thickness for EPI scans. Was there any gap?
- Under “Organization” do not need to define BIDS again. Also the sentence about “skull-stripped anatomical images” being included is confusing as all images provided are the defaced images.

Is the rationale for creating the dataset(s) clearly described?
Yes

Are the protocols appropriate and is the work technically sound?
Yes

Are sufficient details of methods and materials provided to allow replication by others?
Yes

Are the datasets clearly presented in a useable and accessible format?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Parkinson's disease, neuroimaging

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.