

DOCUMENTATION

of

RESTRICTED ACCESS DATA

in

MIDUS Refresher 2

Neuroscience Project (P5)

University of Wisconsin ♦ Institute on Aging
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TABLE OF CONTENTS

INTRODUCTION	2
BEHAVIORAL.....	3
OUT-OF-SCANNER PSYCHOPHYSIOLOGY EMOTIONAL RESPONSE TASK.....	3
AMBIGUOUS FACES TASK	3
FREE RECALL TASK.....	4
PICTURE RATINGS TASK.....	4
fMRI EMOTIONAL RESPONSE TASK.....	6
FACE RATINGS TASK.....	7
PSYCHOPHYSIOLOGICAL MEASURES	7
OUT-OF-SCANNER PSYCHOPHYSIOLOGY	7
DURING THE fMRI	7
IMAGING	8
REFERENCES.....	13

INTRODUCTION

This document is intended to provide an overview of the Neuroscience Project's (P5) MIDUS Refresher 2 data available through restricted access procedures. Please see <https://midus.wisc.edu/midus-neuroscience-repository/> for instructions on how to access.

Restricted data described here are categorized as behavioral, psychophysiology, or imaging data. More details including subject counts, explanations for missing data, and confidentiality procedures are provided in the data access request's accompanying README.

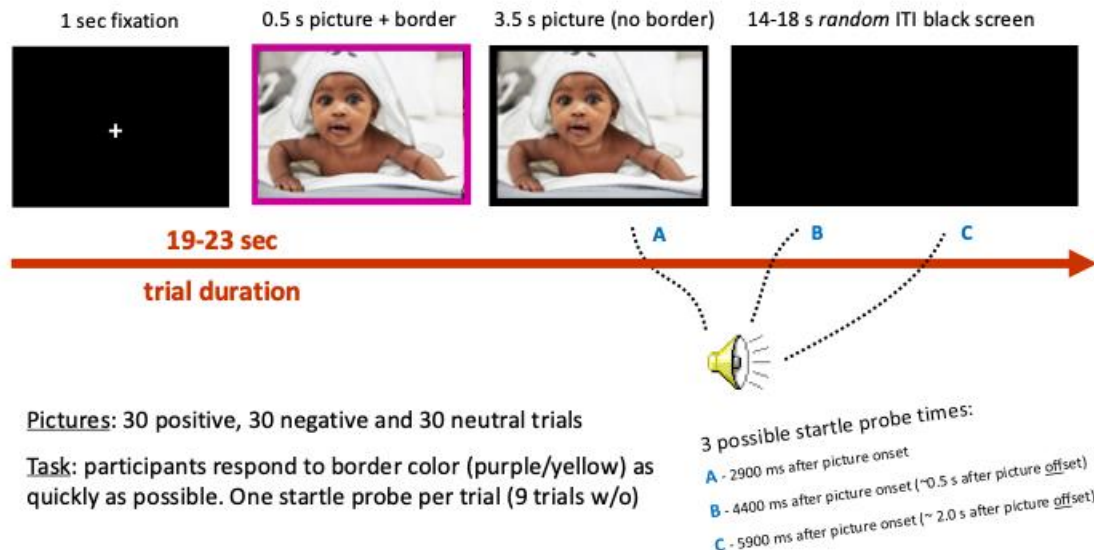
Data type	Number of participants with data
Out-of-scanner psychophysiology Emotional Response Task	208
Ambiguous Faces Task	207
Free Recall	205
Picture ratings (out-of-scanner Emotional Response Task)	201
Structural T1-weighted images (ADNI4 MPRAGE)	158
Structural T2-weighted images (FLAIR)	156
Structural T2-weighted images (CUBE)	156
Structural T2-weighted images (CUBE - Hippocampus)	156
fMRI Emotional Response Task BOLD images + physio	147
fMRI Emotional Response Task behavioral files	147
fMRI resting state BOLD images + physio	144
Diffusion weighted images	*Coming soon*
Perfusion (arterial spin labeling) images	*Coming soon*
Picture ratings (obtained after the scan)	144
Face probe ratings (obtained at home usually 3 days after the scan)	138

These data are arranged and organized according to the Brain Imaging Data Structure specification, available at: <http://bids.neuroimaging.io/>

BEHAVIORAL

Out-of-scanner psychophysiology Emotional Response Task

Psychophysiology trial schema



The Psychophysiology Emotional Response Task presents a series of positive, negative, or neutral images, each briefly framed with a purple or yellow border. Using their right hand, a participant presses the index finger key when the color is purple, and the middle finger key when the color is yellow. The border only displays for 500 ms while the image remains for another 3500 ms. Pictures are selected from the International Affective Picture System (IAPS; Lang, Bradley, and Cuthbert, 2005, 2008) and valence sets (negative, neutral, positive) are matched on luminosity and visual complexity and the number of images rated to be social versus non-social in content. Images are presented using a pseudorandom trial order with the requirement that no more than two pictures from the same valence category are presented sequentially. Within each valence category, stimuli were randomly ordered for each participant by the E-prime task software. The Psychophysiology Emotional Response Task was programmed in E-Prime (Psychology Software Tools, Inc, Pittsburgh, PA) and run on a PC outside the psychophysiology booth in the Waisman Brain Imaging Core, located in the Waisman Center on the UW-Madison campus. Behavioral data were recorded on this PC using E-Prime software with simultaneous psychophysiology data recorded on another PC while the participant was performing the task.

Summary variables will be available via ICPSR and/or the Colectica portal, while the raw behavioral data from this task are on Globus and can be requested following restricted access instructions.

Ambiguous Faces Task

After completing the Emotional Response Task, participants completed the Ambiguous Faces Task (e.g. Neta et al. 2009). Participants were shown faces in quick succession for 500 ms each and 2000 ms between each face. As they saw each face, participants were asked to rate the face as positive or negative by pressing one of two buttons on the keyboard (A or L). Prior to starting the task, the assigned valence of the buttons was randomized so that roughly half of participants used "A" as positive and "L" as negative and half used "A" as negative and "L" as positive. The set of faces had 3 different facial expressions represented (12 happy, 12 angry,

and 24 surprised faces). The task assessed emotional biases in appraisals of the ambiguously-valenced (surprised) faces.

Summary variables will be available via ICPSR and/or the Colectica portal, while the raw behavioral and physiological data from this task are on Globus and can be requested following restricted access instructions.

Free Recall Task

For the Free Recall task, participants were given *exactly* 15 minutes to recall as many of the pictures seen during the out-of-scanner Psychophysiology Emotional Response Task as possible by either typing on a computer, dictating descriptions to the experimenter, or writing descriptions onto a blank sheet of paper. Written descriptions were carefully matched to the appropriate picture by study staff. Summary variables will be available via ICPSR and/or the Colectica portal, while the raw behavioral data of all pictures described per subject are on Globus and can be requested following restricted access instructions.

Picture Ratings Task

After the Free Recall task, participants were asked to rate each picture from the out-of-scanner Psychophysiology Emotional Response Task on scales of valence and arousal using Bradley and Lang's Self-Assessment Manikin (1994). After the completion of functional scans, participants were also asked to rate each picture from the fMRI Emotional Response Task on those same scales of valence and arousal. Instructions reflected which pictures the participants would be rating (i.e. "you saw during the psychophysiology task" became "you saw during the fMRI task")

Instructions to participant:

"Now you will rate the pictures you saw during the psychophysiology task. We need to know how YOU feel when you see these pictures. You will see lots of pictures showing different things that may make you feel happy or unhappy, excited or relaxed, or maybe even angry, scared, or thrilled.

There are no wrong answers. Whatever you feel is the right answer, so simply respond as honestly as you can.

Some of the pictures may elicit an emotional response and others may seem relatively neutral, producing little or no emotional experience. Your rating of each picture should reflect your immediate personal experience and no more.

Please rate each picture AS YOU ACTUALLY FEEL WHILE YOU WATCH THE PICTURE.

Now we will look at the ratings scales so you can get a better idea of the task.

Below you will see 9 figures displaying a range of how you may feel in response to the picture. Please look at them closely. The figures are meant to help you provide your ratings from 1-9.

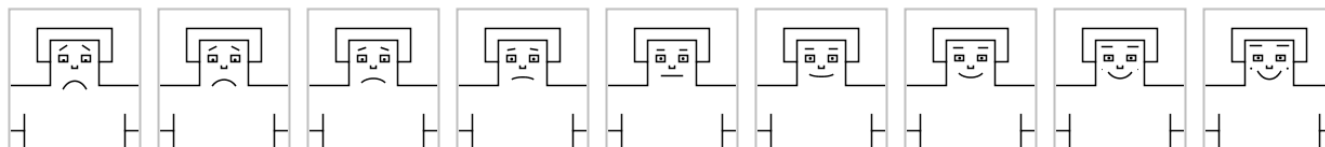
You will use these figures with associated numbers to rate EACH of the pictures on."

Valence: Unhappy vs. Happy (Unpleasant vs. Pleasant)

Instructions to participant while they look at figures:

“how UNHAPPY vs. HAPPY you feel (or PLEASANT vs. UNPLEASANT) in response to the picture”

UNHAPPY <-----> HAPPY



1

2

3

4

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7

8

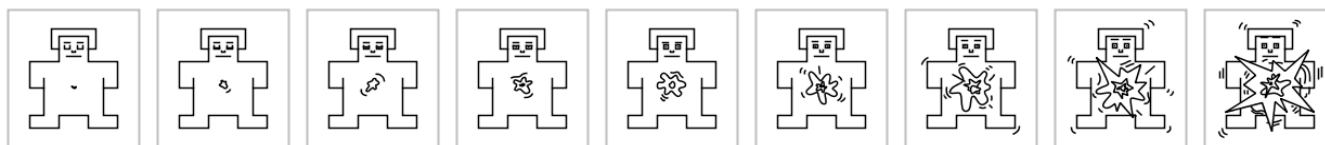
9

Arousal: Calm vs. Excited (Unaroused vs. Aroused)

Instructions to participant while they look at figures:

“how CALM vs. EXCITED you feel (or UNAROUSED vs. AROUSED) in response to the picture”

CALM <-----> EXCITED



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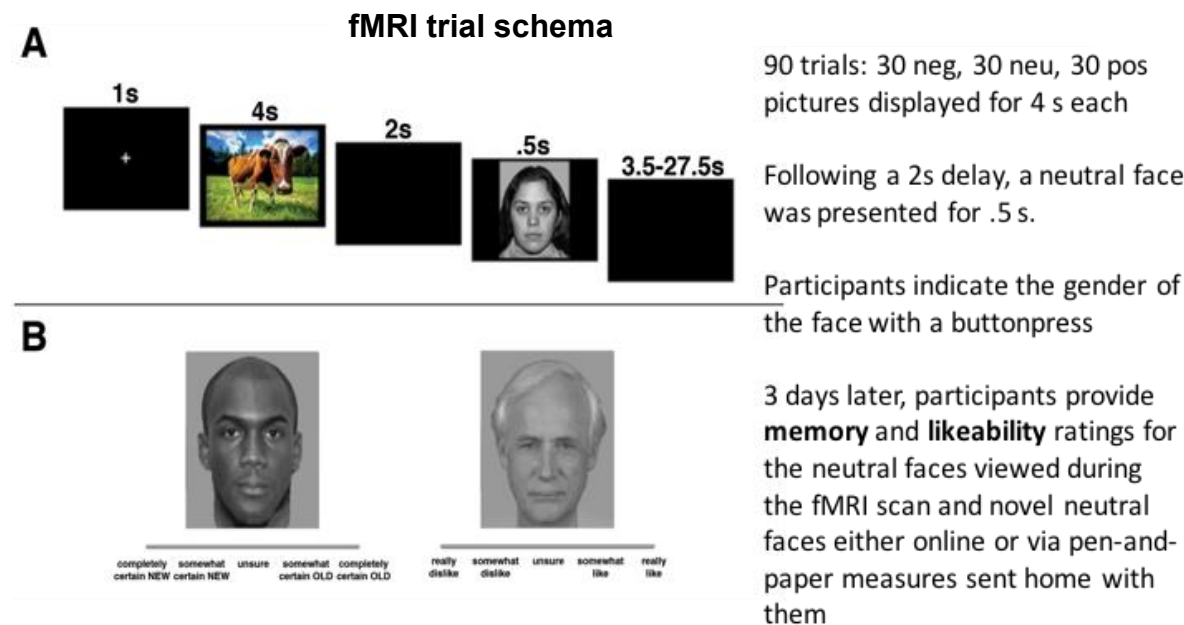
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9

Individual picture ratings per subject are available via restricted access and can be requested according to the instructions described on <https://midus.wisc.edu/midus-neuroscience-repository/>

fMRI Emotional Response Task

Participants completed the fMRI Emotional Response Task, as described below and in Grupe et al. 2018. Raw behavioral data from this task are on Globus and can be requested following restricted access instructions.



During fMRI scanning, participants passively viewed pictures from the International Affective Picture System (IAPS; Lang, Bradley, and Cuthbert, 2005, 2008), each one presented for 4s. Every task run contained 10 pictures each from negative, neutral, and positive valence categories, for a total of 30 picture presentations per task run, or 90 pictures total. Pictures were presented using a pseudorandom trial order with the requirement that no more than two pictures from the same valence category be presented sequentially. Within each valence category, stimuli were randomly ordered for each participant. Each picture was followed by a 2s inter-stimulus interval and a .5s neutral face presentation.

Simulations conducted using optseq2 (<https://surfer.nmr.mgh.harvard.edu/fswiki/optseq2>) to generate different timing profiles compared different static intervals, as well as jittered timings between the picture and face. These simulations suggested that this fixed 2s interval provided the greatest power to detect effects of interest during the face period.

Participants were instructed to press one of two buttons to indicate the gender of the face, a categorization task chosen to confirm task engagement without interfering with natural processing of the faces or preceding IAPS pictures. Participants pressed a blue button (recorded either as “1” or “b”) to indicate seeing a male face, and a yellow button (recorded as a “2” or “y”) to indicate seeing a female face. Faces were followed by an inter-trial interval between 3.5-27.5s (mean duration=7.5s). A 1s crosshair appeared before the start of each trial to orient participants’ attention.

Average normative arousal ratings were equivalent for negative (5.46 ± 0.66) and positive (5.47 ± 0.53) IAPS pictures, with neutral pictures arousal ratings normed slightly lower (3.16 ± 0.42 ; $t_s > 16.1$, $p_s < 0.001$). Valence sets of images were matched on luminosity, visual complexity, as number of images rated to be social in content. Faces were drawn from the XM2VTSDB multi-modal face database

(Messer et al. 1999), the NimStim database (Tottenham et al. 2009), and the Montreal Set of Facial Displays of Emotion (Beaupre, Cheung, and Hess 2000). To reflect our diverse subject population, these faces included equal proportions of male and females with a broad range of ages and ethnicities. Faces were cropped just above the hair and below the chin, converted to black and white, and edited (e.g., to remove distinctive facial hair and eyeglasses). A total of 45 neutral faces were presented, and each face was presented following 2 randomly selected pictures from the same valence category.

Face Ratings Task

Three days after the fMRI, participants were asked to complete memory and likeability ratings for the neutral faces presented during the scan. They completed this task on paper or online, rating each of the 45 faces viewed during the fMRI task interspersed with 45 novel faces. The novel faces are indicated with an 'A' next to the image number.

Each of these 90 faces was presented with two Likert rating scales. First, participants rated their memory of each face selecting from the following options: “*completely certain new*”, “*somewhat certain new*”, “*unsure*”, “*somewhat certain old*”, and “*completely certain old*”. Second, each of the 90 faces was presented again with a Likert rating scale for likeability of each face with options labeled “*really dislike*”, “*somewhat dislike*”, “*unsure*”, “*somewhat like*”, and “*really like*.” Memory ratings were always completed prior to liking ratings.

Ratings from both scales per subject are on the restricted access data repository and can be requested following restricted access instructions.

PSYCHOPHYSIOLOGICAL MEASURES

Out-of-scanner psychophysiology

During the Psychophysiology Emotional Response Task and baseline recording we collected facial electromyography (corrugator, zygomatic, eyeblink reflex), electrodermal activity, respiration, and electrocardiography data. During the Ambiguous Faces Task we collected facial electromyography (corrugator and zygomatic), electrodermal activity, respiration, and electrocardiography data. An experimenter placed electrodes on the seated participant's face. Electrodes were placed on either the left or right side of the face for each EMG measure (eyeblink startle reflex, corrugator supercilii, and zygomaticus major) following a predetermined counterbalance system, and then the participant was escorted into an electrically shielded booth to complete the baseline recording, computerized Psychophysiology Emotional Response Task, and Ambiguous Faces Task. Raw EMG signals were amplified 5,000 times prior to digitization at either 1000 Hz (Baseline or Psychophysiological Emotional Response Task) or 2000 Hz (Ambiguous Faces Task) with 16-bit precision using Biopac AcqKnowledge software on a BIOPAC MP160 hardware system using EMG100C amplifiers (BIOPAC systems, Inc., Goleta, CA).

During the fMRI

Psychophysiological measures (electrodermal activity, respiration, pulse oximetry) were collected during the fMRI Emotional Response Task and resting state scans using a BIOPAC MP160 system at 1000Hz with the EDA 100C (EDA), OXY 100C (Pulse Ox), and RSP 100C (Resp) amplifiers.

IMAGING

Image acquisition

MRI data were collected on a 3T scanner (GE MAGNUS, Waisman Brain Imaging Center, University of Wisconsin – Madison, Madison, WI) using a 32-channel Nova Medical head coil. Structural and functional imaging were done as 2 separate one-hour sessions, with structural scans done in the afternoon and functional scans in the morning, typically on the following day. Routine verbal checks were done between scans to ensure participant comfort and confirm motivation levels remained high.

The imaging protocol followed this sequence of scans (for more acquisition details see below):

Structural Imaging Session:

- T1w ADNI4 MPRAGE₅
- T2 FLAIR (MSV22)
- Cube T2 (HBCD)
- Diffusion Weighted Images of opposite phase encoding polarities₂
- 3D ASL₂
- Pseudoswan_{1,2}
- Cube T2 Hippocampus
- PCVIPR_{1,2}

Functional Imaging Session:

- MPnRAGE_{1,2,4}
- Topup field maps with opposite phase encoding polarities₃
- Task fMRI (7.5 min x 3)₃
- Resting state fMRI (10 min)₃

¹ Added later in data collection because acquisition sequences for the GE MAGNUS scanner were still in development when data collection began.

² Images are still being processed and will be shared at a later date and/or are part of the ADRD Project led by Dr. Sterling Johnson. Although collected in the same imaging sessions with the Affective Neuroscience Project data, the ADRD Project's raw imaging data will be shared separately.

³ Field maps have mismatching shims with the fMRI data and thus cannot be used for susceptibility distortion correction for the fMRI images. Instead, we provide a synthetic fMRI generated from SynBOLD-DisCo (Synthetic BOLD images for distortion correction; Yu et al., 2023).

⁴ Prior to MPnRage acquisition becoming available for the Magnus scanner, participants (n=17) had an additional T1 image acquired sagittally (3D – Sag MP-RAGE) in its place. One participant had an additional T1 image acquired axially (acq-axial) in its place.

⁵ Some participants showed visible motion artifact on their first T1w (ADNI4 MPRAGE), so a second identical T1w scan was attempted to see if motion improved. This is identified as run-2 in their /anat/ directory.

T1-weighted ADNI MP-RAGE

A 3D ADNI MPRAGE image was acquired with the following parameters: repetition time (TR) = 2355 ms, echo time (TE) = 2.56 ms, Inversion Time (TI) = 900 ms, flip angle = 9°, field of view (FOV) = 256 mm², acquisition matrix = 256 mm², reconstructed matrix = 256 mm², voxel size = 1 mm², slice thickness = 1 mm, 208 sagittal slices.

T1-weighted 3D Sag MP-RAGE

A 3D Sag MPRAGE image was acquired for a limited number of participants with the following parameters: repetition time (TR) = 2606 ms, echo time (TE) = 3 ms, Inversion Time (TI) = 920 ms, flip angle = 8°, field of view (FOV) = 256 mm², acquisition matrix = 320 mm², reconstructed matrix = 512 mm², voxel size = 0.5 mm², slice thickness = 0.8 mm, 208 sagittal slices.

T2-weighted FLAIR

A 3D Cube T2 FLAIR image with the following acquisition parameters: TR = 5000 ms, TE = 101 - 104 ms, TI = 1598 ms (1580 – 1600ms, 2 scans @ 1718ms), flip angle = 90°, Echo Train Length = 182 ms, FOV = 256 mm², acquisition matrix = 256 mm², reconstructed matrix = 256 mm², voxel size = 1 mm², slice thickness = 1 mm, 208 sagittal slices.

Cube T2 structural MRI

A 3D Cube T2 HBCD image with the following acquisition parameters: TR = 2500 ms, TE = 90 – 99 ms, flip angle = 90°, Echo Train Length = 120 ms, FOV = 256 mm², acquisition matrix = 320mm², reconstructed matrix = 512mm², voxel size = 0.5 mm², slice thickness = 0.8 mm, 208 sagittal slices.

Diffusion weighted imaging (DWI)₂

TR = 3400 ms, TE = 38.2 ms, 1.5 mm slice thickness; within plane FOV = 240 mm², acquisition matrix = 160 mm² (readout S/I), voxel size = 1.5 mm², 100 sagittal slices with a multi-band factor 3. Data were acquired using a Nova 32 channel head coil.

· Partial Fourier encoding 60% and ASSET (SENSE) x 1. Six non-diffusion weighted ($b = 0$ s/mm²) images were acquired. A total of 63 diffusion weighted images in 63 non-collinear directions were also acquired. Of these 9 were acquired at $b = 500$ s/mm², 18 $b = 800$ s/mm² and 36 at $b = 2000$ s/mm².

· A total of 10 non-diffusion weighted ($b = 0$ s·mm⁻²) images (5 in AP phase encoding direction and 5 in PA phase encoding direction) were acquired. A total of 113 diffusion weighted images in 113 non-collinear directions (56 in AP, 57 in PA) were acquired. Of these 12 (6 AP, 6 PA) images at nominal $b = 350$ s·mm⁻², 20 (10 AP, 10 PA) images at nominal $b = 1000$ s·mm⁻², 32 (16 AP, 16 PA) at nominal $b = 2000$ s·mm⁻², and 49 (24 AP, 25 PA) at nominal $b = 3000$ s·mm⁻² were acquired. Please note that the gradient non-uniformity corrections need to be applied to these nominal bvalues for processing the data.

Resting perfusion (arterial spin labeling; ASL)₂

Two sets of 3D images (stack of spirals) - one with labeling and one without labeling - were acquired with the following parameters: TR = 4765 ms, TE = 45.6 ms, flip angle = 111°, FOV = 240 mm², acquisition matrix = 512 × 8 mm, reconstructed matrix = 128 mm², voxel size = 1.875 mm², slice thickness = 4 mm, 34 axial images.

Pseudoswan_{1,2}

A 2D Gradient Echo image with the following parameters: TR = 2000 ms, TE = 35 ms, flip Angle = 60°, FOV = 240 mm², acquisition matrix = 256 × 512 mm, reconstructed matrix = 512 mm², voxel size = 0.468 mm², slice thickness = 3 mm (spacing = 1.0 mm), 48 axial slices.

Cube T2 Hippocampal structural MRI

A 3D Cube T2 Hippocampal image with the following acquisition parameters: TR = 2500 ms, TE = 104 – 112 ms, flip angle = 90°, Echo Train Length = 120 ms, FOV = 240 mm², acquisition matrix = 384 × 256 mm, reconstructed matrix = 512 mm², voxel size = 0.468 mm², slice thickness = 0.6 mm, 280 sagittal slices.

PCVIPR_{1,2}

A 3D Vascular Phase Contrast image with the following parameters: TR = 5.9 ms, TE = 1.7 ms, flip Angle = 8°, FOV = 220 mm², voxel size = 0.69 mm², slice thickness = 0.69 mm.

MPnRAGE_{1,2}

A 3D Spoiled Gradient Echo image with the following acquisition parameters: TR = 3.8 ms, TE = 1.4 ms, first TI = 15 ms, first 520 views were at flip angle = 4° and the last 60 views were at flip angle = 8°, FOV = 256 mm² with 160 mm z-coverage, voxel size = 1 mm², slice thickness = 1 mm.

Task functional MRI

Three sets (3 runs) of gradient echo planar images were acquired with these parameters: 450 volumes, TR = 1000 ms, TE = 30 ms, flip angle = 60°, FOV = 240 mm², Acquisition matrix = 96 mm², reconstructed matrix = 128 mm², voxel size = 1.875 mm², slice thickness = 2.5 mm. 60 interleaved sagittal slices, ASSET parallel imaging with an acceleration factor of 4.

Resting state functional MRI

One set (1 run) of gradient echo planar images was acquired with the following parameters: 600 volumes, TR = 1000 ms, TE = 30 ms, flip angle = 60°, FOV = 240 mm², acquisition matrix = 96 mm², reconstructed matrix = 128 mm², voxel size = 1.875 mm², slice thickness = 2.5 mm, 60 interleaved sagittal slices, ASSET parallel imaging with an acceleration factor of 4.

Anatomical updates and defacing:

- Json files for all anatomical images were updated in compliance with BIDS. Additional information which could be helpful were added.
- T1w images were defaced with `afni_refacer_run`.
- Both T2w images (including the hippocampal) were defaced in the following 2 steps:
 - Run `mri_reface`, which blurs the facial voxels (change the intensity values).
 - Blurred voxels were then removed completing the defacing:

- Refaced images were subtracted from the original images. Outputs keep intensity of face voxels and all other voxels '0' because those were identical between the 2 images.
 - Reverse binarized the difference image so that all 0 voxels are now have an intensity of 1 and all face voxels have intensity of 0
 - Use the binarized image to mask the original image which leaves only non-face voxels.
- FLAIR images were defaced with PyFaceWipe.

Functional updates:

- fMRIs are reoriented to LAS+ using `fsloreorient2std`.
- Since the phase encoding (polarity) of the fMRI is anterior to posterior, the Phase Encoding direction on the jsons were changed to j-.
- Slice timing parameters were added to the json files.

Note there are 60 slice timing parameters corresponding to the 60 acquisition slices which are on the z-axis following reorientation.

There are a few fMRI scans with very low z-shims. These scans will have substantial signal loss towards the inferior portions of the brain, particularly the cerebellum. These will likely need to be excluded from any whole brain analyses.

The field maps cannot be used for susceptibility distortion correction of fMRI data since their shims are sometimes different. Rather, SynBOLD DiSCO is used generate an fMRI with an opposite phase encoding polarity. This is shared in the fmap directories for each fMRI scan. Researchers can use the original and SynBOLD fMRIs for distortion corrections via topup or input into fMRIPREP.

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