Midlife in the United States (MIDUS 2): Neuroscience Project

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Instruments
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Electroencephalography (EEG)

**Type of instrument:** EEG is a procedure for measuring electrical brain activity non-invasively. 128 channels of EEG are recorded from the scalp using a geodesic electrode net (http://www.egi.com/). For an introduction to EEG methods, please see Pivik and colleagues (1993) guidelines paper and/or Davidson, Jackson, and Larson’s “Human Electroencephalography” chapter in *The Handbook of Psychophysiology.*

**Mode of Administration:** Participants had the net placed on their head and were then escorted into a soundproof booth where they were seated in front of a computer screen. A computer located outside the booth recorded the data. This portion of the study took place in the Laboratory for Brain Imaging and Behavior, located in the Waisman Center on the UW-Madison campus.

**Method by which respondent will receive and return instrument:** All EEG recording and data collection was done in the lab.

**Other information:**

a. **Baseline Collection.** The participant was instructed to rest for six 1-min periods. During three of the 1-min periods they were asked to keep their eyes open; for the remaining three 1-min periods they were asked to keep their eyes closed.

b. **Time points.** EEG Baselines were collected at two different time points over the course of the session. The first set of six baselines were collected at the beginning of the session; the second set of six baselines were collected at the end of the session. EEG variables currently included are restricted to the 6 baselines collected at the beginning of the session. To increase the reliability of the EEG baseline data, we collapsed across conditions and across minutes.

c. **Processing.**

i. **EEG recording.** EEG activity was recorded using a 128-channel geodesic net of Ag/AgCl electrodes encased in saline-dampened sponges (Electrical Geodesics, Inc [EGI], Eugene, OR). Electrode impedances were reduced to less than 100 KΩ, and analog EEG signals were amplified and sampled at a rate of 500 Hz (band-pass filtered from 0.1-100 Hz) with 16-bit precision using an online vertex (Cz) reference.

ii. **Data cleaning.** After 60 Hz notch filtering and 0.5 Hz high-pass filtering to remove slow frequency drift, bad channels were identified and removed. Bad sections of data were also removed. Using EEGLAB6, the EEG data was then submitted to a PCA/ICA forcing the identification of 20 components. Components containing obvious eye blinks, eye movements and other artifacts were then removed from the data. Bad channels were then replaced using a spherical spline interpolation. Epochs of 2 second length were then created. The EEGLAB automated artifact identification routine was then run on these epoched datafiles, identifying epochs containing deviations of ±100 microvolts, which were then subsequently removed.
iii. **Frequency analysis.** Using LORETA-KEY, the spectral power density was then computed for each sensor and for each 0.5 Hz time frame using epochs of 2 seconds duration (with 50% overlap) following linear detrending and application of a Hanning window. Due to variability of the actual peak of the alpha frequency across age, an alpha power band was determined on the basis of each individual's alpha peak frequency (see e.g. Klimesch, 1999, Brain Research Reviews; Doppelmayr et al., 1998, Neuroscience Letters for more information). The peak frequency was identified using an automated routine which picked the peak in a frequency window ranging from 6 to 14 Hz across the scalp. Lower and upper alpha bands were then defined as follows:

Using Individual Alpha Peak to determine bands =

Lower band of Alpha 1: individual alpha peak frequency (IAP) – 30% of IAP
Upper band of Alpha 1: up to IAP
Lower band Alpha 2: actual IAP
Upper band Alpha 2: IAP + 30 % of IAP

In addition, the Standard Alpha Bands are provided in the dataset.

Using Standard Alpha Bands=

Lower band of Alpha 1: 8 Hz
Upper band of Alpha 1:10 Hz
Lower band of Alpha 2:10 Hz
Upper band of Alpha 2: 13 Hz

Average spectral power density was then computed across the frequency frames falling within each band definition. The spectral power density was then log-transformed to normalize the distribution.

iv. **Computing laterality scores.** Log alpha power is averaged across multiple sites on the scalp to create more reliable indices that approximates sites in the standard 10-20 EEG system (e.g., F3, F4). Log alpha power in the left hemisphere is subtracted from log alpha power in the right hemisphere (right – left) to create an index of laterality. Because greater alpha activity indicates less neural activation, larger laterality scores indicate greater LEFT HEMISPHERE activation.

v. **Missing data.** Data from participants with 50% or more bad EEG channels (i.e., 64+ bad channels of data) were excluded from the datafile.

vi. **EMG power** (70-125 Hz) was also averaged across the scalp.

**Eyeblink Startle Reflex (EBR)**

1. **Type of instrument:** Two passive mini-electrodes are placed below one eye on the inferior orbicularis oculi muscle to measure blink magnitude in response to acoustic startle probes (50ms duration at 105 dB) presented 2.9 seconds after picture onset, 0.4
s after picture offset or 1.9 s after picture offset (pictures are presented for 4 seconds). For an introduction to EBR methods, please see Blumenthal and colleagues (2005) guidelines paper and/or Tassinary and Cacioppo’s "The Skeletal Motor System - Surface Electromyography" chapter in *The Handbook of Psychophysiology*.

2. **Mode of Administration:** Participants had the electrodes placed on their face and were then escorted into a soundproof booth where they were seated in front of a computer screen. A computer located outside the booth recorded the data. This portion of the study took place in the Laboratory for Brain Imaging and Behavior, located in the Waisman Center on the UW-Madison campus.

3. **Method by which respondent will receive and return instrument:** All startle recording was done in the lab.

4. **Other information:**
   a. **HEM recording (~ 15% of the data collected):** Using SAI Bioelectric amplifiers (SA Instrumentation Co., Caroga Lake, NY), raw EMG signals were amplified 10,000 times prior to digitization at 1000 Hz using SnapStream software (HEM Data Corporation, Springfield, MI) and a 12-bit analog-to-digital board (Analogic Corporation, Wakefield, MA). Subsequent processing with Matlab included 30 Hz highpass filtering, rectification and integration with a time constant of 20 ms.
   b. **BIOPAC recording (~85% of the data collected):** Raw EMG signals were amplified 5,000 times (using ERS100C amplifiers) prior to digitization at 1000 Hz with 16-bit precision using Acknowledge software and BIOPAC hardware (BIOPAC systems, Inc., Goleta, CA). Subsequent processing with Matlab included 30 Hz highpass filtering, rectification and integration with a time constant of 20 ms.
   c. **Startle scoring:** Eyeblink reflex magnitudes (in microvolts) were calculated by subtracting the amount of integrated EMG at reflex onset from that at peak amplitude (maximum amount of integrated EMG between 20 and 120 ms following probe onset). Trials with no perceptible eyeblink reflex were assigned a magnitude of zero and included in analysis. Eyeblink reflex magnitudes were log-transformed to normalize the data, then z-scored to range-correct the data separately for each participant. A participant’s data was excluded when the participant did not respond with a perceptible eyeblink reflex on less than 75% of the total number of probes presented (which is 81). Eyeblink reflex amplitudes were calculated similarly, except trials with no perceptible eyeblink reflex were excluded from the analysis.

**Corrugator supercilii (COR)**

1. **Type of instrument:** Two passive mini-electrodes are placed above one brow line on the corrugator supercilii muscle to measure “frowning” responses to positive, neutral, and negative pictures. For an introduction to COR methods, please see Tassinary and Cacioppo’s "The Skeletal Motor System - Surface Electromyography" chapter in *The Handbook of Psychophysiology*.

2. **Mode of Administration:** Participants had the electrodes placed on their face and then were escorted into a soundproof booth where they were seated in front of a computer screen. A computer located outside the booth recorded data. This portion
of the study took place in the Laboratory for Brain Imaging and Behavior, located in the Waisman Center on the UW-Madison campus.

3. **Method by which respondent will receive and return instrument:** All corrugator recording and data collection was done in the lab.

4. **Other information:**
   a. **Recording details.** Corrugator activity was measured from session 35 onwards using sensors placed on the corrugator muscle. Recording details are identical to those of the EBR (see above).
   b. **Processing:** After 60 Hz notch filtering, the data are visually inspected and artifacts are removed from the corrugator data. A Fast Fourier Transform (FFT) was performed on all artifact-free 1 s chunks of data (extracted through Hanning windows with 50% overlap) to derive estimates of spectral power density ($\mu V^2/Hz$) in the 30 – 200 Hz frequency band. These values were log-transformed to normalize the data. Missing values were interpolated. Corrugator activity was computed for 13 distinct epochs for each of the image valences (positive, neutral, negative). The first epoch covers a 1 s pre-picture epoch that served as a baseline recording and was subtracted from corrugator activity in the subsequent 12 epochs. The baseline-corrected epoch data were then averaged across 4-seconds creating 3 distinct blocks, in order to create a summary score of corrugator activity during the picture presentation (1-4 seconds~EARLY corrugator activity), immediately following picture offset (5-8 seconds~MIDDLE corrugator activity), and later after offset (9-12 seconds~LATE corrugator activity).

**Reaction Times (RT) and Accuracy**

1. **Type of instrument:** Behavioral observations recorded during the performance of the task.

2. **Mode of Administration:** The task was comprised of a decision of the color of the border (purple or yellow) which surrounded the positive, negative, or neutral image for a duration of 500 ms. (The image remained 3500 ms after the border offset.) The participant pressed the left (right) key with their index (middle) finger when the color was purple, and the right (left) key with their middle (index) finger when the color was yellow.

3. **Method by which respondent will receive and return instrument:** The task was programmed in E-Prime (Psychology Software Tools, Inc, Pittsburgh, PA) and ran on a PC outside the booth in the Laboratory for Brain Imaging and Behavior, located in the Waisman Center on the UW-Madison campus. Data were recorded on this PC using E-Prime software while the participant was performing the task.

4. **Other information:**
   a. **Quantification:** Reaction times are recorded as the difference between the time of the onset of the image and the onset of the button press. Accuracy is scored by summing the number of correct identifications of the border color, and expressed as a proportion of the total number of trials presented to the participant.
Self Report

1. **Type of instrument**: Paper and pencil report.

2. **Mode of Administration**: Given to participants on paper to complete during the lab visit.

3. **Method by which respondent will receive and return instrument**: Completed and returned during the lab visit.

4. **Other information**:
   a. **Time 1**: Self-reports are first administered immediately after we obtain informed consent. At that time, participants complete:
      i. Spielberger State-Trait Anxiety Inventory, “now” form (STAI-X1)
      ii. Spielberger State-Trait Anxiety Inventory, general form (STAI-X2)
      iii. Positive and Negative Affect Schedule, general form (PANAS-GEN)
      iv. Positive and Negative Affect Schedule, “now” form (PANAS-NOW)
      v. Reactivity to Affective Stimuli Questionnaire (RASQ)
      vi. Dispositional Positive Emotion Scale (DPES)
   b. **Time 2**: Immediately after completing the picture-viewing task, participants complete:
      i. Spielberger State-Trait Anxiety Inventory, “now” form (STAI-X1)
      ii. Positive and Negative Affect Schedule, “now” form (PANAS-NOW)
   c. **Scoring**:
      i. **Reverse-coding**: The STAI-X1 and STAI-X2 are the only measures that included reverse coding. Items were reverse coded as necessary and as indicated by published guidelines for scale use.
      ii. **Average**: A score for each scale/subscale was determined by taking an average of all unambiguously-completed items (i.e., skipped items and questions for which more than one response was indicated were dropped). An average was taken instead of a sum to simplify problems of missing items (a sum would be affected by missing items; an average is not). Scales for which fewer than 50% of items were completed were excluded.

**Explanation of missing values**:
The data were set as missing when a majority of the observations were judged as not valid or reliable (see “Other Information” for each measure”) due to too many artifacts in the raw data, or when large parts or entire recordings for different measures were missing due to technical problems with the equipment, or time constraints resulting in partial completion of the session. With some of the measures acquired, a combination of these factors resulted in missing values.

**Publications from this MIDUS wave using this instrumentation**:
van Reekum, C.M., Schaefer, S.M., Lapate, R.C., Norris, C.J., Greischar, L.L., & Davidson, R.J. (2010). Aging is associated with positive responding to neutral information but reduced recovery from negative information. *Social Cognitive and Affective Neuroscience*

**References**


