Associations between hippocampal volume and function with cumulative adulthood stress

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Background

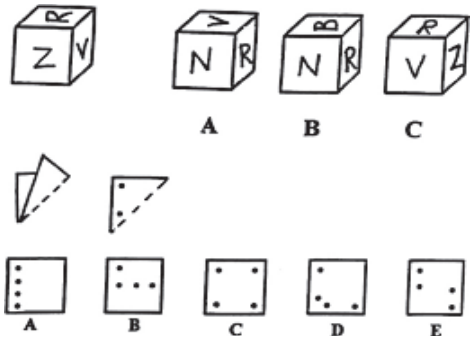
- The hippocampus is a brain region involved in learning, memory, emotional regulation, and spatial reasoning[1].
- Spatial reasoning supports complex problem solving, navigation, and creativity.
- Stress exposure has been linked to cognitive decline, emotional dysregulation, and structural brain changes[1].
- Research on stress and hippocampal volume is mixed.
  - Smaller hippocampal volume thought to be a pre-existing factor to worse stress-related mental health[2,5].
  - Higher levels of perceived stress associated with smaller hippocampal volume[3].

Research Aims:

- Replicate previous findings linking total hippocampal volume to performance on the Cube & Paper task
- Investigate the relationship between cumulative adulthood stress and hippocampal volume.

Methods

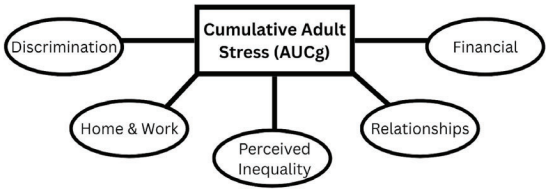
- 118 Participants, aged 48-95, 60.17% female, 88.98% white from the third wave of the Midlife in the United States study (MIDUS 3).
- Analyzed survey responses, structural MRIs, and performance on the Cube and Paper task .
- Cube and Paper scores transformed using the reflected log to improve normality.
- Cumulative adult stress was calculated from self-reported stress data from the MIDUS Survey project[4].
- Covariates: total intracranial volume, age, sex, race, educational attainment, and time difference between data collection from the Survey and Neuroscience projects.
- SPSS was used to conduct an ordinary least squares (OLS) linear regression for both hypotheses.



Sample Cube and Paper questions. The Cube & Paper task is a **pen-and-paper-based measure of spatial reasoning.** Participants must mentally reorient a cube and visualize the folding and unfolding of a hole-punched piece of paper[2].

Hypotheses

- H1: Poorer performance on the Cube & Paper task will be associated with smaller relative hippocampal volume
- H2: Greater cumulative stress will be associated with smaller relative hippocampal volume and poorer performance on the Cube & Paper task



Area Under the s-Factor Curve (AUCg) [4]

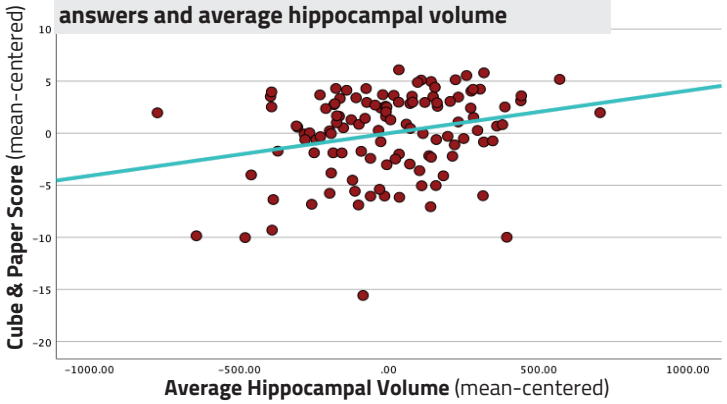
- Models change in stress over time
- Uses 5 major domains of stress
- Calculated from 19 self-report stress measures

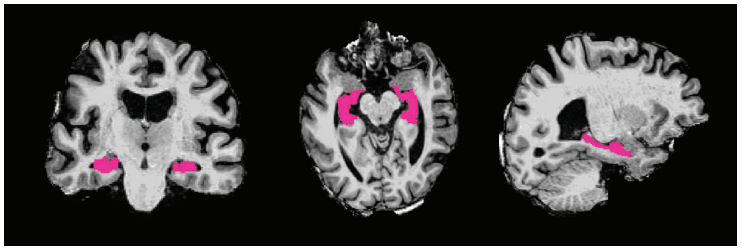
Regression analysis results:

- Adjusted for total intracranial volume, age, sex, race, educational attainment, and the difference between data collection days
- Adjusted R-squared=0.18
- **p=0.007**
- Mean score=14.70

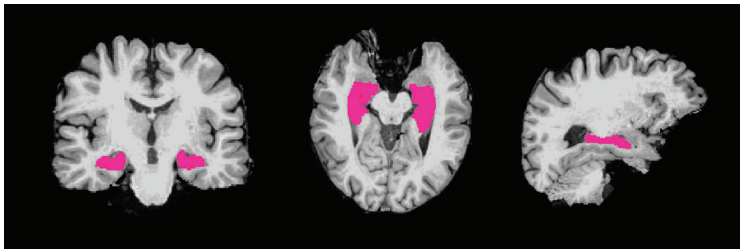
Better performance on the Cube & Paper task is associated with greater relative hippocampal volume

Partial regression plot of total correct Cube & Paper answers and average hippocampal volume





Hippocampus of a 72-year-old male participant scoring 8 out of 20 on the Cube & Paper task. Average volume = 3342.85 mm^3



Hippocampus of a 72-year-old male participant scoring 20 out of 20 on the Cube & Paper task. Average volume = 4369.75 mm^3

Results & Discussion

- Average hippocampal volume and education were **significant predictors** of performance on the Cube & Paper task
- Cumulative adulthood stress **did not significantly** predict hippocampal volume or performance on the Cube & Paper task
- Stress-related **effects may depend on** timing, duration, chronicity, or assessment methods (i.e., biological markers versus self-report)

Future Directions

- Investigate the impact of stress exposures in **sensitive developmental periods**.
- Incorporate **biological markers** to capture aspects of stress not reflected in self-report.
- Differentiate **specific stress** types and experiences (i.e. interpersonal, discrimination, financial, etc.).
- Examine how **education may buffer** against stress-related cognitive decline.
- Expand analysis of associations between Cube & Paper performance and hippocampal volume to **different samples**.
- Compare results across sociodemographic groups.

Acknowledgements

Publicly available data from the MIDUS study was used for this research. Since 1995, the MIDUS study has been funded by the following: the John D. and Catherine T. MacArthur Foundation Research Network, and the National Institute on Aging (P01-AG020166, U19-AG051426, U01-AG077928). The MIDUS Neuroscience Project's data collection was also supported in part by a core grant to the UW-Madison Waisman Center from the National Institute of Child Health and Human Development (P50HD105353). Additional funding was provided by the UW-Madison L&S Honors Summer Research Apprenticeship.

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