

Frontal Neural Correlates of Working Memory Decline in Problem Drinkers Living with HIV.

Vaughn E. Bryant¹, Adam J. Woods¹, Eric Porges¹, Robert L. Cook², Christopher W. Kahler³, Andrew O'Shea¹, Peter Monti³, Karen Tashima⁴ & Ronald Cohen¹
¹Center for Cognitive Aging and Memory, Department of Aging and Geriatric Research, University of Florida; ²Department of Epidemiology, University of Florida; ³Department of Behavioral and Social Sciences, Center for Alcohol and Addiction Studies, Brown University; ⁴The Miriam Hospital, Department of Medicine, Brown University

Background

- Working memory (WM) has been defined as a form of memory that supports the temporary storage and maintenance of internal representations and mediates the controlled manipulations of these representations.¹⁻²
- Prior work suggests that WM may play a critical role in: the decision to engage in substance use, sexual risk behavior substance use trajectories.³⁻⁵
- Purpose: To examine: 1) which frontal gray matter regions were associated with working memory 2) whether among significant region(s), whether working memory remained a significant predictor of frontal structure(s), when controlling for covariates 3) whether problem drinking interacts with working memory as a predictor of frontal structure(s)..

Participants

- Sample:** N = 66 HIV + adults
- Age:** M = 47.23 (SD = 8.7 years)
- Education:** M = 13.1 (SD = 2.7)
- Race:** 68.2% Caucasian, 18.2% African American
- Sex:** 71.2 % Male

Methods

Participants: 66 HIV+ adults from the Providence, RI area

Measures:

Scanner:

- Data was extracted from 3T high-resolution structural MRIs.
- Analyses were conducted using FreeSurfer standard regions of interest.

Working Memory Task:

- Letter Number Sequencing Task⁶ - participants are read a series of letters and numbers and asked to recite both back in ascending order, with the numbers first and then the letters.

Sample Items From The Letter-Number Sequencing Test

	Item	Correct response
LNS-Forward	9 - A - 6 - J - 3 - P	9 - A - 6 - J - 3 - P
LNS-Reordered	E - 1 - R - 8 - M - 7	1 - 7 - 8 - E - M - R

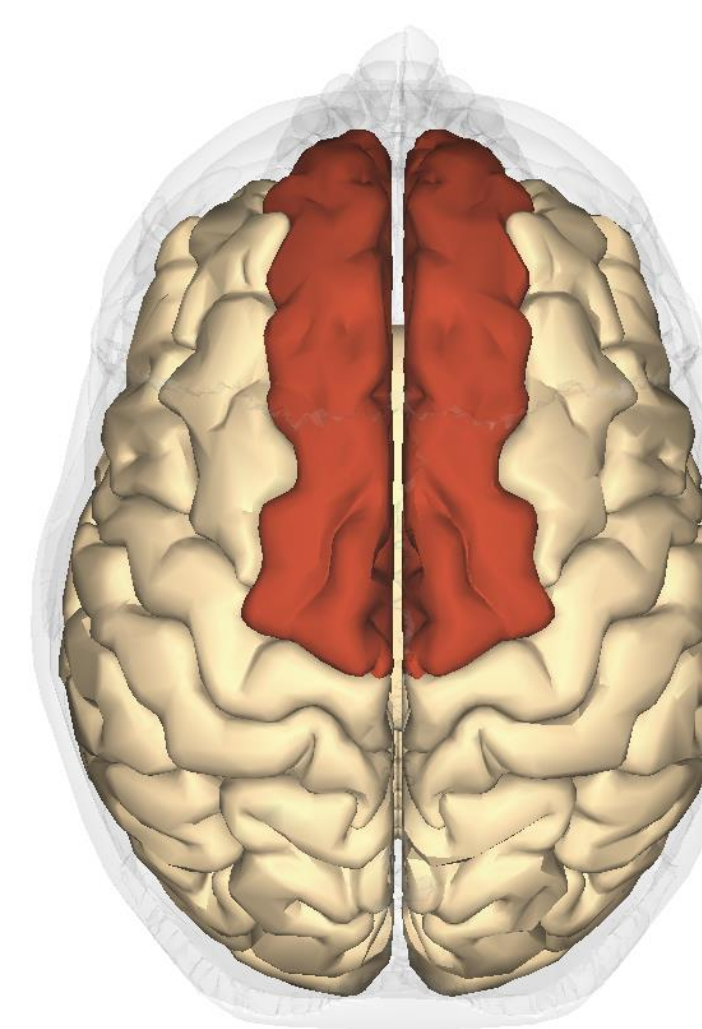
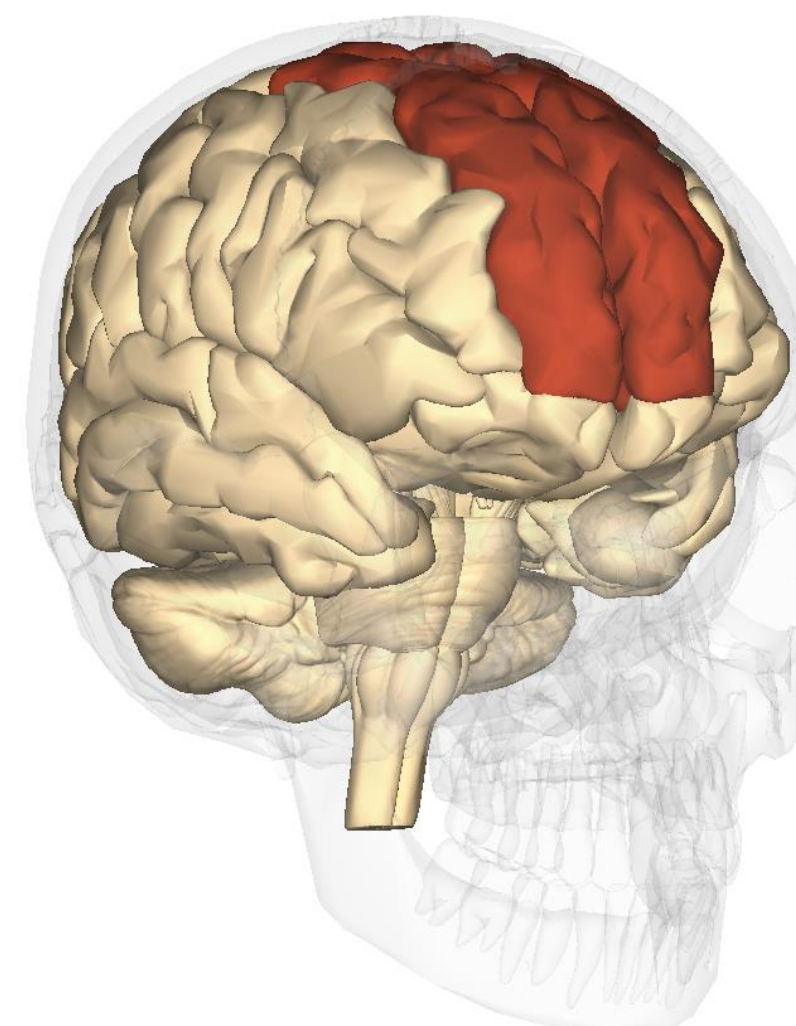
Disinhibition

- Frontal Systems Behavior Scale⁷

Statistical Analyses:

- Multiple regression analyses
- Analysis of Covariance
- Mediation Analyses (Preacher and Hayes)⁸

SFG



Results

Predictors of Working Memory (Left Hemisphere)

	B	SE	Beta	p
SFG	00.190	0.091	0.204	0.039**
LOF	00.849	1.815	0.048	0.641
MOF	-01.368	1.757	-0.075	0.438
Parsopercularis	00.624	0.452	0.150	0.171
ICV	-00.189	1.709	-0.011	0.912

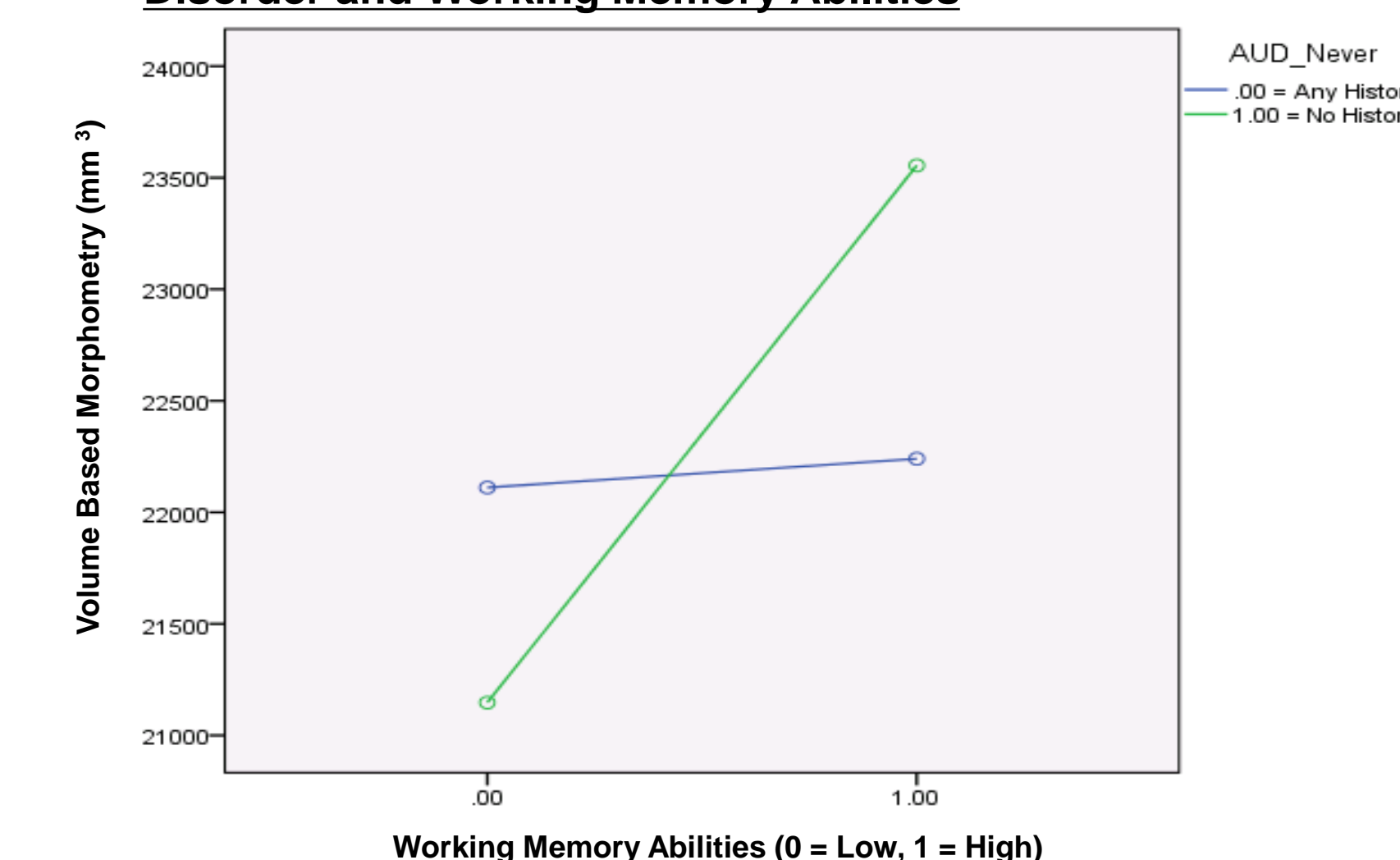
p < .06, ** *p* < .05, *** *p* < .01, *R*² = .191; Note. Right hemisphere model was not significant; SFG = superior frontal gyrus, LOF = lateral orbitofrontal, MOF = medial orbitofrontal, ICV = intracranial volume.

Predictors of LSFG Volume

	B	SE	Beta	p
WM	-01.230	25.709	-0.005	0.962
AUD Never	80.472	39.387	0.201	0.046**
AUD Current	59.330	47.614	0.119	0.219
Disinhibition	-27.570	13.885	-0.158	0.053*
Yrs Since Diag	-75.440	27.434	-2.75	0.008***
ICV	00.012	00.001	0.666	0.001***

p < .06, ** *p* < .05, *** *p* < .01, *R*² = .385; Note. Past but not current AUD was excluded due to tolerance issues. Right hemisphere model and mediation analyses were not significant. WM = working memory; AUD = alcohol use disorder, Yrs = years, ICV = intracranial volume.

The Interaction Between History of Alcohol Use Disorder and Working Memory Abilities



GLM Predictors of LSFG Volume

	F	p	Partial η ²
WM x AUD Never	4.907	0.031**	.089
WM (Low vs. High)	5.600	0.022**	.101
AUD Never	0.108	0.744	.002
Disinhibition	7.783	0.007***	.135
Yrs Since Diag	7.260	0.010**	.127
ICV	73.853	0.001***	.596

* *p* < .06, ** *p* < .05, *** *p* < .01, *R*² = .756. Note. WM = working memory, AUD = alcohol use disorder, Yrs = years, ICV = intracranial volume.

Discussion

- Working memory abilities may be critical measures of frontal lobe structure and function.
- Frontal lobe structure is related to a number of other important behaviors in this population including: the decision to engage in substance misuse and other risky behaviors.
- Working memory is also critical for effectively responding to substance abuse and risk behavior interventions.
- Interventions targeting substance abuse reduction should adapt interventions to accommodate working memory deficits.
- Interventions targeting enhancing working memory abilities may have multiple benefits.

References

- Alexander S, Kerr ME, Yonas H, Marion DW. The effects of admission alcohol level on cerebral blood flow and outcomes after severe traumatic brain injury. *Journal of neurotrauma*. 2004;21(5):575-83.
- Wagner AD. Working memory contributions to human learning and remembering. *Neuron*. 1999;22(1):19-22. Epub 1999/02/23.
- Feldstein Ewing SW, Filbey FM, Hendershot CS, McEachern AD, Hutchison KE. Proposed model of the neurobiological mechanisms underlying psychosocial alcohol interventions: the example of motivational interviewing. *Journal of studies on alcohol and drugs*. 2011;72(6):903-16. Epub 2011/11/05.
- Khurana A, Romer D, Betancourt LM, Brodsky NL, Giannetta JM, Hurt H. Working memory ability predicts trajectories of early alcohol use in adolescents: the mediational role of impulsivity. *Addiction*. 2013;108(3):506-15. Epub 2012/10/05.
- Khurana A, Romer D, Betancourt LM, Brodsky NL, Giannetta JM, Hurt H. Stronger Working Memory Reduces Sexual Risk Taking in Adolescents, Even After Controlling for Parental Influences. *Child development*. 2015. Epub 2015/06/18.
- Wechsler D. Wechsler Adult Intelligence Scale-III (WAIS-III). San Antonio: The Psychological Corporation; 1997.
- Grace J & Malloy Malloy, P.F. Frontal Systems Behavior Scale: Professional Manual. Lutz, FL: Psychological Assessment Resources, Inc. 2001.
- Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*. 2013;76:408-420.

Acknowledgements: Research supported in part by NIAAA AA019072 and KL2TR001429