

BIOGRAPHICAL SKETCH

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NAME Cary R. Savage		POSITION TITLE Associate Professor, Psychiatry	
eRA COMMONS USER NAME CRSAVAGE		Director, Functional MRI, Hoglund Brain Imaging Center	
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)			
INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY
University of Northern Colorado	B.A.	1986	Psychology
Oklahoma State University	Ph.D.	1991	Clinical Psychology
Massachusetts General Hospital	Fellowship	1992-1995	Neuropsychology / Neuroimaging

A. Positions and Honors

Professional Experience

1990-1992 Clinical Psychology Intern, Department of Psychiatry, Massachusetts General Hospital (MGH)
1992-1994 Psychiatric Neuroscience Fellowship, MGH
1994-1995 National Cancer Institute Fellow in Radiological Sciences: PET, MGH
1993-1996 Clinical Assistant in Psychology, Department of Psychiatry, MGH.
1993-1996 Instructor in Psychology, Department of Psychiatry, Harvard Medical School.
1995-2002 Director, Cognitive Neuroscience Group, Department of Psychiatry, MGH.
1996-2002 Assistant Professor in Psychology, Department of Psychiatry, Harvard Medical School
1997-2001 Director, Biostatistics Unit, Department of Psychiatry, MGH
2001-2002 Director, Research and Training, Behavioral and Mental Health, Spaulding Rehabilitation Hosp.
2003-Present Director of Functional MRI, Hoglund Brain Imaging Center, University of Kansas Medical Center
2003-Present Associate Professor, Department of Psychiatry, University of Kansas Medical Center

Editorial Boards

1994-Present Journal of Geriatric Psychiatry and Neurology

Review Panels

1999 External Reviewer, Department of Veterans Affairs Merit Grant Program
2000 The PPP Foundation, London, England
2000 Chair, NIMH Special Emphasis Panel — Dissertation Research Grants
2001 NIMH Review Panel Member, BSTART
2003 National Science Foundation, Ad-hoc reviewer
2003-2005 National Science Foundation, Review Panel Member, Cognitive Neuroscience
2006-Pres Obsessive-Compulsive Foundation Review Committee
2006 The Israel Science Foundation, Ad-hoc reviewer
2006 Netherlands Organization for Scientific Research (Dutch Research Council), Ad Hoc Reviewer
2006 NIH-NIGMS K99, Ad-hoc reviewer
2007 Department of Defense Congressionally Directed Medical Research Programs (CDMRP), Ad-hoc reviewer

B. Selected Peer-Reviewed Publications

Savage CR, Thomas DG. Information processing and interhemispheric transfer in left- and right-handed adults. *Int J Neurosci* 1993; 71:201-19.

Savage CR, Weilburg JB, Duffy FH, Baer L, Shera D, Jenike MA. Low-level sensory processing in obsessive-compulsive disorder: An evoked potential study. *Biol Psychiat* 1994; 35:247-52.

Rauch SL, **Savage CR**, Alpert NM, Miguel E, Baer L, Breiter HC, Fischman AJ, Manzo P, Moretti C, Jenike MA. A positron emission tomographic study of simple phobic symptom provocation. *Arch Gen Psychiat* 1995; 52:20-28.

Rauch SL, **Savage CR**, Brown HD, Curran T, Alpert NM, Kendrick A, Fischman AJ, Kosslyn SM. A PET investigation of implicit and explicit sequence learning. *Hum Brain Map* 1995; 3:271-286.

Schacter DL, Alpert NM, **Savage CR**, Rauch SL, Albert MS. Conscious recollection and the human hippocampal formation: Evidence from positron emission tomography. *Proc Natl Acad Sci* 1995; 93:321-325.

Savage CR, Keuthen NJ, Jenike MA, Brown HD, Baer L, Kendrick AD, Miguel EC, Rauch SL, Albert, M.S. Recall and recognition memory in obsessive-compulsive disorder. *J Neuropsychiat Clin Neurosci* 1996; 8:99-103.

Schacter DL, **Savage CR**, Alpert NM, Rauch SL, Albert MS. The role of hippocampus and frontal cortex in age-related memory changes: A PET study. *NeuroReport* 1996; 7:1165-1169.

Rauch ST, **Savage CR**, Alpert NM, Dougherty D, Kendrick A, Curran T, Brown HD, Manzo P, Fischman AJ, Jenike MA. Probing striatal function in obsessive-compulsive disorder: A PET study of implicit sequence learning. *J Neuropsychiat Clin Neurosci* 1997; 9:568-573.

Rauch SL, **Savage CR**, Alpert NM, Fischman AJ, Jenike MA. The functional neuroanatomy of anxiety: A study of three disorders using positron emission tomography and symptom provocation. *Biol Psychiat* 1997;42:446-452.

Heckers S, Rauch SL, Goff D, **Savage CR**, Schacter DL, Fischman AJ, Alpert NM. Impaired recruitment of the hippocampus during conscious recollection in schizophrenia. *Nature: Neurosci* 1998; 1:318-323.

Savage CR, Baer L, Keuthen NJ, Brown HD, Rauch SL, Jenike MA. Organizational strategies mediate nonverbal memory impairment in obsessive-compulsive disorder; *Biol Psychiat* 1999; 45, 905-916.

Savage CR, Deckersbach T, Wilhelm S, Rauch SL, Baer L, Reid, T, Jenike MA. Strategic processing and episodic memory impairment in obsessive-compulsive disorder. *Neuropsychology* 2000; 14:141-151.

Savage CR, Rauch SL. Cognitive deficits in obsessive-compulsive disorder. *Am J Psychiat* 2000; 157:1182.

Savage CR, Deckersbach T, Heckers S, Wagner AD, Schacter DL, Alpert NM, Fischman AJ, Rauch SL. Prefrontal regions supporting spontaneous and directed application of verbal learning strategies: Evidence from PET. *Brain* 2001; 124:219-31.

Cabrera AR, McNally RJ, **Savage CR**. Missing the Forest for the Trees? Deficient memory for linguistic gist in obsessive-compulsive disorder; *Psychol Med* 2001; 31:1089-1094.

Savage CR, Deckersbach T, Heckers S, Wagner AD, Schacter DL, Alpert NM, Fischman AJ, Rauch SL. Prefrontal systems underlying spontaneous and directed strategic processing during verbal learning. *Brain Cog* 2001; 47:116-120.

Deckersbach T, **Savage CR**, Curran T, Bohne A, Wilhelm S, Baer L, Jenike MA, Rauch SL. A study of parallel implicit and explicit information processing in obsessive-compulsive disorder. *Am J Psychiat* 2002; 159:1780-1782.

Deckersbach T, **Savage CR**, Reilly-Harrington N, Clark L, Sachs G, Rauch SL. Episodic memory impairment in bipolar disorder and obsessive-compulsive disorder: The role of memory strategies. *Bipolar Dis* 2004; 6:233-244.

Hartl TL, Frost RO, Allen GJ, Deckersbach T, Steketee G, Duffany SR, **Savage CR**. Actual and perceived memory deficits among individuals with compulsive hoarding; *Depression and Anxiety* 2004; 20:59-69.

Deckersbach T, **Savage CR**, Dougherty DD, Bohne A, Loh R, Nierenberg A, Sachs G, Rauch SL. Spontaneous and directed application of verbal learning strategies in bipolar disorder and obsessive compulsive disorder. *Bipolar Dis* 2005; 7:166-175.

Holsen LM, Zarcone JR, Thompson TI, Brooks WM, Anderson MF, Ahluwalia JS, Nollen NL, **Savage CR**. Neural Mechanisms Underlying Food Motivation in Children and Adolescents. *NeuroImage* 2005;27:669-676.

Miotto EC, **Savage CR**, Wilson BA, Evans J, Martins MGM, Iaki S, Amaro E. Bilateral activation of the prefrontal cortex after strategic semantic cognitive training. *Hum Brain Mapping* 2006; 27:288-295.

Wright C, Keuthen NJ, **Savage CR**, Martis B, Williams D, Wedig MM, McMullin K, Rauch SL. Brain Correlates of Negative and Positive Visuospatial Priming in Adults. *NeuroImage* 2006; 30: 983-991.

Okuyemi KS, Powell JN, **Savage CR**, Hall SB, Nollen NL, Holsen LM McClernon FJ, Ahluwalia JS. Cue elicited brain activation in African American and Caucasian smokers. *Addiction Biol* 2006: 97-106.

Buhlmann U, Deckersbach T, Engelhard I, Cook LM, Rauch SL, Kathmann N, Wilhelm S, **Savage CR**. Cognitive retraining for organizational impairment in obsessive-compulsive disorder. *Psychiatry Research*; 2006; 144:109-116.

Holsen LM, Zarcone JR, Brooks WM, Butler MG, Thompson TI, Ahluwalia JS, Nollen NL, **Savage CR**. Neural Mechanisms Underlying Hyperphagia in Prader-Willi Syndrome. *Obesity* 2006; 14:1028-1037.

Sherman BJ, **Savage CR**, Eddy KT, Connor C, Blais MA, Deckersbach T, Jackson SC, Franko DL, Rauch SL, Herzog DB. Strategic memory in adults with anorexia nervosa: Are there similarities to obsessive-compulsive disorder? *International Journal of Eating Disorders* 2006; 39:468-476.

Rauch SL, Wright CI, **Savage CR**, Martis B, McMullin KG, Wedig MM, Gold A, Keuthen N. Brain activation during implicit sequence learning in individuals with trichotillomania. *Psychiat Res* 2007;154:233-40.

Bohne A. **Savage CR**, Keuthen NJ, Deckersbach T, Wilhelm S. Motor inhibition in trichotillomania and obsessive-compulsive disorder. *J Psychiatric Res* 2008; 42:141-150.

Strangman GE, O'Neil-Pirozzi TM, Goldstein R, Kelkar K, Katz DI, Burke D, Rauch SL, **Savage CR**, Glenn MB. Prediction of memory rehabilitation outcomes in traumatic brain injury using functional magnetic resonance imaging. *Arch Phys Med Rehab* 2008; 89:974-981.

O'Hare AJ, Dien J, Waterson LS, **Savage CR**. Activation of the posterior cingulate by semantic priming: A co-registered ERP/fMRI study. *Brain Research* 2008; 1189:97-114.

C. Research Projects Ongoing or Completed in the last 3 years
Ongoing Research Support

R01 DK080090 NIH	Savage, Cary (PI)	07/01/08 – 06/30/11
Brain function predictors and outcome of weight loss and weight loss maintenance We will use functional magnetic resonance imaging (fMRI) to characterize brain systems underlying food motivation in obese and healthy weight individuals and to identify predictors of weight loss and maintenance in obese individuals participating in a diet-based behavioral weight loss intervention. Role: PI		
R21 HD050534 NIH	Savage, Cary (PI)	05/15/07 – 05/14/09
Predicting Response to Memory Training in TBI with fMRI This project uses fMRI and a strategic verbal learning paradigm to identify brain activation predictors of everyday cognitive functioning and improvement following mild to moderate traumatic brain injury. Role: PI		
Alzheimer's Association	Pohl, Patricia (PI)	07/31/07-08/01/10
Effects of Delivery Mode of Cognitive Intervention in Early AD The aim of this study is to use fMRI and a verbal memory paradigm to identify changes in brain function after intensive cognitive rehabilitation in individuals with early AD. Role: Co-Investigator		
No Number Dana Foundation	Burns, Jeffrey (PI)	01/01/08-13/31/09
fMRI investigation of the effects of intranasal insulin on memory in Alzheimer's disease. This study evaluates functional changes following administration of intranasal insulin, using fMRI and a visual memory encoding paradigm. Role: Co-Investigator		
0860041Z AHA-Heartland	Cirstea, Carmen (PI)	01/01/08 – 12/31/09
Multimodal Neuroimaging in Stroke Motor Rehabilitation This project utilizes fMRI and MRS data to characterize neural plasticity in primary motor cortex following motor rehabilitation. Role: Co-Investigator		
F32 DA023327 NIH	Martin, Laura (PI)	5/15/07-5/14/09
Nicotine Addiction and Reward Processing: An fMRI Investigation		

This project uses fMRI and a reward prediction paradigm to examine reward and punishment sensitivity in smokers and non-smokers.

Role: Sponsor

K01 HD047148 Quaney, Barbara (PI) 12/15/04-11/30/09

NIH
Motor Performance and Cortical Changes in Chronic Stroke
This is an NIH Scientist Development Award designed to further Dr. Quaney's development in the use of fMRI.
Role: Co-Mentor

Completed Research Support (Partial List)

R01 NS39123 Brooks, William (PI) 08/01/03 – 07/31/07

NIH
Neurometabolism and Outcome in Traumatic Brain Injury
The aim of this study is to determine the usefulness of neurochemical markers of brain injury determined by non-invasive magnetic resonance spectroscopy to predict cognitive outcome and monitor recovery following traumatic brain injury. Further aims are to understand the biochemistry and physiology of TBI.
Role: Co-Investigator

Hereditary Disorders Heartland Collaborative Grant Award Savage, Cary (PI) 10/1/05-5/31/07

Heartland Collaborative HRSA U22MC03962-02
fMRI Studies of Food Motivation in Prader-Willi Syndrome
This project uses fMRI to study neural mechanisms underlying abnormal food motivation in three genetic subtypes of Prader-Willi syndrome.
Role: PI

KUMC Research Institute Clinical Pilot Program Savage, Cary (PI) 02/01/06 - 06/30/07

fMRI Investigation of D-Cycloserine and Exposure in Specific Phobia
This project uses fMRI to identify brain networks underlying enhancement of cognitive behavior therapy response with D-Cycloserine in individuals with specific (spider) phobia.
Role: PI

Research Grant Savage, Cary (PI) 09/01/03-06/30/06

Hall Family Foundation
Studies of Developmental Disabilities in Children
The objective of this project is to use fMRI to evaluate neural systems underlying abnormal cognitive development in individuals with genetic developmental disorders.
Role: PI

R01 HD41672 Zarcone, Jennifer (PI) 04/26/01-03/31/06

NIH/NICHD
Compulsive Behavior and Food Seeking in Prader-Willi Syndrome
The focus of this project is on the brain mechanisms underlying compulsive behavior in people with Prader-Willi syndrome.
Role: Co-Investigator

0655759Z Brooks, William (PI) 07/01/06 – 06/30/08

AHA-Heartland
Arm Movement Patterns in Stroke: Neural Substrates
The major goals of this project are characterize brain plasticity in a motor task in stroke patients using magnetic resonance spectroscopy and functional magnetic resonance imaging.
Role: Co-Investigator