Memorandum

SUNTRUST

Date: February 7, 2018

To: McKnight Brain Research Foundation Trustees
Henry H. Raattama, Jr. Legal Counsel

From: Melanie Cianciotto

Subject: MBRF Meeting: February 19 – 21, 2018 (Tucson, AZ)

Enclosed you will find the meeting package for the February Trustees meeting to be held in Tucson, Arizona. Included in this package for your review are the following items: the agenda, final draft of the minutes of the November 8, 2017 Trustee's meetings, minimum distribution calculation and other supporting material for the agenda items.

Reservations have been made at the Tucson University Park Hotel.

Dr. Lee Dockery/Dr. Michael Dockery	Confirmation # 48189
Dr. Robert Wah	Confirmation # 48191
Dr. Madhav Thambisetty	Confirmation # 48192
Dr. Nina Ellenbogen Raim	Confirmation # 48188
Dr. Gene Ryerson	Confirmation # 48190
Mr. Hank Raattama	Confirmation # 48194

Look forward to seeing you all in Tucson!

/mc

cc: Mike Hill

Enclosures

MCKNIGHT BRAIN RESEARCH FOUNDATION
February 19 – 21, 2018
Tucson University Park Hotel
Executive Boardroom
880 East 2nd Street
Tucson, Arizona

AGENDA

Monday ,February 19, 2018

1:00 p.m.	1.	Lunch & Call to order
2:00 p.m. – 3:00 p.m.	2.	Interview, Executive Director Candidate (Application materials to follow)
3:30 p.m. – 4:30 p.m.	3.	Interview, Executive Director Candidate (Application materials to follow)
4:30 p.m. – 5:00 p.m.	4.	Executive Session, temporary adjournment
6:00 p.m. – 8:00 p.m.	5.	Trustee Reception and Dinner (Location to be announced)

Tuesday, February 20, 2018

8:00 a.m.	1.	Breakfast & Call to order
8:30 a.m. – 9:00 a.m.	2.	Approval of Minutes Board of Trustees Meeting, November 8, 2017
	3.	Travel Award Program Cognitive Aging and Memory Intervention Core Pilot Proposals
	4.	Minimum Distribution Calculation
9:00 a.m. – 10:00 a.m.	5.	Interview, Executive Director Candidate (Application material to follow)
10:00 a.m. – 1A0:15 a.m.	6.	Break
10:15 a.m. – 10:30 a.m.	7.	Upcoming Dates and Events

A. Trustees' Meeting and McKnight Inter-Institutional Meeting
University of Alabama at Birmingham
April 4 -6, 2018

B. Trustees' Meeting
Orlando, FL
July – August 2018 ????

C. MBRF Poster Reception
Society for Neuroscience
San Diego, CA
November 4, 2018

10:30 a.m. – 11:30 a.m.	8. Interview, Executive Director Candidate (Application material to follow)
11:30 a.m. – 12.30 p.m.	9. Investment Review
12:30 p.m. – 1:15 p.m.	10. Lunch/Break Guest: Susan Pekarske, MD, Trustee nominee (see attached CV)
1:15 p.m. – 1:45 p.m.	11. Request for applications McKnight Clinical Translational Research Scholarships
1:45 p.m. – 2:45 p.m.	12. Annual Reports A. University of Alabama at Birmingham Primary review by Dr. Richard Isaacson B. University of Arizona Primary review by Dr. Madhav Thambisetty C. University of Florida Primary review by Dr. Gene Reyerson D. University of Miami Primary review by Dr. Michael Dockery
2:45 p.m. – 3:00 p.m.	13. Break
3:00 p.m. – 3:30 p.m.	14. Report, University of Arizona Foundation A. Mr. John-Paul Roczniak President and CEO University of Arizona Foundation B. Jenny Flynn Senior Vice President Development Services University of Arizona Foundation C. Vicki Fleisher Senior Vice President for Development & Regional Discovery University of Arizona Foundation D. Elaine Cunnigham Director of Development Evelyn F. McKnight Brain Institute at the University of Arizona
3:30 p.m. – 4:00 p.m.	Trustees transported by bus to main campus (Old Main) to meet with Dr. Robbins
4:00 p.m. – 5:00 p.m.	15. Trustees meet in Old Main Board Room: Robert C. Robbins, MD President, University of Arizona and selected leadership, UA (Provost, Andrew Comrie, Senior Vice President for Research, Kimberly Espy, EMBI Director, Carol Barnes) meet with Trustees

5:00 p.m. – 6:30 p.m.	16. Reception (Old Main Silver and Sage Room) MBRF Trustees, President Robbins, Provost Comrie, Senior Vice President for Research Kimberly Espy, J.P. Roczniak, Jenny Flynn, Vicki Fleisher, Elaine Cunningham and all speakers for the February 21 scientific session, EMBI Affiliate Faculty, special guests Trustees, UA leadership and faculty
7:00 p.m. – 9:00 p.m.	17. Trustees' Dinner (Location to be announced)

Wednesday, February 21, 2018

7:30 a.m.	Trustees transported by car service to Keating 103
8:00 a.m. – 11:30 a.m.	1. Scientific Program University of Arizona Evelyn F. McKnight Brain Institute Faculty and guests
11:30 a.m.	2. Program concludes Box lunches, Trustees depart

MINUTES
MCKNIGHT BRAIN RESEARCH FOUNDATION
BOARD OF TRUSTEES MEETING
November 8, 2017

The Trustee's meeting of the McKnight Brain Research Foundation (MBRF) was called to order at 8:00 a.m. on November 8, 2017 in the Endeavor Conference Room at the Hyatt Regency Orlando International Airport Hotel in Orlando, Florida.
(See Agenda Attachment 1)

The following members were present:
Dr. J. Lee Dockery, Trustee
Dr. Michael Dockery, Trustee
Dr. Richard I. Isaacson, Trustee
Dr. Nina Ellenbogen Raim, Trustee
Dr. Gene G. Ryerson, Trustee
Dr. Madhav Thambisetty, Trustee
Dr. Robert Wah, Trustee (via conference call)
Ms. Melanie Cianciotto, Corporate Trustee
SunTrust Bank Institutional Investment Solutions

Others attending:
Mr. Henry H. Raattama, Jr., Legal Counsel
Mr. Mike Hill, SunTrust Bank Institutional Investment Solution (via conference call)
Ronald Lazar, PhD, Evelyn F. McKnight Chair for Learning and Memory in Aging
Director, Evelyn F. McKnight Brain Institute, University of Alabama at Birmingham (UAB).

1. Investment Review

Mr. Hill presented the investment review and commented on key economic and investment factors for the third quarter, via conference call. (Attachment 2).

A. Market Environment

- U.S. and International equities increased in the third quarter, while Emerging Markets continued to hold a commanding lead. Non-US developed emerging markets out performed US for the quarter.
- Increasing yields in interest hurt the September bond returns, but the bond returns are solid year to date and posted gains in the third quarter particularly in the high yield corporate bonds.
- Economic data continued to improve, but shifts in policy and the series of hurricanes will weigh heavily on forthcoming data. However, third quarter data continues strong, especially manufacturing, which expanded its fastest pace since 2004.

B. Portfolio Review

Asset Allocation: The asset classes of the investments within the portfolio of the MBRF remain within the guidelines established by trustees in the Investment Policy Statement of the Foundation. Reference was made to the modifications of the investment policy reflecting the changes approved by the trustees on July 25, 2017. (Attachment 3).

Portfolio Performance: For the quarter ending September 30, 2017 the total return for the portfolio was 4.14% versus 3.27% for the Investment Policy Statement index.

Action Item 1: The trustees received the investment review for information (Attachment 2).

2. Approval of Minutes

The minutes of the July 25, 2017 Board of Trustees Meeting and the October 2, 2017 Strategic planning conference call of the McKnight Brain Research Foundation were reviewed (Attachment 4 and 5). The minutes were approved as presented.

Action Item 2: The trustees approved the minutes of the July 25, 2017, Board of Trustees meeting and the October 2, 2017 strategic planning conference call of the McKnight Brain Research Foundation, as presented (Attachment 4 and 5).

3. Minimum Distribution Calculation

The trustees reviewed the projected minimum distribution calculation for information (Attachment 6).

Action Item 3: The trustees reviewed, for information, the projected minimum distribution calculation (Attachment 6).

4. Travel Award Program Update

The trustees reviewed the travel award program payments for information (Attachment 7). The Trustees requested progress reports on the funding for the Inter-institutional cognitive aging assessment core, the Inter-Institutional Bioinformatics core and the Inter-Institutional Neuro-imaging core.

Action Item 4: The trustees reviewed, for information, the travel award program payments and requested reports be submitted on the funding for the Inter-Institutional Cognitive Aging Assessment Core, the Inter-Institutional Bioinformatics Core and the Inter-Institutional Neuro-imaging Core. (Attachment 7).

5. Review of Strategic Planning Documents Relevant to the Reorganization of the MBRF

The trustees reviewed and approved the following documents as amended.

A. Duties of the Executive Director (Attachment 8)
B. Duties of the Chair of the Board of Trustees (Attachment 9)
C. Duties of the Corporate Trustee (Attachment 10)
D. Advertisement of Executive Director Position (Attachment 11)

The trustees after discussion, confirmed their approval to establish a part time Executive Director Position, at 20 hours per week, and to begin advertising for the position with a closing date of January 30, 2018 for applications. Salary ranges were discussed using the survey by Exponent Philanthropy, an association of small foundations. The trustees approved a salary range between $125 to $150 per hour based upon the candidates' credentials, knowledge and experience as comparable to the ranges reported in the 2017 survey report.

The trustees agreed the chair of the board and the corporate trustee will screen the applications for candidates who are thought to meet the published required qualifications prior to presenting to the list of candidates to the full board.

Action Item 5:

A. The Trustees approved the documents outlining the duties of the Executive Director, the Chair of the Board, the Corporate Trustee and the advertisement for the executive director position as amended. (Attachments 8,9,10, and 11 respectively).

B. The trustees unanimously approved the establishment of a part time Executive Director position, at 20 hours per week, and to begin advertising for the position with a closing date of January 30, 2018.

C. The trustees approved a salary range between $125 to $150 per hour based upon the candidates' credentials, knowledge and experience as comparable to the ranges reported in the 2017 salary survey report.

D. The chair of the board and the corporate trustee will screen the applications for candidates who are thought to meet the published required qualifications prior to presenting to the list of candidates to the full Board.

6. Recruitment Update for Scientific Director position, Evelyn F. McKnight Brain Institute, University of Miami

Dr. Lee Dockery informed the trustees of his recent conversation with Dr. Ralph Sacco, executive director of the Evelyn F. McKnight Brain Institute at the University of Miami regarding the status of the recruitment to fill the vacant scientific director position. The final candidate, Dr. Stephan Rao, has withdrawn his candidacy because of wife's health status. Dr. Rao was thought to be an excellent candidate, has visited the University of Miami campus twice and had submitted his vision statement regarding the position.

Dr. Sacco indicated he will convene the search committee again and will continue to keep the trustees informed.

Action Item 6: The trustees received the report on the status of the recruitment of the scientific director position, Evelyn F. McKnight Brain Institute, University of Miami for information.

7. Report from Dr. Ronald Lazar, the Evelyn F. McKnight Chair for Learning and Memory in Aging and the Director of the Evelyn F. McKnight Brain Institute (EMBI) at the University of Alabama at Birmingham (UAB)

The trustees welcomed Dr. Lazar who assumed his duties at the EMBI at the UAB, June 1, 2017. Dr. Lazar commented verbally on a detailed written outline of his activities since his arrival and his plans for the advancing the research initiatives in cognitive aging and age-related memory loss at the EMBI at UAB. (Attachment 12). In addition, Dr. Lazar described plans for enhancing the collaborative initiatives with the research scientists between each of the McKnight Brain Institutes.

The EMBI at the UAB will host the 10th annual inter-institutional meeting between the four McKnight Brain Institutes and Dr. Lazar gave a brief overview of the format of the meeting scheduled April 4-6, 2018. A key note speaker has been identified and trustee, Dr. Madhav Thambisetty, has also been invited to speak at the meeting. The remainder of the scientific program will feature presentations from selective research scientists throughout the four McKnight Brain Institutes.

The budget for the meeting had been approved at the July 25, 2017 trustees meeting. Dr. Lazar presented a supplemental budget request in the amount of $4,946.04 to support a pre-interinstitutional meeting. The additional budget request is to enable members of specific collaborative research groups to meet before the start of the official scientific program of the meeting. (Attachment 13). The trustees, after review of the plans for the pre-interinstitutional meeting scheduled for the afternoon of April 4, 2018, approved the supplemental budget not to exceed $5,000.

The trustees thanked Dr. Lazar for meeting with them and commended his efforts to advance the success of the research initiatives at the EMBI at the UAB as well as the collaborative efforts between each of the four McKnight Brain Institutes (MBIs).

Action Item 7:

A. The trustees, after review of the plans for the pre-interinstitutional meeting scheduled for the afternoon of April 4, 2018, approved the supplemental budget not to exceed $5,000. (Attachment 13).

B. The trustees thanked Dr. Lazar for meeting with them and commended his efforts to advance the success of the research initiatives at the EMBI at the UAB as well as the collaborative efforts between each of the four McKnight Brain Institutes (MBIs).

8. Upcoming Dates & Events

A. Society for Neuroscience (SfN) 2017 McKnight Poster Session

The poster/reception is an MBRF sponsored and hosted event for graduate students and faculty who will be attending the annual meeting of the SFN from each of the four institutions to which the MBRF provides funding. The reception will feature scientific poster displays from each of the four McKnight Brain Institutes. Trustees, Lee Dockery, Richard Isaacson, Gene Ryerson and Madhav Thambisetty have indicated they will attend the event, which will be held on Sunday, November 12, 2017; 5:00 PM-7:00 PM, at the Embassy Suites DC Convention Center in Washington, D.C. Dr. Molly Wagster and Dr. Jon King from the National Institute on Aging (NIA) will act again as judges for

the poster abstracts to award three cash prizes in the amounts of $500, $300 and $200 and three honorable mention awards

B. February 20-21, 2018 Trustees Meeting

In consultation with Dr. Carol Barnes, the Evelyn F. McKnight Chair and Director of the EMBI at the University of Arizona (UA), the dates of February 20-21, 2018 have been confirmed for the meeting of the MBRF in Tucson, Arizona in combination with a site visit to the EMBI at the (UA). The trustees will meet with the leadership of the UA in the afternoon of February 20, followed by a reception with the leadership and faculty associated with the EMBI at the UA. The President of the University and the University of Arizona Foundation are scheduled to meet with the trustees. The scientific program will be on February 21, 2018, concluding at noon with box lunches for early afternoon departures.

The annual reports from each of the four MBIs will be reviewed at the February 2018, meeting of the trustees. In addition, with the possibility of interviewing candidates for the executive director position, the difference in time zones and the unpredictable arrival times, trustees discussed the advantage of arriving in the evening of February 19, 2018 and beginning the trustees meeting at 8:00 AM on February 20, 2018. After discussion, the trustees approved 8:00 AM, February 20, 2018, as the start time of the trustees meeting.

Action Item 8:
The trustees approved 8:00 AM, February 20, 2018, as the start time of the trustees meeting.

C. 2018 Inter-Institutional Meeting

The tenth McKnight Brain Research Foundation Inter-Institutional Meeting will be hosted by the Evelyn F. McKnight Brain Institute at the University of Alabama at Birmingham April 4 – 6, 2018. The trustees will arrive the morning of April 4, 2018 and meet in the afternoon beginning at 12:00 noon. The Inter-Institutional meeting will begin with a reception on the evening of April 4, 2018 followed by the scientific sessions on April 5 - 6, adjourning at noon on April 6, 2018.

9. Research Partnership in Cognitive Aging

The MBRF will conclude the second five-year Research Partnership in Cognitive Aging agreement with the NIA at the end of 2018. The trustees have received an inquiry from the NIA regarding the interest of the MBRF in renewing the partnership in 2019. The MBRF has received a summary of the executive summary of the executive session of the Cognitive Aging Summit III with a list of research topics for further exploration and consideration for funding of research proposals. (Attachment 14). The trustees discussed the goals and objectives of continuing the Research Partnership in Cognitive Aging, with regard to the measurable benefits and contributions to the body of knowledge in cognitive aging and age-related memory loss. The trustees were unable to identify any specific topics for research support through the Research Partnership in Cognitive Aging, but expressed strong support for a clinical translational emphasis. The discussions concluded with the trustees endorsing the renewal of the Research

Partnership in Cognitive Aging with the NIA in support of cognitive aging and memory research with a mutually agreeable clinical translational emphasis.

Action Item 9:
The trustees endorsed the renewal of the Research Partnership in Cognitive Aging with the NIA in support of research in cognitive aging and memory with a mutually agreeable clinical translational emphasis.

10. New Trustee Discussions

There are potentially three trustee vacancies with expiring terms of two trustees and the resignation of another by July 2019. At the July 25, 2017 meeting of the trustees, each trustee was asked to identify potential nominees for consideration at the current, November 8, 2017 meeting. Biographical information was presented and discussed on 10 candidates. (Attachment 15). Seven profiles were considered to be the most compatible for the services required by a trustee of the MBRF. After discussion, the trustees gave informal approval to the chair and vice chair to contact named individuals to determine their interest in serving as trustee after which a formal process will be developed for selection and appointment of a new trustee.

Action Item 10:
The trustees gave informal approval to the chair and vice chair to contact named individuals to determine their interest in serving as trustee after which a formal process will be developed for selection and appointment of a new trustee.

11. McKnight Scholarships, Update

July 1, 2107 was the date of the announcement for the first cycle of The McKnight Clinical Translational Research Scholarship in Cognitive Aging and Age-Related Memory Loss. The closing date for the application was October 1, 2017. Trustees, Dr. Richard Isaacson and Dr. Madhav Thambisetty serve on the selection committee for the scholarship awards and reported six applications have been received for the first cycle.

The committee will meet December 14, 2017 and make their final selections. The chair has been invited to attend the meeting of the selection committee by telephone. The trustees expressed their appreciation to Drs. Isaacson and Thambisetty for their representation of the MBRF in the selection process.

Action Item 11: The trustees expressed their appreciation to Drs. Isaacson and Thambisetty for their representation of the MBRF in the selection process.

12. New Business

A. Request for the Foundation for the National Institutes of Health

The Foundation for the National Institutes of Health (FNIH) has requested a response to three questions from the MBRF to include in their Annual Report. (Attachment 16). After discussion, the trustees agreed to respond to the request from the FNIH and authorized the chair to proceed in drafting a reply to the submitted questions.

Action Item 12:
The trustees agreed to respond to the request from the FNIH and authorized the chair to proceed in drafting a reply to the submitted questions.

B. Trustee Annual Self Evaluation

The chair informed the trustees the annual trustee self-evaluations are due by December 31, 2017. The corporate trustee will distribute the forms which are to be returned to her after completion.

Action Item 13:
The trustees are requested to complete the annual trustee self-evaluation form and return to the corporate trustee by December 31, 2017.

14. Adjournment

There being no further business, the trustees meeting was adjourned at 2:30 PM.

Respectfully Submitted,

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Melanie A. Cianciotto
SunTrust Bank, Corporate Trustee

Appendix 1: Summary of Actions, Pages 8 and 9

Appendix 1: Summary of Actions

MCKNIGHT BRAIN RESEARCH FOUNDATION
BOARD OF TRUSTEES MEETING
November 8, 2017

Action Item 1: The trustees received the investment review for information (Attachment 2).

Action Item 2: The trustees approved the minutes of the July 25, 2017, Board of Trustees meeting and the October 2, 2017 strategic planning conference call of the McKnight Brain Research Foundation, as presented (Attachment 4 and 5).

Action Item 3: The trustees reviewed, for information, the projected minimum distribution calculation (Attachment 6).

Action Item 4: The trustees reviewed, for information, the travel award program payments and requested reports be submitted on the funding for the Inter-Institutional Cognitive Aging Assessment Core, the Inter-Institutional Bioinformatics Core and the Inter-Institutional Neuro-imaging Core. (Attachment 7).

Action Item 5:

A. The Trustees approved the documents outlining the duties of the Executive Director, the Chair of the Board, the Corporate Trustee and the advertisement for the executive director position as amended. (Attachments 8,9,10, and 11 respectively).

B. The trustees unanimously approved the establishment of a part time Executive Director position, at 20 hours per week, and to begin advertising for the position with a closing date of January 30, 2018.

C. The trustees approved a salary range between $125 to $150 per hour based upon the candidates' credentials, knowledge and experience as comparable to the ranges reported in the 2017 salary survey report.

D. The chair of the board and the corporate trustee will screen the applications for candidates who are thought to meet the published required qualifications prior to presenting to the list of candidates to the full Board.

Action Item 6: The trustees received the report on the status of the recruitment of the scientific director position, Evelyn F. McKnight Brain Institute, University of Miami for information.

Appendix 1: Summary of Actions, November 8, 2017, continued

Action Item 7:

A. The trustees, after review of the plans for the pre-interinstitutional meeting scheduled for the afternoon of April 4, 2018, approved the supplemental budget not to exceed $5,000. (Attachment 13).

B. The trustees thanked Dr. Lazar for meeting with them and commended his efforts to advance the success of the research initiatives at the EMBI at the UAB as well as the collaborative efforts between each of the four McKnight Brain Institutes (MBIs).

Action Item 8: The trustees approved 8:00 AM, February 20, 2018, as the start time of the trustees meeting.

Action Item 9: The trustees endorsed the renewal of the Research Partnership in Cognitive Aging with the NIA in support of research in cognitive aging and memory with a mutually agreeable clinical translational emphasis.

Action Item 10: The trustees gave informal approval to the chair and vice chair to contact named individuals to determine their interest in serving as trustee after which a formal process will be developed for selection and appointment of a new trustee.

Action Item 11: The trustees expressed their appreciation to Drs. Isaacson and Thambisetty for their representation of the MBRF in the selection process.

Action Item 12: The trustees agreed to respond to the request from the FNIH and authorized the chair to proceed in drafting a reply to the submitted questions.

Action Item 13: The trustees are requested to complete the annual trustee self-evaluation form and return to the corporate trustee by December 31, 2017.

Travel Award Program

Date	Name	School	Amount		
5/6/2009	Marsha Penner	University of Alabama	$1,305.43		
11/4/2010	Clinton Wright	University of Miami	$1,005.26		
11/20/2010	Gene Alexander	University of Arizona	$354.39		
7/26/2011	Gene Alexander	University of Arizona	$1,006.74		
	MBRF Working Groups				
8/3/2011 - 8/4/2011	Cognitive Test Battery Working Group - Retreat #1	University of Alabama, University of Arizona, University of Florida, University of Miami	$7,505.06		
12/1/2011 - 12/2/2011	Cognitive Test Battery Working Group - Retreat #2	University of Alabama, University of Arizona, University of Florida, University of Miami	$10,971.11		
4/10/2012 - 4/11/2012	Cognitive Test Battery Working Group - Meeting #3	University of Alabama, University of Arizona, University of Florida, University of Miami	$4,280.42		
8/1/2012 - 8/3/2012	MRI Standardization Working Group Meeting	University of Alabama, University of Arizona, University of Florida, University of Miami	$10,540.91		
8/8/2012 - 8/9/2012	Cognitive Test Battery Working Group - Meeting #4	University of Alabama, University of Arizona, University of Florida, University of Miami	$4,273.80		
8/13/2012 - 8/14/2012	Epigenetics Planning Meeting	University of Alabama, University of Arizona, University of Florida, University of Miami	$7,122.85		
1/8/2013 - 1/9/2013	Epigenetics Planning Meeting	University of Alabama, University of Arizona, University of Florida, University of Miami	$10,684.25		
	MRI Standardization - Scanning Project	University of Alabama, University of Arizona, University of Florida, University of Miami	$1,735.38		
4/8/2013 - 4/10/2013	MRI Standardization Working Group Meeting #2	University of Alabama, University of Arizona, University of Florida, University of Miami	$7,851.43		
12/6/2013	MRI Standardization	University of Florida & University of Miami	$1,094.90		
8/2016	Brain and Cognitive Health Working Group	University of Alabama, University of Arizona, University of Florida, University of Miami	$10,454.20		
		Total Spent	**$80,186.13**		
		MBRF Cores			
	Inter-Institutional Bioinformatics Core	**Commitment: $600,000 (9/1/2013 - 8/31/2015)**	**Paid**		
1/28/2014	Inter-Institutional Bioinformatics Core	University of Arizona	$52,000.00		
10/28/2014	Inter-Institutional Bioinformatics Core	University of Florida	$21,092.48		
5/18/2015	Inter-Institutional Bioinformatics Core	University of Arizona	$121,343.35		
6/18/2015	Inter-Institutional Bioinformatics Core	University of Florida	$73,703.25		
9/22/2015	Inter-Institutional Bioinformatics Core	University of Arizona	$101,922.80		
11/6/2015	Inter-Institutional Bioinformatics Core	University of Florida	$62,714.87		
1/29/2016	Inter-Institutional Bioinformatics Core	University of Arizona	$361.46		
6/16/2016	Inter-Institutional Bioinformatics Core	University of Florida	$90,335.30		
10/13/2016	Inter-Institutional Bioinformatics Core	Univeristy of Arizona	$250.00		
			$523,723.51	**$76,276.49**	**Remaining Balance**

	Inter-Institutional Neuro-Imaging Core	Commitment: $931,759 (1/1/2015 - 12/31/2017)	Paid		
4/23/2015	Inter-Institutional Neuro-Imaging Core	University of Miami	$45,000.00		
7/29/2015	Inter-Institutional Neuro-Imaging Core	University of Arizona	$21,660.31		
1/27/2016	Inter-Institutional Neuro-Imaging Core	University of Miami	$95,000.00		
1/27/2016	Inter-Institutional Neuro-Imaging Core	University of Arizona	$11,748.73		
3/21/2016	Inter-Institutional Neuro-Imaging Core	University of Florida	$5,991.48		
8/1/2016	Inter-Institutional Neuro-Imaging Core	University of Arizona	$8,175.01		
4/21/2017	Inter-Institutional Neuro-Imaging Core	University of Miami	$70,000.00		
6/27/2017	Inter-Institutional Neuro-Imaging Core	University of Florida	$2,319.99		
8/23/2017	Inter-Institutional Neuro-Imaging Core	University of Florida	$70.00		
10/3/2017	Inter-Institutional Neuro-Imaging Core	University of Florida	$870.00		
10/27/2017	Inter-Institutional Neuro-Imaging Core	University of Florida	$1,500.00		
12/20/2017	Inter-Institutional Neuro-Imaging Core	University of Florida	$730.45		
1/24/2018	Inter-Institutional Neuro-Imaging Core	University of Arizona	$17,868.28		
2/1/2018	Inter-Institutional Neuro-Imaging Core	University of Florida	$647.32		
			$281,581.57	**$650,177.43**	**Remaining Balance**
	Inter-Institutional Cognitive Aging Assessment Core	**Commitment: $800,000 (9/1/2015 - 8/31/2017)**	**Paid**		
1/27/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Miami	$102,735.00		
3/1/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$923.96		
3/21/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$1,154.89		
3/21/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$5,991.48		
3/30/2016	Inter-Institutional Cognitive Aging Assessment Core	Univeristy of Arizona	$11,516.32		
4/14/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$1,501.50		
5/16/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$1,582.45		
6/29/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$2,288.25		
7/19/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$1,570.22		
9/8/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$4,226.49		
9/8/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$4,468.20		
9/22/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Arizona	$30,269.81		
11/4/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$5,576.49		
12/15/2016	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$5,938.55		
1/18/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$6,686.87		
2/10/2017	Inter-Institutional Cognitive Aging Assessment Core	Univeristy of Arizona	$19,299.22		
2/17/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$5,606.64		
3/7/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$10,330.40		
4/18/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$6,003.77		
4/21/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Miami	$89,770.00		
5/10/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$8,167.95		
5/24/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Arizona	$16,976.96		
6/7/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$9,102.92		
6/26/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$1,655.87		
7/28/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$12,556.43		
8/7/2017	Inter-Institutional Cognitive Aging Assessment Core	Univeristy of Alabama	$13,021.96		
8/17/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$18,313.75		
8/22/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$2,089.09		
9/12/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$7,084.24		

10/3/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$4,025.81		
10/16/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$3,297.02		
10/27/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$727.86		
11/16/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$6,421.74		
11/30/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$4,898.29		
12/13/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$6,848.59		
12/201/2017	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$6,101.18		
1/16/2018	Inter-Institutional Cognitive Aging Assessment Core	University of Alabama	$4,517.27		
2/1/2018	Inter-Institutional Cognitive Aging Assessment Core	University of Florida	$3,551.17		
2/6/2018	Inter-Institutional Cognitive Aging Assessment Core	University of Arizona	$18,308.60		
			$465,107.21	**$334,892.79**	**Remaining Balance**

UF UNIVERSITY of FLORIDA

Center for Cognitive Aging and Memory Clinical Translational Research (CAM)
McKnight Brain Institute
Department of Clinical and Health Psychology

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January 16, 2018

Re: Cognitive Aging and Memory Intervention Core Pilot Proposals

Dear Dr. Dockery and MBRF Trustees,
Members of the Cognitive Aging and Memory Intervention Core met to discuss the pilot grant proposals submitted to the Core, including the input that we obtained from external reviewers. To summarize the results of that meeting, we are recommending that two of three submitted proposals be considered for funding by the MBRF. Below, we provide the scores obtained from external reviews and a summary of the impact statement and key points from the review and our Core committee discussion. Proposals were rated on a 1-9 scale, with 1 being the best overall score.

PI	Proposal	R1	R2	Mean
Levin	Scamming proposal	3	3	**3**
Bowers	NIRS intervention	2	5	**3.5**
Williamson	Vagal nerve stimulation proposal	4	7	**5.5**

All three applications were deemed to have merit according to reviewers. As evident from these scores, two of the three applications were rated significantly better than the third. The Williamson application, which received the weakest score, was rated less well in large part because plans for collaborative inter-institutional logistics had not been fully developed prior to the submission. Summaries of the two proposals that we are recommending for funding are provided below. The recommended proposals have similar overall mean impact scores.

Vulnerability of older adults to financial deception schemes. Levin, PI. This proposal from Dr. Levin and collaborators at Universities of Miami, Arizona and Florida aims to test an intervention to reduce susceptibility to financial scams in older adults. The application was judged to be significant because of its potential for clinical translational impact. Specifically, it was anchored in important social and cognitive issues associated with advanced age. The investigators provide evidence that age-associated declines in memory, attention, and certain executive functions contribute to increased vulnerability. The proposed study will develop a prototype scam detection intervention software that may be used in the future to help prevent seniors from being scammed. One reviewer noted that similar software exists, however, the members of the Core who evaluated the reviews concluded that this study could result in new and potentially more powerful methods and also would pilot the use of these in a small sample of older adults. They would also create in lab scamming susceptibility tools and ultimately evaluate cognitive, physical and socio-effective correlates

of scam susceptibility. In summary, the proposed study was judged to have considerable clinical and public health significance in the context of cognitive aging and memory. The approach was judged to be sound overall. Finally, it appears that this study has a high probability of leading to a future extramural funded clinical trial.

A Pilot Intervention with Near Infrared Stimulation: Revitalizing Cognition in Older Adults. Bowers, PI. This study will involve a collaboration between MBI investigators at the University of Florida and the University of Arizona. The goal of the study is to evaluate the potential of near infrared non-invasive brain stimulation for remediating age-related cognitive decline. This study proposes a neuromodulation method that is highly novel, based on use of infrared light to impact underlying mitochondrial activity in the brain. The investigators provided compelling pilot data to support the mechanistic action of the stimulation method. The proposed mechanism of action differs from other non-invasive neuromodulation approaches that focus on synaptic plasticity (e.g., transcranial direct current stimulation). This study proposes to evaluate this method in a pilot clinical trial of 52 older adults, of whom half will receive active intervention vs. a sham intervention procedure. At baseline, prior to the intervention, cognitive and neuroimaging assessments will be performed, with assessments repeated immediately post intervention and at 8 weeks after intervention completion. Although one reviewer expressed the need for more initial pilot work, the Core committee felt that the innovation of the method and the potential for high impact provided added justification and support for the approach. The proposal was judged to be clinically and scientifically significant given that there is a need for additional approaches to remediate cognitive decline in older adults and its focus on modulation of cerebral metabolic factors underlying age-associated cognitive dysfunction. The approach was deemed sound and highly innovative. The study was judged to have a high probability of leading to future extramural funded clinical trial.

We will not provide an impact statement on the third proposal given that our evaluation of the reviews suggest that this proposal will likely be viable in the future, but that the principal investigator needs to address logistical concerns regarding inter-institute collaboration. There were also some details in the proposal that the Core committee felt needed to be addressed before this application could be viewed as viable for potentially moving forward in the process.

To summarize, based on the reviews and adjudication of the proposals that have been invited and submitted for consideration, the Cognitive Aging and Memory Intervention Core voted unanimously that the two proposals described above be recommended for consideration for funding. The budgets requested for these proposals appear well justified and reasonable given the scope of work required for each study. If both are funded, we would request a total budget of $120,000/year for two years with this amount divided between the two studies equally.

We appreciate your support and encouragement regarding the Cognitive Aging and Memory Intervention Core and also with respect to the pilot proposal process. We look forward to your consideration of the two recommended proposals and would be happy to discuss them in greater detail.

Best wishes,

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PROJECT SUMMARY

Scamming, the cheating of people out of money or information, is a pressing public health problem associated with decreased quality of life, functional dependence, and negative health outcomes. Individuals in late middle and late adulthood are at particular risk for scamming, but the cognitive, socio-affective, and neurobiological mechanisms underlying this increased risk with advanced age are unclear. Moreover, **there are currently no effective interventions to reduce scam susceptibility** in these age groups. The long-term goal of this multi-site collaboration is to propose such an intervention; specifically, we will develop and validate a decision-supportive device to reduce online scam susceptibility in late midlife and old age. The web tool MERLIN (Merlin, according to the legend, served as advisor to King Arthur) will alert Computer users to the possibility that an email is a scam and assist them, in an age-tailored fashion, in the art of scam detection. As summarized in **Figure 1**, the goals of this pilot grant are to develop a prototype of the MERLIN web tool (**Aim 1**), build the experimental infrastructure required to test its efficacy in the lab (**Aim 2**), and investigate the cognitive, socio-affective, and health-related functional correlates of scam susceptibility of late midlife and older adults to provide a more comprehensive understanding of susceptibility profiles (**Aim 3**) and to generate data that will allow fine-tuning of MERLIN to age-group specific vulnerabilities. **Achieving these integrated aims across the three collaborating sites will provide a strong foundation for an R01 funding application**. Successful completion of this pilot project will show feasibility of the study approach, demonstrate an organized and effective multi-site data collection strategy, and provide the crucial pilot data and effect sizes to determine sample size and design characteristics for an R01 submission. Importantly, NIH currently has a particular interest in deception and aging as reflected in recent calls (e.g., *PAR16-448: Decision Making and Aging in Alzheimer's Disease; RFA-AG-18-010: Uncovering the Causes, Contexts, and Consequences of Elder Mistreatment*). Our proposed research to deploy and study the efficacy of MERLIN as an intervention tool to reduce online deception in late midlife and aging falls directly into this realm. For an R01 submission we plan an extension of the proposed work in a large and more diverse sample (including independent adults living with mild MCI) for a full validation of the MERLIN tool and an in-depth investigation of cognitive, socio-affective, and neurobiological (e.g., brain structure and function)[1] susceptibility profiles in late midlife and old age. The long-term goal of our collaboration is to **implement a comprehensive risk assessment and warning framework against scamming in advanced age**.

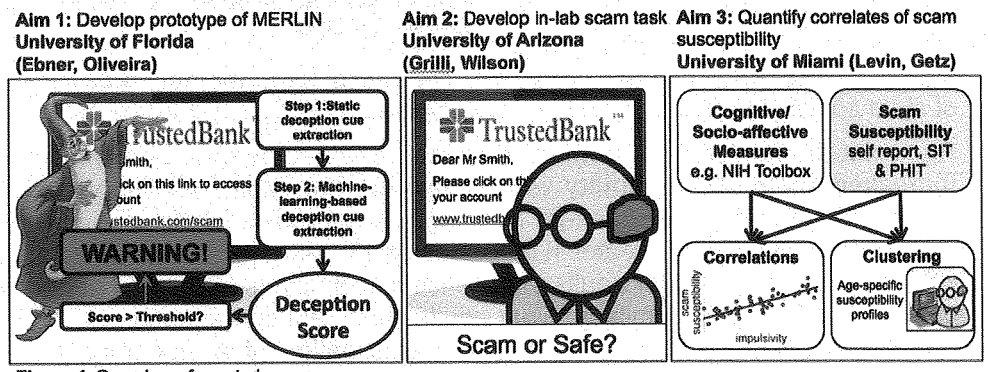

Figure 1. Overview of grant aims

SPECIFIC AIMS

Aim 1 (Ebner/Oliveira, University of Florida): Develop a prototype of MERLIN, an automated warning tool to support decision-making online. The browser plug-in MERLIN will scan email text to deliver alerts when an email is deemed suspicious, by combining methods from machine learning with our previous work identifying the particular psychological principles of influence or "weapons" (e.g., authority, commitment, liking, social proof) [2] used by scammers to lure users into visiting web pages that procure personal information or into clicking on links to malicious downloads. **Aim 2** (Grilli/Wilson, University of Arizona): Develop the in-lab Scam Identification Task (SIT), a new behavioral task to effectively "scam people in the lab" and will allow validation of the efficacy of MERLIN under controlled conditions. **Aim 3** (Levin/Getz, University of Miami): Quantify the cognitive, physical, and socio-affective correlates of scam susceptibility to tailor MERLIN to age-specific user profiles. Scam susceptibility will be measured using self-reported measures, SIT (from Aim 2), and performance on our previously developed Phishing Internet Task (PHIT) [3], an ecologically valid task to elicit scam-related behavior in the real world, by sending simulated phishing emails to participating Computer users, unbeknownst to them, and measuring the extent to which users fall for the "attacks" (i.e., clicking on the link present in the emails).

SIGNIFICANCE

Scamming is a major issue and late midlife and older adults are at particular risk. In 2010, financial fraud cost older adults $2.9 billion [4]. Metropolitan Insurance Company data from 2010 showed that one in five Americans aged 65 years or older fell victim to some form of financial abuse [5-7]. These estimates, combined with the rapidly growing proportion of older adults in the US and other industrialized nations projected by the Census Bureau, raise concern that increased vulnerability to deception will directly impact quality of life, lead to loss of independence, and produce significant financial hardship for a large segment of the aging population. Scamming is prevalent at all ages but the age 50+ years demographic is most vulnerable [8-10].

The internet has increased the reach and dangers of scamming. Scam-related deception is becoming increasingly sophisticated and difficult to track. Phishing programs, defined as computerized software designed to deceive and exploit individuals through fraudulent electronic media such as emails and pop-up messages, are particularly insidious and effective, especially in older individuals, given that older compared to younger adults have less experience with computers and lower confidence in their IT skills [11, 12].

Our preliminary data using the PHIT task on 52 younger (18–31 yrs.) and 31 older (61–89 yrs.) participants showed that older Computer users clicked on more links in simulated phishing emails (number of clicks M=1.71, SD=1.14) than younger users (M=1.33, SD=0.64; t=−2.93, p=0.008). This was combined with significantly lower susceptibility awareness in older than younger adults. Further, greater susceptibility to phishing was associated with lower memory recall, lower positive affect, and higher levels of state anxiety in old-old (75−89 yr.) participants (*N*=17) [13] (**Figure 2**).

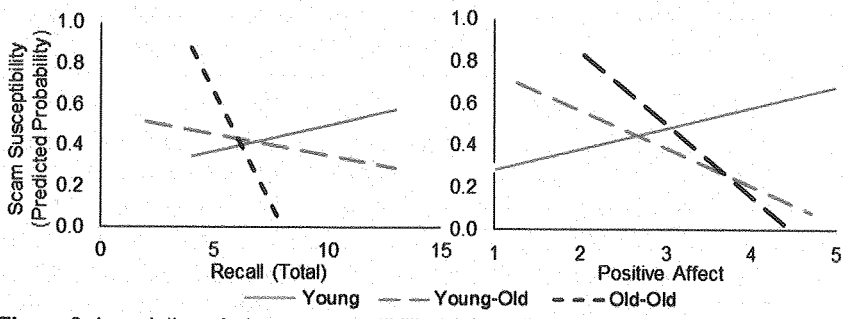

Figure 2. **Associations between susceptibility to deception online and cognitive and socio-affective capacities**

Age-related change in cognitive, physical, socio-affective, and neurobiological systems may underlie increased scam susceptibility with advanced age. Multidisciplinary evidence from cognitive neuroscience, psychology, and economics offers an intriguing neurobiological framework for understanding why late midlife and older adults are at greater risk for scams [3, 14]. Recent research suggests an age-related asymmetry wherein younger and older adults experience similar levels of positive affect, but older adults report lower levels of negative affect [15]. Similarly, older adults show reduced attention to and memory for negative material [16]. Neuroimaging data further reveals that in anticipation of a monetary gain, younger and older adults show recruitment of the same brain region (nucleus accumbens), however, during loss anticipation, younger, but not older adults, show recruitment of the anterior insula [17]. This age-related asymmetry in loss anticipation may increase susceptibility to scams [18] and could be one of the contributing factors to the alarmingly high rates of scamming among older adults.

INNOVATION

The proposed interdisciplinary project combines research in experimental aging with recent advances in decision-making and cybersecurity. It conceptually, methodologically, and translationally extends previous work: (i) The development of MERLIN is based on a **paradigm shift** in cybersecurity research. It proposes that **technical defense solutions alone cannot combat cyber social engineering attacks—rather, human behavior must be considered** to bring security information to users in a user-friendly, age-tailored fashion. (ii) In targeting **late midlife and older adults**, our studies will investigate scam susceptibility in age cohorts that have received little attention with regard to cognitive, physical, and socio-affective changes in their impact on decision-making. In this effort, our project has **great potential to conceptually advance a new model of decision-making in aging** that considers interpersonal difference variables relating to fraud susceptibility and poor decision-making. (iii) MERLIN will be the **first intervention aimed at reducing scam susceptibility in late midlife and old age**. The savings to society would be substantial: If this intervention leads to even a 10% decline in scam susceptibility among older Computer users, it could save millions of dollars every year, and therefore have a large translational impact. (iv) In a multi-methods approach to measuring scam susceptibility, the newly developed in-lab SIT will allow for **efficient assessment of susceptibility under controlled lab conditions**, facilitating an in-depth characterization of susceptibility profiles in the targeted age groups.

APPROACH

Aim 1: Develop a prototype of MERLIN, an automated machine learning-based browser plugin that warns on-the-spot about cues to deception in email messages in an age-targeted and user-friendly fashion. This pilot version of MERLIN will be developed as a Chrome browser extension for Gmail. Future work will extend the tool to other browsers and email programs as part of our R01 proposal for broader application. In a typical use case, a user will install the MERLIN tool by clicking on a single link on our website. As part of the installation process, the user will be prompted to input their age, gender, and other demographic information which will ultimately be used to tailor the parameters of MERLIN to a personalized profile. MERLIN will run in the background automatically scanning the text of emails whenever the user opens an email on the Gmail webpage (**Figure 3**). Based on text analysis, MERLIN will assign the email a "Deception Score" ranging from 0 (*low likelihood of scam*) to 100 (*high likelihood of scam*). If the Deception Score passes a threshold, MERLIN will pop up a warning message indicating that the email is suspicious. For the prototype version of MERLIN, both the threshold for determining whether an email is suspicious and the content of the warning message will be identical for all users. As we learn more about the factors associated with scam susceptibility (by leveraging data collected under Aims 2 and 3), the levels of these thresholds will be set according to age-group specific user profiles pertaining to cognitive and socio-affective measures (**towards a personalized use of MERLIN**). As an example of age-group specific behavior of MERLIN, our data analysis from Aims 2 and 3 may determine the old-old (75+ yrs.) profile as particularly susceptible to the weapons of authority and reciprocation and characterized by executive function deficits. MERLIN will tailor its behavior accordingly toward an old-old user by, for example, only generating warnings for authority and reciprocation, using color highlight for weapons in the email, and employing a high frequency of brief warnings in large font size in light of cognitive and sensory impairments in this age cohort. **Our pilot data supports the feasibility of developing MERLIN.** Ebner and Oliveira asked users to forward emails present in their spam folder [3]. A random selection of spam emails was used as a training set for development of a machine-learning classifier. Using the Random Forest algorithm, we predicted with 90% accuracy which age group (young vs. old) a spam email targeted. In addition to demonstrating feasibility of the proposed tool development, these data show that email-based social engineering attacks are already age-tailored to deceive users.

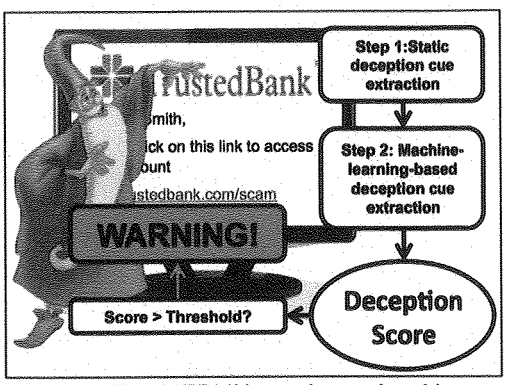

Figure 3. **The MERLIN warning tool architecture**

Aim 2: Development of in-lab assessment of scamming susceptibility and investigation of MERLIN's warning efficacy. We will develop and validate a lab task, the Scam Identification Task (SIT), to effectively measure individual differences in susceptibility to scam emails. This task will allow us to assess the efficacy of MERLIN under controlled conditions. *We hypothesize that older relative to younger adults will perform worse on the SIT when unaided, and MERLIN will improve scam detection among late middle-aged and older adults.*

Participants. 80 healthy young (18-30 yrs.) and 80 healthy middle-aged and older adults (50-90 yrs.) will be recruited from the Tucson community screened for neurologic, cognitive (cutoff score of 26 on the Montreal Cognitive Assessment; MoCA), and psychiatric conditions, leveraging existing recruitment logistics for these age groups at UA.

Scam Identification Task (SIT). The objective of the SIT is to efficiently measure individual differences in susceptibility to scam emails by simulating the real-world computing demands of the PHIT [3]. In SIT participants will make a series of forced-choice decisions about emails. On each trial of the task, participants will be presented with an email that they must classify as either a "scam" email they should ignore or a "safe" email they should reply to. In reality, 50% of the messages will be scam emails, which will be the most effective phishing emails from the PHIT, while the remaining 50% will be newly developed "safe" emails. "Safe" emails will be designed to mimic an important email that would normally require a response (e.g., an email from the electricity company about a late payment). To incentivize performance on the task, participants will be paid 10 cents for each correct answer and penalized 10 cents for each incorrect answer. To minimize learning effects, feedback on performance will not be given after each trial, but will instead be presented as aggregate performance every 10 minutes. To ensure no participant loses money on the task, participants will start the game with a balance of $10. Participants in the **experimental condition** will use a version of SIT with the MERLIN plugin and will receive targeted warnings as they work through the emails. Participants in the **control condition** will do a standard version of SIT, with no MERLIN plugin.

Analysis. Our main analysis will focus on the experimental vs. control between-group comparison of false negative rates (scam emails classified as safe) and false positive rates (safe emails classified as scams). We predict that older individuals in the control group will be more likely to classify emails as safe leading to a higher false negative rate and lower false positive rate, relative to older individuals in the experimental group (MERLIN). Whether younger adults in the control group demonstrate similar performance relative to the experimental group is an empirical question. Assuming that MERLIN has a moderate to large effect on false negative rates in older adults (effect size of 0.35), our sample size of 40 participants per cell will give us 87% power to detect this effect at a threshold of p=0.05. In addition we will compare behavior between age groups in the control condition. Assuming a similar age effect to that observed in the PHIT (effect size 0.31), 40 participants in each group will give us 78% power to detect such an effect at a threshold of p=0.05.

Aim 3: Quantify cognitive, physical, and socio-affective correlates of scam susceptibility. We will employ a selected test battery to identify correlates of deception susceptibility among cognitively healthy late middle and older adults. Within this aim, we will measure participants' actual behavioral response when faced with deceptive stimuli and their self-reported level of scam susceptibility. *We hypothesize that older compared to younger adults, and those with evidence of executive dysfunction, increased frailty symptoms, and a negative socio-affective profile (e.g., more negative affect, more loneliness) will show higher scam susceptibility.*

Participants. 100 healthy middle-aged and older adults (50–90 yrs.) will be recruited from the community and the Memory Disorders Clinic at UM, Miller School of Medicine. Participants will be screened to rule out neurologic, cognitive (cutoff of 26 on the MoCA), and psychiatric conditions, applying recruitment logistics in place at UM.

In addition to well-validated screening measures of cognition (MoCA) [19] and intelligence (The National Adult Reading Test-Revised) [20], we will administer the NIH Toolbox-Cognitive Module and the Hopkins Verbal Learning Test-Revised (HVLT-R) [21]. Mood will be assessed with: (i) the Beck Depression Inventory-II (BDI-II) [22] and (ii) the Beck Anxiety Inventory (BAI) [23]. Socio-affective function will be measured with: (i) the General Trust Scale [24] and (ii) the Social and Emotional Loneliness Scale for Adults [25]. Physical/health functional status will be assessed with Fried's criteria [26], based on: (i) weight loss, (ii) fatigue, (iii) weakness (grip strength), (iv) slow gait speed, and (v) low physical activity. We will measure scam susceptibility in three ways: (i) a self-reported measure of scam susceptibility (What Would You Do (WWYD) questionnaire; developed by Levin et al.), which consists of 29 items that present various common scamming scenarios; (ii) the SIT developed in Aim 2, and (ii) the previously developed PHIT [3].

Analysis. Multiple linear regressions, with age as covariate, will be used to investigate the relationship between the cognitive, physical, and socio-affective measures to performance on the three scam susceptibility tasks (WWYD, SIT, PHIT). 100 participants will allow us to detect small to moderate effects (r=0.275) between scam susceptibility and the other variables at 80% power and a threshold of $p<0.05$. Further, as a test of the validity of SIT, we will investigate correlations between the different measures of scam susceptibility, i.e. SIT, PHIT and self-reported scam susceptibility. If SIT behavior is truly capturing scam susceptibility then we predict strong correlations between the SIT false negative rate and the likelihood of clicking on simulated phishing emails in PHIT. Conversely, in line with preliminary data from Ebner and Oliveira, we do not predict strong correlations between participants' subjective assessment of scam susceptibility and either their SIT and PHIT behavior.

Anticipated Challenges and Alternative Strategies. The proposed work fits the MBRF Clinical Intervention core call for pilot funding particularly well in its conceptual and methodological innovation and significance in developing an intervention with potential for broad application and translational impact. We recognize that there will be challenges and outline them briefly here, along with potential remediation strategies. **Infrastructure and study logistics** for PHIT are complex. However, the task has been implemented successfully at UF, including IRB approval. We will leverage implementation at UF for task transfer to UM where we have a broader catchment area of late midlife and older adults. **Measurement and analytic approach.** Machine-learning approaches complement (or can substitute) conventional statistical analysis to generate profiles based on data collected under Aims 2 and 3 for fine-tuning of MERLIN (Aim 1). Machine-learning models for MERLIN can be trained on existent pilot data from Ebner and Oliveira and other online text sources (e.g., online ads), should Aims 2 and 3 not generate the expected outcomes. However, this significantly smaller and less diverse training data set would result in less accurate and robust algorithms. **Study costs.** To maximize knowledge gain, we will combine questions that are firmly grounded in the literature with novel, exploratory, and thus riskier questions (e.g., gender differences in scam susceptibility, consideration of age and gender as deceiver characteristics).

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MCKNIGHT CROSS-SITE COLLABORATION

Our team is well placed to conduct the planned studies towards our integrated aims. Our group brings together a unique skill set on experimental aging research (Ebner, Grilli, Levin, Getz), decision making (Wilson, Ebner), and computer science (Oliveira), including machine learning approaches for a comprehensive cross-site data collection and data analysis towards a joint R01 grant submission. With regard to clinical translatability, we are operating at the interface of basic and applied human cognitive neuroscience/psychology with ecologically valid tasks. Our collective areas of expertise, in addition to clinical neuropsychology (Grilli, Levin) and computer program development (Ebner, Oliveira), will be major assets for ensuring that we remain on a clear path towards clinical translation and implementation. In regard to our trajectory towards R01 funding, the proposed research will collect the necessary preliminary data and determine effect sizes for MERLIN's efficiency and for uncovering cognitive, physical, and socio-affective mechanisms underlying scam susceptibility. These data will directly relate to a future R01 proposal in which we will study the efficacy of MERLIN in the real world and extend the investigation of cognitive and socio-affective risk profiles to neurobiological factors contributing to scam susceptibility in midlife and old age (*PAR16-448: Decision Making and Aging in Alzheimer's Disease; RFA-AG-18-010: Uncovering the Causes, Contexts, and Consequences of Elder Mistreatment)*. The proposed aims, each developed by PIs with unique expertise at one of the three MBRI sites, will develop a different part of the infrastructure required to test, tailor, and ultimately deploy the MERLIN tool. We expect to complete the proposed three Aims in the two-year time period (see Table 1). Monthly Skype calls, along with two in-person meetings (in Florida to reduce travel costs), will coordinate research across sites and ensure a coherent approach to the joint R01.

Word count: 292 (max 300)

Year 1		Year 2	
Site	**Goal**	**Site**	**Goal**
UF	Build MERLIN prototype	UF	Fine-tune MERLIN; publish tool and apply for patent
UA	Develop SIT; run 40 younger and 40 older participants; begin analyzing data	UA	Run 40 younger and 40 older participants; complete data analysis; write up results for publication
UM	Run 50 late midlife and older participants; begin analyzing data	UM	Run 50 late midlife and older participants; complete data analysis; write up results for publication
		All	Write and submit R01 proposal

Table 1. Cross-site goals for Years 1 and 2.

BUDGET AND BUDGET JUSTIFICATION

Site	Year 1	Year 2
University of Florida (Aim 1)		
Personnel	$21,053.61	$21,952.01
Supplies	$1,000.00	
Other costs		
Travel	$800.00	
Subtotal	***$23,053.61***	***$21,952.01***
University of Arizona (Aim 2)		
Personnel	$13,229.57	$13,725.56
Supplies	$1,000.00	
Other costs	$800.00	$800.00
Travel	$1,000.00	$1,000.00
Subtotal	***$16,029.57***	***$15,525.56***
University of Miami (Aim 3)		
Personnel	$17,220.00	$17,736.60
Supplies	$1,000.00	$500.00
Other costs	$1,500.00	$1,500.00
Travel		$800.00
Subtotal	***$19,720.00***	***$19,936.00***
Total Budget	**$58,803.18**	**$57,413.56**

UNIVERSITY OF FLORIDA (UF)

Personnel

Natalie Ebner, PhD, PI, Associate Professor, University of Florida Term Professor (no salary requested in budget periods 1&2), will, in conjunction with Dr. Oliveira, provide oversight of all aspects of this research project at UF, including communication with the research team at UF and the other sites, development and refinement of the MERLIN tool under Aim 1, and budget management. She will oversee training and mentoring of the participating postdoc and any lab managers and graduate and undergraduate students involved in the project. In close communication with all PIs across the three sites, she will work on data analysis, interpretation of the data, write up of reports, dissemination of the results, and R01 grant submission.

Daniela Oliveira, PhD, PI, Associate Professor, IoT Term Professor (no salary requested in budget periods 1&2), will, together with Dr. Ebner, serve as the liaison between psychology and computer engineering for the machine-learning approach toward MERLIN development. She will be responsible for the cyber-security aspects of the study design and data collection infrastructure. She will work closely with Dr. Ebner in supervision of the machine-learning postdoc. She will also actively participate in results interpretation and dissemination, including grant reports, manuscripts, and R01 submission.

TBA, PhD, Postdoc (40% salary requested in budget periods 1&2), under close supervision of Drs. Ebner and Oliveira, will develop machine-learning algorithms and pattern-recognition methods to identify risk profiles and to automatically discover potent deception cues for implementation of the warning solution, MERLIN. S/He will also actively participate in report and manuscript write up.

Supplies

Computer and computer supplies are requested including funds for hardware for machine-learning and pattern-recognition methods, server processing and storage, and software licenses for analysis.

Other costs

N/A

Travel
Travel funds are requested for collaborative meetings across sites. A kick-off collaborative meeting will take place at UM in January 2018; another collaborative meeting at UF will take place in March 2019 during the grant writing phase. Total travel funds in the amount of $800 are requested in Year 1 for travel to UM.

UNIVERSITY OF ARIZONA (UA)

Personnel
Robert Wilson, PhD, PI, Assistant Professor (no salary requested in budget periods 1&2), will, in collaboration with Dr. Grilli, provide oversight of all aspects of this research project at UA, including development of SIT for Aim 2, and budget management. He and Dr. Grilli will be in close contact with the PIs at the other sites. His responsibility will include co-supervision of the to-be-named research assistant, who will lead data collection and day-to-day responsibilities for this project. Dr. Wilson will work closely with Dr. Grilli to ensure that SIT is methodologically and psychometrically sound. He also will actively participate in results interpretation and dissemination, including grant submission and manuscripts. He will also be responsible for data transfer from UA to UF and UM for cross-site analyses.

Matthew Grilli, PhD, PI, Assistant Professor, Licensed Clinical Neuropsychologist (no salary requested in budget periods 1&2), will, in collaboration with Dr. Wilson, serve in the same oversite role for all aspects of the research conducted at UA. This will include development of SIT, co-supervision of research staff, and all aspects of results interpretation and dissemination. He also will provide access to his subject pool and outreach program for recruitment of older adults. As a clinical neuropsychologist, he will ensure that the SIT and MERLIN protocols are optimized for older adults and translatable to real-world contexts, as well as older adults with cognitive impairment for future translation of this research.

TBA, Research Assistant (40% salary requested in budget periods 1&2), will be responsible for managing the day-to-day duties of this project, including management of the participant database, scheduling participants, conducting behavioral tests, communicating with IRB, and managing results databases.

Supplies
We request funds to purchase a laptop dedicated to this project, primarily for administration of the SIT.

Other costs
Participant payment is requested in the amount of $800 (80 participants at $10 each) for each of Years 1 and 2.

Travel
Travel funds are requested for the collaborative meetings across sites. Total travel funds in the amount of $2,000 are requested, $1,000 for each of Years 1 and 2.

UNIVERSITY OF MIAMI (UM)

Personnel
Bonnie Levin, PhD, PI, Alexandria and Bernard Schoninger Professor of Neurology and Director of the Division of Neuropsychology (no salary requested in budget periods 1&2), will, in collaboration with Dr. Getz, provide oversight of all aspects of this research project at UM, including communication with the research team at UM and the other sites, supervision of data collection, and budget management. This will include co-supervision of the to-be-named research assistant, who will lead data collection and day-to-day responsibilities for this project. Dr. Levin will actively participate in results interpretation, data analyses and dissemination, including the submission of the R01 funding and manuscripts.

Sarah Getz, PhD, PI, Postdoctoral Fellow (no salary requested in budget periods 1&2), will, in collaboration with Dr. Levin, serve in a similar oversite role for all aspects of the research conducted at UM.

This will include supervision of cognitive, physical, and socio-emotional data collection, co-supervision of research staff, and all aspects data collection. This will include co-supervision of the to-be-named research assistant, who will lead data collection and day-to-day responsibilities for this project, including data analysis. She will also be responsible for data transfer from UM to UF and UA for cross-site analyses.

TBA, Research Assistant (40% salary requested in budget periods 1&2), will be responsible for managing the day-to-day duties of this project, including the participant database, scheduling participants, conducting behavioral tests, communicating with IRB, and managing results databases.

Supplies
We request funds to purchase an IPad ($500) and annual licenses ($500 each of Years 1 and 2) for the NIH toolbox for data collection.

Other costs
Participant costs will amount to $30 per participant, which includes payment for taking part in the experiment and parking costs. Funds are requested to run 50 participants per year, totaling $3,000 overall ($1,500 in each of Years 1 and 2).

Travel
Travel funds are requested for the collaborative meetings across sites. Total travel funds in the amount of $800 are requested for Year 2 for travel to UF.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Bonnie E. Levin, Ph.D.	Professor of Neurology and Psychology
eRA COMMONS USER NAME bonnie_levin	

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
Georgetown University	BS	1974	Psychology
Temple University	Ph.D.	1983	Psychology

A. Personal Statement

I hold the Bernard and Alexandria Schoninger Professorship in Neurology. I founded and currently lead the Division of Neuropsychology at the University of Miami Miller School of Medicine. I direct the Neuropsychology Program in the Dept of Neurology and supervise the clinical activities of PhD graduate students enrolled the Child and Behavioral Medicine tracks in the Department of Psychology. I have taught the graduate level course, Foundations of Neuropsychology, for over 25 years. I have a long history of collaborations with interdisciplinary research teams in neurology, psychology, radiology and neurosurgery, and participate in multiple projects examining cognitive, behavioral and imaging changes associated with normal aging, acquired brain trauma and neurodegenerative disease. I am currently the site PI of the Mcknight Oldest Old Cognitive Core. Recently, I initiated the Mcknight Frailty Study, a clinic based and community outreach program to examine the association between symptoms of frailty and cognitive impairment and to educate those at risk on the detection and prevention of this symptom complex. I am particularly interested preventive health science and participate in several funded projects examining early biomarkers of cognitive change, including the NIH-funded population based Northern Manhattan Study (NOMAS), in which I am a member of the neuropsychology team and the dementia adjudication consensus panel, the Bugher AHA exercise grant, a Dept of Defense(DOD) study examining MRS brain metabolites underlying pain in traumatic injury and a funded study examining the role of cannabinoids in acquired brain injury in young and mid-life. The proposed project is focused on identifying the underlying basis of susceptibility to deception (scamming) in mid and later life. We have assembled a collaborative team with expertise in cognitive neuroscience, normative aging, and social cognition to tackle this growing public health crisis. My experience in cognitive aging, developmental neuropsychology, and social neuroscience provides the necessary background and expertise to serve as the Miami site PI on the proposed study.

These peer reviewed publications highlight my experience and qualifications for this project:

1. **Levin BE**, Llabre MM, Dong C, Elkind MS, Stern Y, Rundek T, Sacco RL, Wright CB. Modeling metabolic syndrome and its association with cognition: the northern Manhattan study.J Int Neuropsychol Soc. 2014 Nov;20(10):951-60.
2. Maudsley A, Govind V, **Levin B**, Saigal G, Harris LT, Sheriff S. Distributions of MR Diffusion and Spectroscopy Measures with Traumatic Brain Injury.J Neurotrauma. 2014 Oct 21. [Epub ahead of print] PMID: 25333480
3. **Levin BE**, Katzen HL, Maudsley A, Post J, Myerson C, Govind V, Nahab F, Scanlon B, Mittel A.Whole-brain proton MR spectroscopic imaging in Parkinson's disease. J Neuroimaging. 2014 Jan-Feb;24(1):39-44
4. Getz, S., **Levin, B.** Cognitive and neuropsychiatric features of early Parkinson's disease. Archives of Neuropsychology (in press)

B. Positions and Honors

POSITIONS AND EMPLOYMENT

Academic Appointments

1979-1980	Fellow (Psychology) Dept of Psychiatry, Harvard Medical School, Boston, MA
1979-1980	Intern, Clinical Pediatric Neuropsychology, Children's Hosp Med Ctr,Boston, MA.

1980	Extern, Boston Veteran's Administration Hospital, Boston, MA
1981-1982	Instructor, Department of Neurology, University of Miami
1981	Director, Division of Neuropsychology, Department of Neurology, University of Miami
1986-1992	Assistant Professor, Department of Neurology, University of Miami
1992-2011	Associate Professor (with tenure), Department of Neurology, University of Miami Miller School of Medicine
2011-	Professor of Neurology, Department of Neurology, University of Miami Miller School of Medicine

Honors

Cum Laude, Georgetown University; Psi Chi Honor Society1974
Fellow, Mahoney Residential College
International Neuropsychology Society (INS) Program Chair-1997
INS Board of Governors 1998-2001
NINDS Study Section Member NSD-K, 2001-2005
NINDS AD hoc Reviewer-NSD-A 2001, 2002
NINDS Special Emphasis Panels 7/1998, 8/1999, 12/1999, 5/2000, 8/2000, 10/2000, 12/2001, 6/2001, 10/2001, 8/2002, 12/2002, 1/2004, 8/2004, 12/2004, 2/2005, 1/2006, 10/2006, 11/2006, 11/2006, 6/2007, (6/24 & 6/29) 3/2008, 4/2008.
NINDS Ad hoc reviewer, NSD-K, 2006 - 2008
Alzheimer Association Medical and Scientific Council Reviewer, 1999, 2002
Consultant: University of Miami Brain Endowment Bank, Department of Neurology; Clinical Neuroscience Unit, UM Department of Neurology
Member, National Acute Brain Injury Study: Hypothermia II: Data Safety of Monitoring Board
Pediatrics; UM Sleep Center, Department of Neurology.
Professional Advisory Board: Epilepsy Foundation of South Florida
Editorial Boards: Neuropsychology, Journal of International Neuropsychology Society, Neuropsychology Review, Aging, Neuropsychology and Cognition
Alexandria and Bernard Schoninger Endowed Professorship in Neurology, 2009

C. Contributions to Science

C.1. Over the past 30 years, I have focused on cognitive and behavioral changes over the life course. My research projects are largely in the field of aging, examining age related cognitive decline and early biomarkers of behavioral and cognitive decline in normal aging and neurodegenerative disease. As the Schoninger Professor or Neurology, I oversee the Division of Neuropsychology, a major training and research site that evaluates over 300 patients a year examining age related cognitive change as well as pathological behavioral alterations associated with degenerative disease. I have published extensively on cognitive change across the lifespan.

1. Kelley, R.E., Chang, JY, Scheinman, NJ, **Levin, BE**, Duncan, RC, Shih-Chang, L: Transcranial doppler ultrasonographic assessment of cerebral artery flow velocity during cognitive activity. Stroke, 1992; 23:9-14.
2. Tomer, R, **Levin, BE**, Differential affects of aging in two verbal fluency tasks. Perceptual and Motor Skills, 1993; 76: 465-466
3. **Levin, BE**, Katzen, H.L., Klein, B., Llabre, M. Cognitive decline affects subject attrition in longitudinal research. Journal of Clinical and Experimental Neuropsychology. 2000, 22 (5), 580-586.
4. Grossman A, Levin B, Katzen H, Lechner S. PTSD symptoms and onset of neurologic disease in elderly trauma survivors. Journal of Clinical and Experimental Neuropsychology 2004: 26(5): 698-705.

C.2.Our group was among the earliest investigators to document and describe non-motor changes in Parkinson's disease. I have also examined how gait and other lateralized motor changes are linked to cognitive and behavioral symptoms and PD progression. These studies reflect my longstanding interest in gait, movement and cognition.

1. **Levin, BE**, Llabre, MM, Weiner, WJ: Cognitive impairments associated with early Parkinson's disease. Neurology, 1989, 39:557-561.
2. **Levin, BE**, Llabre, MM, Weiner, WJ, Brown, MC: Visuospatial decline in Parkinson's disease. Neurology, 1991; 41:365-369.
3. Tomer, R, **Levin, BE**, Weiner, WJ: Side of motor onset influences cognition in Parkinson's disease. Annals of Neurology, 1993; 34:579-584.
4. Katzen, H, **Levin, BE**, Llabre, M: Age of onset influences cognition in Parkinson's disease. Journal of International Neuropsychological Society, 1998, 4, 285-290.

C.3. I am currently involved in several studies examining the relationship between MRS metabolites and cognitive changes in normative aging, TBI, ALS and Parkinson's disease. These studies utlize a unique whole brain analysis that permits a study of a large fraction of the brain volume, including the cortical mantle. My role as the neuropsychologist on these projects is to identify sensitive outcome measures and to work with my collaborators linking the behavioral presentation associated a traumatic injury or neurologic illness with distributions of proton magnetic resonance spectroscopy (MRS) observed metabolites throughout the whole brain.

1. **Levin BE**, Katzen, HL, Maudsley, A, Post, J, Myerson, C, Govind, G, Nahab, F, Scanlon, B, Mittel. A Whole-brain proton MR spectroscopic imaging in Parkinson's disease. Journal of Neuroimaging, 2014, 24, 39-44
2. Maudsley, A, Govind, V, **Levin, BE**, Saigal, G, Harris, L, Sheriff, S Distributions of MR Diffusion and Spectroscopy Measures with Traumatic Brain Injury. J. Neurotrauma. 2015; 32 (14): 1056-1063
3. Widerstrom-Noga, E, Govind, VB, Adcock, J, **Levin, BE**, Maudsley, A Subacute Pain after TBI is associated with lower insular N-acetyl-aspartate concentrations. Journal of Neurotrauma (in press)

Complete List of Published Work at NCBI:
http://www.ncbi.nlm.nih.gov/pubmed/?term=(%22levin%2C%20bonnie%22%5BAll%20Fields%5D)&cmd=DetailsSearch

D. Research Support

Ongoing Research Support

Scythian Bioscience 08/01/2016-7/30/2021
The Effects of Cannabinoids on TBI
(B. Levin, Co-Investigator, Director of Clinical Trials)
This study will examine the inflammatory properties of cannabinoids and determine whether they can be used as a therapeutic intervention in traumatic brain injury

7 R01 NS 029993 (PI, Sacco) NIH/NINDS **02/01/03-03/31/21** **1.20 calendar**
Stroke Incidence and Risk Factors in a TriEthnic Region **$1,795,509**
(B. Levin, Co-Investigator)
The goals of this project are to determine the effects of risk factors for stroke, MI, and vascular death, as well as evaluate predictors of cognitive impairment and the importance of subclinical MRI findings in a prospective cohort study of 3300 persons from 3 race-ethnic groups from Northern Manhattan.

National Multiple Sclerosis **09/28/12-09/27/15** **1.20 calendar**
$169,003
Fast Forward a Randomized Double Blind Placebo Controlled (PI: Ortega; B. Levin, Co-Investigator)
To evaluate the therapeutics effects of caprylic triglyceride administered once a day for 90 days on cognitive impairment in subjects with multiple sclerosis.

AHA/ASA 14BFSC1759000 (PI: Sacco) **04/01/14 – 03/31/18** **0.6 calendar**
AHA (B. Levin, Co-Investigator) **$234,667**
Bugher Center Foundation Center of Excellence in Stroke Award
This award will conduct two projects evaluating the effects of physical activity and cognitive training on animals and stroke survivors on cognitive recovery

DoD/CDMRP/USAMRMC (PI: Widerstrom-Noga) **11/2015-10/2018** **.84 calendar**
(B. Levin, Co-Investigator) **$977,099** (direct)
Utility of MRS Brain Biomarkers of Pain Phenotypes after TBI
Goals are to evaluate advanced metabolic imaging methods for injury assessment and prognosis following mild and moderate traumatic brain injury.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Ebner, Natalie C

eRA COMMONS USER NAME (agency login): NATALIE.EBNER

POSITION TITLE: Associate Professor of Psychology

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Free University Berlin, Berlin	BA	04/1998	Psychology
Free University Berlin, Berlin	MA	03/2001	Psychology
Free University Berlin, Berlin	PHD	05/2005	Psychology

A. Personal Statement

I am an expert in experimental aging research using a multi-methods approach including self-report, cognitive-behavioral measures, and neuroimaging techniques. My body of work is documented in 47 publications. As a pre- and postdoctoral fellow at the Free University Berlin and the Max Planck Institute for Human Development, I have supervised behavioral research on emotion-cognition interactions across adulthood. As a postdoctoral fellow and later as Associate Research Scientist at Yale University and as faculty at University of Florida (UF), I expanded my research to examine neuropsychological changes associated with cognition-emotion interactions across adulthood using neuroimaging and eye tracking techniques as well as pharmacological interventions. In addition to my primary appointment in the Department of Psychology at UF, I hold a joint appointment as faculty in the Center for Cognitive Aging and Memory (CAM) in the Aging Department at the College of Medicine at UF. I am also affiliated with the McKnight Brain Institute (MBI) and the Florida Institute for Cybersecurity Research (FICS) on campus, where I work jointly with co-Is Oliveira and Woodard. I have received multiple awards such as the Young Research Scientist Award from the German Psychological Association, the International Max Planck Research School on the Life Course Outstanding Alumni Award, the UF Assistant Professor Excellence Award, and the UF College of Liberal Arts and Sciences International Educator of the Year Award. Since 2015, I have been a Kavli Fellow of the National Academy of Sciences. The proposed project is focused on uncovering fraud susceptibility profiles in aging towards implementation of effective surveillance and warning of financial deception risk. We have put together a superb research team of investigators with outstanding, complementary expertise. We have demonstrated feasibility of the proposed work by (i) developing the study logistics and infrastructure needed to determine real-life susceptibility to deception via simulated spear-phishing email attacks (with co-I Oliveira), including IRB and research compliance, and (ii) developing first machine-learning algorithms for profiling and automated detection/warning (with co-I Oliveira). My broad expertise in cognitive and socioemotional aging, decision making, and experimental aging neuroscience and my previous experiences as investigation leader across various research projects, including coordination across national and international sites, put me in an excellent position to serve as site PI on this grant.

Representative Publications:

a. **Ebner, NC**, Chen, H, Porges, E, Lin, T, Fischer, H, Feifel, D, & Cohen, RA. Oxytocin's effect on resting-state functional connectivity varies by age and sex. Psychoneuroendocrinology, 2016 Apr, 69:50-59. PubMed PMID: 27032063; PubMed Central PMCID: PMC4942126.

b. **Ebner NC**, Johnson MR, Rieckmann A, Durbin KA, Johnson MK, Fischer H. Processing own-age vs. other-age faces: neuro-behavioral correlates and effects of emotion. Neuroimage. 2013 Sep; 78:363-71. PubMed PMID: 23602923; PubMed Central PMCID: PMC3684564.

c. **Oliveira, D**, Rocha, H, Yang, H, Ellis, D, Dommaraju, S, Muradoglu, M, Weir, D, Soliman, A, Lin, T, **Ebner, NC**. Dissecting spear phishing emails for older vs young adults: On the interplay of weapons of influence and life domains in predicting susceptibility to phishing. CHI'17: CHI Conference Proceedings on Human Factors in Computing Systems, 2017.

d. Chen, A, Brahma, P, Wu, DO, **Ebner, NC**, Matthews, B, Crandall, J, Wei, X, Faloutsos, M, **Oliveira, D.** Cross-layer personalization as a first-class citizen for situation awareness and computer infrastructure security. NSPW '16: Proceedings of the 2016 New Security Paradigms Workshop, 2016.

B. Positions and Honors

Positions and Employment

2001 - 2005	Predoctoral Fellow, Free University Berlin & Max Planck Institute for Human Development, Berlin
2005 - 2007	Postdoctoral Fellow, Max Planck Institute for Human Development, Berlin
2007 - 2010	Postdoctoral Fellow, Yale University, Department of Psychology, New Haven, FL
2010 - 2011	Associate Research Scientist, Yale University, Department of Psychology, New Haven, CT
2011 - 2017	Assistant Professor, University of Florida, Department of Psychology, Gainesville, FL
2013 -	Adjunct Faculty, at Cognitive Aging and Memory Clinical Translational Research Program; CAM-CTRP, University of Florida, Gainesville, FL
2017 -	Associate Professor, University of Florida, Department of Psychology, Gainesville, FL

Other Experience and Professional Memberships

2000 - 2011	Member, German Psychological Association
2003 -	Member, Society for Personality and Social Psychology
2003 - 2009	Member, American Psychological Association
2008 -	Member, Association for Psychological Science
2009 - 2009	Reviewer, Retirement Research Foundation Doctoral Dissertation Award in the Psychology of Aging (American Psychological Association)
2010 -	Member, Society for Social Neuroscience
2012 -	Member, Cognitive Neuroscience Society
2012 -	Reviewer, Swiss National Science Foundation
2012 -	Early Career Reviewer (ECR), National Institute ofHealth, Center for Scientific Review (CSR)
2014 -	Member, Society for Affective Science

Honors

2006	Heinz-Heckhausen-Jungwissenschaftlerpreis (Young Research Scientist Award), German Psychological Association
2014	International Max Planck Research School on the Life Course (LIFE) Outstanding Alumni Award, APA Board of Educational Affairs Award to Advance Interdisciplinary Education and Training in Psychology
2015	Kavli Fellow National Academy of Sciences
2016	UF Excellence Award -- Assistant Professors
2016	UF College of Liberal Arts and Sciences International Educator of the Year Award

C. Contribution to Science

My expertise in experimental behavioral aging research coupled with my background in affective, social, and cognitive neuroscience allows for a comprehensive view of brain-behavior relationships in the study of emotion, motivation, and social cognition in aging (Ebner & Fischer, 2014a, 2014b). I use a multi-methods approach in my research that combines convergent measures, including self-report, cognitive-behavioral measures, eye tracking, functional neuroimaging (fMRI, ERP), and as of recently, highly innovative pharmacological (oxytocin administration), neurofeedback training (real-time fMRI), and applied (cybersecurity related decision making) interventional approaches, with the aim to integrate introspective, behavioral, and neuropsychological data.

Representative Publications:

a. **Ebner NC**, Johnson MK. Young and older emotional faces: are there age group differences in expression identification and memory?. Emotion. 2009 Jun;9(3):329-39. PubMed PMID: 19485610; PubMed Central PMCID: PMC2859895.

b. **Ebner NC**, Fischer H. Studying the various facets of emotional aging. Front Psychol. 2014a;5:1007. PubMed PMID: 25250008; PubMed Central PMCID: PMC4158868.
c. **Ebner NC**, Fischer H. Emotion and aging: evidence from brain and behavior. Front Psychol. 2014b;5:996. PubMed PMID: 25250002; PubMed Central PMCID: PMC4158975.

2. **Own-Age Bias in Attention, Memory, and Emotion Perception**

One line of my research builds on the fact that our environment is complex and our cognitive system is limited so that not all stimuli can be fully and simultaneously analyzed. There is evidence that emotional and self-relevant information is preferentially processed, possibly due to the highly practiced and elaborate knowledge-structures associated with it and the greater personal and social costs of inattention or inaccurate memory. My research findings open new insights into how faces of different ages are processed and how they bias attention and memory. I show that this bias is affect by the emotional content of the faces and impacts memory for person-related information (e.g., personal goals and agendas). My results challenge and inform interpretations of face and emotion processing and age-related differences therein as older participants may be at a disadvantage relative to young participants when stimuli are faces of only young individuals. My findings are not only important from a developmental perspective but they also place constraints on general theories of attention and memory and have various important implications for social interactions, emotional regulation, self-perceptions, psychological well-being, and health in adults of different ages.

Representative Publications:

a. Lin, T, Lendry, R, & **Ebner, NC**. Face likeability mediates the memory-enhancing effect of face attractiveness in young but not older adults. Memory, 2015 Nov, 30:1-11. PubMed PMID: 26619961.
b. **Ebner NC**, He Y, Fichtenholtz HM, McCarthy G, Johnson MK. Electrophysiological correlates of processing faces of younger and older individuals. Soc Cogn Affect Neurosci. 2011 Sep;6(4):526-35. PubMed PMID: 21030480; PubMed Central PMCID: PMC3150862.
c. **Ebner NC**, Johnson MK, Fischer H. Neural mechanisms of reading facial emotions in young and older adults. Front Psychol. 2012;3:223. PubMed PMID: 22798953; PubMed Central PMCID: PMC3394436.
d. **Ebner NC**, Johnson MR, Rieckmann A, Durbin KA, Johnson MK, Fischer H. Processing own-age vs. other-age faces: neuro-behavioral correlates and effects of emotion. Neuroimage. 2013 Sep;78:363-71. PubMed PMID: 23602923; PubMed Central PMCID: PMC3684564.

3. **Oxytocin and Socioemotional Aging**

As summarized in recent theoretical papers (Ebner, Diaz, Kamin, MacDonald, & Cohen, 2015; Ebner, Maura, MacDonald, Westberg, & Fischer, 2013), oxytocin is a neuropeptide with beneficial effects in social and emotional domains, mostly studied in young adults, schizophrenia, and autism. Our group is the first to comprehensively study acute and chronic oxytocin effects in the context of emotional, motivational, and social-cognitive aging. We have developed a theoretical framework that allows us to examine the extent to which the neuropeptide oxytocin is associated with improved functioning in aging, considering gene-brain-behavior relationships using behavioral, (epi)genetic, pharmacological, and neuroimaging techniques.

Representative Publications:

a. Ebner, NC, Horta, M, Lin, T, Feifel, D, Fischer, H, Cohen, RA. Oxytocin modulates meta-mood as a function of age and sex. Front Aging Neurosci. 2015,7,175. PubMed Central PMCID: PMC4565056.
b. Ebner NC, Maura GM, Macdonald K, Westberg L, Fischer H. Oxytocin and socioemotional aging: Current knowledge and future trends. Front Hum Neurosci. 2013;7:487. PubMed PMID: 24009568; PubMed Central PMCID: PMC3755210.
c. Ebner NC, Kamin H, Diaz V, Cohen RA, MacDonald K. Hormones as "difference makers" in cognitive and socioemotional aging processes. Front Psychol. 2014;5:1595. PubMed PMID: 25657633; PubMed Central PMCID: PMC4302708.

4. **Decision Making and Aging**

We aim at identifying adult age differences in cognitive, affective, and social influences on decision making in the applied contexts of health and computer security. We have shown that young and older adults differ in their use of future time travel towards healthy decision making. In addition, we have developed an infrastructure that allows us to determine internet users' susceptibility to cyberattacks (e.g., spear phishing emails) in the natural setting of the participants' homes and have found evidence of a particular vulnerability in older compared to young internet users, combined with very low susceptibility awareness in the elderly.

Representative Publications:

a. Chen, A, Brahma, P, Wu, DO, **Ebner, NC**, Matthews, B, Crandall, J, Wei, X, Faloutsos, M, **Oliveira, D.** Cross-layer personalization as a first-class citizen for situation awareness and computer infrastructure security. NSPW '16: Proceedings of the 2016 New Security Paradigms Workshop, 2016.
b. **Oliveira, D**, Rocha, H, Yang, H, Ellis, D, Dommaraju, S, Muradoglu, M, Weir, D, Soliman, A, Lin, T, **Ebner, NC**. Dissecting spear phishing emails for older vs young adults: On the interplay of weapons of influence and life domains in predicting susceptibility to phishing. CHI'17: CHI Conference Proceedings on Human Factors in Computing Systems, 2017.
c. Tasdemir-Ozdes, A, Strickland-Hughes, CM, Bluck, S., & **Ebner, NC**. Future perspective and healthy lifestyle choices in adulthood. Psychol Aging. 2016 Sep;31(6):618-30. PMID: 27064600.

D. Research Support

Ongoing Research Support

2017/03/01-2019/2/28
NIH/NIA - R21AG057200
Ebner, Natalie C. (MPI)
Determining Plasticity of Brain-Regulatory Mechanisms Related to Emotion Processing: A Neurofeedback Approach in Aging and Parkinson's Disease
The goal of this project is to determine plasticity in emotion processing regions in aging using neurofeedback based on real-time functional magnetic resonance imaging and to determine beneficial neurofeedback effects on emotion-regulatory skills in aging and Parkinson's Disease.

2017/01/01-2021/12/31
US DEPT OF DEFENSE DARPA HR0011-17-2-0020
Oweiss, Karim (PI)
Role: Co-Investigator
OLPENS: Optimized Learning via PEripheral Nerve Stimulation
The goal of this project is to determine and optimize learning effects via peripheral vagus nerve stimulation.

2015/09/01-2019/08/31
National Science Foundation SaTC Medium 1513572
Ebner, Natalie C. (MPI)
Developer Crowdsourcing: Capturing, Understanding, and Addressing Security-related Blind Spots in APIs
The goal of this project is to determine blind spots in programmer's attention when writing code.

2016/07/01-2017/12/31
PRICE-CTSI-IOA ARG DTD 03-26-2008
Ebner, Natalie C. (MPI)
Neurobiological Mechanisms of Oxytocin's Pain-Modulatory Role in Aging
The goal of this project is to determine the neurobiological mechanisms of chronic oxytocin nasal administration in aging.

2015/10/01-2017/09/30
Massachusetts Institute of Technology, Lincoln Laboratory & US Air Force 7000341318
Ebner, Natalie C. (MPI)
Enhanced Operating System Level User Profile Extraction
The goal of this project is to determine computer user profiles and to develop a tool to alert unusual use.

2013/01/01-2017/12/31
Swedish Research Council
Ebner, Natalie C. (MPI)
Effects of Oxytocin on Physical and Cognitive Functioning in the Elders
The goal of this project is to examine acute effects of intranasal oxytocin administration on cognition and social functioning in aging.

2013/10/01-2017/09/01
1R01AA022456-01, NIH/NIAAA
Nixon, Sara Jo (PI)
Role: Co-Investigator
Neurobehavioral and Emotional Deficits in Male and Female Alcoholics

The goal of this project is to examine gender differences in deficits in cognitive and emotional functioning in alcoholics.

Completed Research Support

2014/09/01-2017/08/31
SaTC EAGERs NSF 13-037, National Science Foundation
Ebner, Natalie C (MPI)
Age-Targeted Automated Security Cueing Against Web-Based Social Engineering Attacks
The goal of this project is to develop and validate an open-source browser extension that provides visual security cues in an age-targeted fashion to protect older adults from web-based social engineering attacks during their everyday internet use.

2013/08/01-2017/03/31
P30AG028740, University of Florida Center for Cognitive Aging and Memory & Claude D. Pepper Older Americans Independence Center (sponsor: NIH/NIA)
Ebner, Natalie C. (PI)
Effects of Oxytocin on Physical and Cognitive Functioning in the Elders
The goal of clinical trial is to examine the effects of intranasal oxytocin administration on cognition, health, and socioemotional functioning in aging over time.

2014/09/01-2015/03/31
Scientific Research Network on Decision Neuroscience and Aging (SRNDNA; sponsored by NIH/NIA)
Ebner, Natalie C. (MPI)
The Role of Oxytocin in Prosocial Decision Making in Aging Across Humans and Monkeys
The goal of this project is to compare the effects of the neuropeptide oxytocin on social preferences and altruism in young and older primates and humans.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Getz, Sarah J

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Postdoctoral Fellow

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Reed College, Portland, OR	BA	05/2004	Psychology
Princeton University, Princeton, NJ	MA	09/2011	Psychology and Cognitive Neuroscience
Princeton University, Princeton, NJ	PHD	09/2013	Psychology and Cognitive Neuroscience
Suffolk University, Boston, MA	Respecialization Certificate in Clinical Psychology	07/2016	Clinical Psychology/ Neuropsychology Track
Miami VA Healthcare System, Miami, FL	Clinical Internship	07/2016	Clinical Psychology and Neuropsychology
University of Miami, Miami, FL	Postdoctoral Fellowship	08/2018	Neuropsychology

A. Personal Statement

My research program has focused on the hypothesis that impulsive and maladaptive decision-making may result from an imbalance between motivational brain circuitry and regulatory control circuitry. In my post-collegiate work at the Sackler Institute for Developmental Psychobiology at Cornell Medical College, I published research that examined the neurobiology of impulsive decision-making in adolescents. This work underscored the importance of addressing individual differences in impulsivity, reward sensitivity, and cognitive control in the context of the developing brain. My doctoral research at Princeton focused on impulsivity and cognitive control in decision-making. I was awarded a dissertation grant from the Center for Health and Wellbeing's Demography of Aging Center, which is funded by the National Institute of Aging at the Woodrow Wilson School of Public and International Affairs. In other lines of my doctoral research, I examined working memory training and intelligence. After earning my PhD in 2013, I realized that combining clinical practice with research and pedagogy would offer me the greatest number of opportunities to directly improve the lives of others. I therefore began postdoctoral respecialization training at Suffolk University in Boston where I completed research interventions and advanced neuropsychology pratica, including training experiences at Brigham and Women's Hospital Harvard Medical School and Beth Israel Deaconess Harvard Medical School. As the Chief Intern and Neuropsychology Intern at the Miami VA, I evaluated patients with Alzheimer's disease, epilepsy, frontotemporal dementia, vascular dementia, multiple sclerosis, and stroke. Under the mentorship of

co-I Dr. Bonnie Levin in the Department of Neurology Division of Neuropsychology at the University of Miami, I have had a full range of clinical experiences, evaluating patients from diverse backgrounds and cultures who present with a wide range of neurologic and psychiatric disorders including epilepsy, neoplasms, closed head trauma, demyelinating and vascular disease, movement disorders, dementia, neuromuscular disease, epilepsy, and behavioral disorders. My specialized research background in decision making science and cognitive neuroscience combined with my clinical training in neuropsychology, make me uniquely qualified to serve as a co-I on this grant.

Representative Publications and Presentations:

a. Casey, B. J., **Getz, S.** Galvan, A. (2008). The adolescent brain. *Developmental Review, 28*, 62-77.
b. Mulder, M. J., Gold, J. I., Durston, S., Heasly, B., Millner, A., Simen, P., **Getz, S.**, Voss, H., Ballon, D., & Casey, B. J. (2009). BOLD Correlates of Reward-related Decision Bias on a Visual Discrimination Task. *Neuroimage, 47* (Supplement 1).
c. **Getz, S. J.,** Tomlin D., Nystrom, L. E., Conway, A. R. A., & Cohen, J. D. (2010, October). *Executive control of intertemporal choice: Effects of cognitive load on impulsive decision-making.* Poster presented at Neuroeconomics. Evanston, IL.
d. Kool, W., **Getz, S. J.***, & Botvinick, M. M. (2013). Neural Representation of Reward Probability: Evidence from the Illusion of Control. *Journal of Cognitive Neuroscience, 25*(6), 852-861. ***Indicates co-first authorship**

B. Positions and Honors

Research Positions and Employment

2005-2006	Research Assistant, Kosslyn Laboratory, Harvard University, Cambridge, MA
2006-2008	Senior Research Aide, Sackler Institute for Developmental Psychobiology, Weill Cornell Medical College, New York, NY
2013	Research Consultant at Educational Testing Services, Princeton, NJ

Clinical Positions

2013-2014	Practicum Clinician, Center for Anxiety and Related Disorders (CARD), Psychological Services Clinic, Boston University, Boston, MA
2014-2015	Research Interventionist, Department of Psychiatry/Behavioral Medicine, Brigham and Women's Hospital/ Harvard Medical School, Boston, MA
2014-2015	Advanced Neuropsychology Practicum Student and Technician, Child and Family Psychological Services, Norwood, MA
2014-2015	Advanced Neuropsychology Practicum Student, Cognitive Neurology Unit, Beth Israel Deaconess Medical Center/ Harvard Medical School, Boston, MA
2015-2016	Neuropsychology Intern and Chief Intern, Miami VA Medical Center, Miami, FL
2016-Present	Neuropsychology Fellowship, University of Miami/Miller School of Medicine, Department of Neurology/Division of Neuropsychology, Miami, FL

Honors and Awards

2005	Mind and Life Summer Research Institute Fellow
2005	Mind and Life Initiative Grant (PI: Daniel Reisberg)
2008	Princeton University Admission Merit Award
2008	Princeton University Graduate Student Fellowship
2012	Princeton University Residential Graduate Fellow, Forbes College
2013	Dissertation Grant, Princeton Center for Health and Wellbeing, Demography of Aging Center, Woodrow Wilson School of Public and International Affairs, Princeton University
2015	Women in Leadership Sponsorship, National Academy of Neuropsychology

Other Experience

2009-2010	Psychology Graduate Representative, Princeton University
2010-2012	Co-director of Neuroscience of Social Decision Making Speaker Series, Princeton University
2012-2013	Resident Graduate Fellow, Forbes College, Princeton University
2015-2016	Chief Intern, Miami VA Medical Center

C. Contributions to Science

1. Impulsive decision making across the lifespan

This research examined the hypothesis that suboptimal decision-making may result from an imbalance between brain regions involved in reward and executive control processes. When this imbalance occurs, the reward-oriented system may override the control system, and give rise to impulsive decision-making. I examined this imbalance in both the developing brain as well as via experimental manipulations. Experimentally, I investigated intertemporal choice—decisions over time that involve trade-offs between costs and benefits. I hypothesized that choosing larger long- term rewards over smaller short-term rewards requires control mechanisms and preferentially recruits brain regions involved in cognitive control. Frequently, decisions are made while tasks that also require control are simultaneously performed, which can cause interference of limited capacity control mechanisms necessary for patient decision- making. My research examined how interference of control mechanisms leads to decisions that are impulsive, maladaptive, or suboptimal. There is still much work to be done in addressing the fundamental question of the role of cognitive control in impulsive decision-making processes, and I aim to continue focusing on this question as it pertains to the aging brain.

Representative Publications and Presentations:

a. Casey, B. J., **Getz, S.** Galvan, A. (2008). The adolescent brain. *Developmental Review, 28*, 62-77.
b. **Getz, S. J.,** Tomlin D., Nystrom, L. E., Conway, A. R. A., & Cohen, J. D. (2010, October). *Executive control of intertemporal choice: Effects of cognitive load on impulsive decision-making*. Poster presented at Neuroeconomics. Evanston, IL.

2. Cognitive training and rehabilitation

The scope of my research has expanded to focus on training of working memory. I am an author on an opinion paper and chapter that argue for a better understanding of the durability and transfer of working memory training to other cognitive domains. Specifically, in this work we argue that the efficacy of our current training paradigms—particularly those that focus on rehabilitation and enhancement of cognitive resources—warrant concerns about the construct measurement, underlying cognitive and neural mechanisms, and durability of cognitive gains. Accordingly, this line of research may produce a means of improving cognitive rehabilitation outcomes for the elderly as well as a range of neuropsychological conditions.

Representative Publications:

a. Conway, A.R.A. & **Getz, S.** (2010). Cognitive ability: Does working memory training enhance intelligence? *Current Biology*, *20*, 362-4.
b. Conway, A. R. A., **Getz, S.**, Macnamara, B., & Engel, P. (2011). Working memory and fluid intelligence: A multi-mechanism view. In R. Sternberg and S. B. Kaufman (Eds.). Cambridge Handbook of Intelligence.

D. Additional Information: Research Support and/or Scholastic Performance

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Grilli, Matthew

eRA COMMONS USER NAME (credential, e.g., agency login): mgrilli

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of California, Irvine, Irvine, California	BA	06/2007	Psychology
University of Arizona, Tucson, Arizona	MA	05/2009	Psychology
University of Arizona, Tucson, Arizona	PHD	08/2013	Clinical Psychology
VA Boston Healthcare System, Boston, Massachusetts	Postdoctoral Fellow	08/2015	Clinical Neuropsychology

A. Personal Statement

I am an Assistant Professor in the Department of Psychology at University of Arizona and Director of the Neuropsychology Track of the Clinical Psychology Doctoral Program. I am also a licensed psychologist in Arizona. My research is broadly focused on the clinical and cognitive neuroscience of autobiographical memory, which is memory for real world events. I utilize a combination of cognitive, neuropsychological, neuroimaging (magnetic resonance imaging), genetic, and intervention methods. For the past five years, I have studied healthy adults and individuals with brain lesions to gain insight into the cognitive and neural bases of autobiographical memory. Since starting my position at University of Arizona in 2015, I have added a new line of research focused on autobiographical memory and aging, both normal and abnormal trajectories. This has become the primary line of research being conducted in my laboratory. As part of this new line of research, I have gained skills in genetic and neuroimaging methods. I also have worked on developing new cognitive tasks that have translational potential to clinical assessment. As demonstrated by my funding record, I am committed to studying cognitive aging. Although this line of work is relatively new for me, I have published research on memory and aging (reference [b] below). Finally, given my expertise in clinical neuropsychology, I believe I am in a strong position to ensure that the proposed line of research has the potential to be translated to improved assessment and intervention, as well as additional lines of research on the functional and wellbeing implications of disrupted scam detection and decision making (e.g., self, social, and future-oriented).

a. **Grilli MD**, Verfaellie M. Personal semantic memory: insights from neuropsychological research on amnesia. Neuropsychologia. 2014;61:56-64. Epub 2014/06/17. doi: 10.1016/j.neuropsychologia.2014.06.012. PubMed PMID: 24949553.

b. **Grilli MD**, Woolverton CB, Crawford M, Glisky EL. Self-reference and emotional memory effects in older adults at increased genetic risk of Alzheimer's disease. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn. 2017:1-14. Epub 2017/01/03. doi: 10.1080/13825585.2016.1275508. PubMed PMID: 28044474.

c. **Grilli MD**. The association of personal semantic memory to identity representations: insight into higher-order networks of autobiographical contents. Memory. 2017:1-9. Epub 2017/04/17. doi: 10.1080/09658211.2017.1315137. PubMed PMID: 28415908.

d. **Grilli MD**, Glisky EL. Imagining a better memory: Self-imagination in memory-impaired patients. Clinical psychological science : a journal of the Association for Psychological Science. 2013; 1(1):93-99.

B. Positions and Honors

Positions and Employment

2012 - 2013	Psychology Intern, Boston Consortium in Clinical Psychology, Boston, MA
2012 - 2014	Teaching Fellow in Psychiatry, Boston University School of Medicine, Boston, MA
2012 - 2015	Clinical Fellow in Psychology, Harvard Medical School, Boston, MA
2014 – 2015	Assistant Professor, Boston University School of Medicine, Boston, MA (Promoted while completing postdoctoral fellowship)
2015 -	Assistant Professor, University of Arizona, Tucson, AZ Director of Neuropsychology Track for the Clinical Psychology PhD Program Director of the Neuropsychology Clinic, Evelyn F. McKnight Brain Institute Affiliate, Graduate Interdisciplinary Program – Cognitive Sciences

Other Experience and Professional Memberships

2014 -	Member, Association for Psychological Science
2014 -	Member, International Neuropsychological Society

Licensure

2015	Clinical Psychologist (Arizona #4712)

Honors

2007	Summa Cum Laude, University of California Irvine
2007	Undergraduate Investigator Spotlight, University of California Irvine
2007	Order of Merit Scholar-Athlete of the Year, University of California Irvine
2007	Undergraduate Research Fellowship, University of California Irvine
2008	Community Outreach Fellowship, University of Arizona
2010	Human Development and Aging Fellowship, Heidelberg University
2012	College of Science Scholar of the Year, University of Arizona
2014	Council of Graduate Schools Dissertation Nominee, University of Arizona

C. Contributions to Science

1. **Advanced understanding of the cognitive neuroscience of autobiographical memory.** A major contribution of my research has been to show that the cognitive and neural bases of autobiographical memory blur the boundaries between episodic memory and semantic memory, which traditionally have been thought of as supported by distinct cognitive components and brain networks. I have been particularly interested in understanding how the medial temporal lobe (MTL), a brain region that is essential to episodic memory, also contributes to the storage, retrieval, and organization of semantic components of autobiographical memory. After I demonstrated that autobiographical facts, which are semantic memories about the self, depend on the MTL for retrieval (Grilli & Verfaellie, 2014), I developed a theoretical model explaining why this might be the case and revealed preliminary support for this framework. Specifically, I built on the idea that autobiographical facts range in the degree to which they have spatiotemporal qualities and demonstrated that only facts that are associated with episodic-like content depend on the MTL for retrieval (Grilli & Verfaellie, 2016). Recently, I extended this logic (Grilli et al., in press) and showed that the

organization of autobiographical memory also depends on the MTL, because this region supports relational processes that form the connections among autobiographical contents. My studies of neuropsychological patients also have shed light on the contributions of other brain regions to storage of autobiographical memory (Grilli et al., in preparation; Marquine, Grilli, et al., 2016). Broadly, this research has advanced our understanding of the specific roles of neural regions within the autobiographical memory network.

a. **Grilli MD**, Verfaellie M. Experience-near but not experience-far autobiographical facts depend on the medial temporal lobe for retrieval: Evidence from amnesia. Neuropsychologia. 2016 Jan 29;81:180-5. PubMed PMID: 26721761; PubMed Central PMCID: PMC4738052.

b. **Grilli MD**, Verfaellie M. Personal semantic memory: insights from neuropsychological research on amnesia. Neuropsychologia. 2014 Aug;61:56-64. PubMed PMID: 24949553.

c. Marquine MJ*, **Grilli MD***, Rapcsak SZ, Kaszniak AW, Ryan L, Walther K, Glisky EL. Impaired personal trait knowledge, but spared other-person trait knowledge, in an individual with bilateral damage to the medial prefrontal cortex. Neuropsychologia. 2016;89:245-53. Epub 2016/06/21. doi: 10.1016/j.neuropsychologia.2016.06.021. PubMed PMID: 27342256; PMCID: PMC5119478.

   * Co-first authors.

d. **Grilli MD**, Wank AA, Verfaellie M. The life stories of adults with amnesia: Insights into the contribution of the medial temporal lobes to the organization of autobiographical memory. Neuropsychologia. 2017. Epub 2017/03/10. doi: 10.1016/j.neuropsychologia.2017.03.013. PubMed PMID: 28286259; PMCID: PMC5592132.

2. **Developed a cognitive strategy for improving memory.** Although much of my research has focused on advancing cognitive neuroscience models, I always consider how insights from basic research can inform the development of new interventions for memory disorders. My first line of research merged two largely separate literatures on self-referential processing and imagination to establish a new cognitive strategy for improving episodic memory in individuals with acquired brain injury, which I referred to as self-imagination. In a series of studies, I have demonstrated that self-imagination is a highly effective cognitive intervention for individuals with traumatic brain injury, capable of enhancing recognition, cued recall, free recall, and prospective memory across various delays and over and above a variety of cognitive strategies.

   a. **Grilli MD**, Glisky EL. Self-imagining enhances recognition memory in memory-impaired individuals with neurological damage. Neuropsychology. 2010 Nov;24(6):698-710. PubMed PMID: 20873930; PubMed Central PMCID: PMC2970672.

   b. **Grilli MD**, Glisky EL. The self-imagination effect: benefits of a self-referential encoding strategy on cued recall in memory-impaired individuals with neurological damage. J Int Neuropsychol Soc. 2011 Sep;17(5):929-33. PubMed PMID: 21729405.

   c. **Grilli MD**, McFarland CP. Imagine that: self-imagination improves prospective memory in memory-impaired individuals with neurological damage. Neuropsychol Rehabil. 2011 Dec;21(6):847-59. PubMed PMID: 22150451; PubMed Central PMCID: PMC3296226.

   d. **Grilli MD**, Glisky EL. Imagining a better memory: Self-imagination in memory-impaired patients. Clinical psychological science : a journal of the Association for Psychological Science. 2013; 1(1):93-99.

3. **Demonstrated that autobiographical memory is necessary for maintaining the self-concept.** Autobiographical memory, which is the repository of experiences and facts that are unique to each person, has long been thought to ground one's conceptualization of the self, which consists of higher-order knowledge structures about personal identity (i.e., traits and roles). My research has supported this idea. First, in a neuropsychological study, I demonstrated that MTL amnesics rely entirely on abstract personal semantic memories to ground their traits and roles, which comes at a cost: they cannot retrieve as many self-defining traits as healthy controls do. This indicates that episodic autobiographical memories serve a necessary role in grounding the self-concept. Second, I showed that the relative importance of episodic autobiographical memory and personal semantic memory depend on the stability of one's traits and roles. Specifically, I found that whereas healthy adults primarily rely on episodic and episodic-like autobiographical memories to ground recently formed traits and roles, they tend to ground remotely formed

traits and roles with abstract personal semantic memories more than other autobiographical contents. These studies provide important insight into the self-supporting function of autobiographical memory.

a. **Grilli MD**, Verfaellie M. Supporting the self-concept with memory: insight from amnesia. Soc Cogn Affect Neurosci. 2015 May 11;PubMed PMID: 25964501.

b. **Grilli MD**. The association of personal semantic memory to identity representations: insight into higher-order networks of autobiographical contents. Memory. 2017:1-9. Epub 2017/04/17. doi: 10.1080/09658211.2017.1315137. PubMed PMID: 28415908.

For a full list of my references, please see My Bibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/matthew.grilli.1/bibliography/48613144/public/?sort=date&direction=ascending

D. Additional Information: Research Support and/or Scholastic Performance

Current Research Support

Arizona Alzheimer's Consortium Project Grant — Grilli (PI) — 7/01/2017 – 06/30/2018
Department of Health Services
"Forgetting one's past: Episodic autobiographical memory in ε4 carriers"
Specific aims: to reveal cognitive and neural mechanisms that contribute to disrupted memory in individuals at risk of Alzheimer's disease.

Arizona Alzheimer's Consortium Project Grant — Grilli (Co-PI) — 7/01/2017 – 06/30/2018
Department of Health Services
"Perirhinal cortical structure and function in older adults and its role in memory"
Specific aims: to elucidate the neural bases of impaired object recognition in aging and determine its relation to pattern separation and associative memory.

University of Arizona Faculty Seed Grant — Grilli (PI) — 7/01/2017 – 06/30/2018
Research, Discovery, and Innovation
"Detecting the earliest signs of Alzheimer's disease: A new cognitive neuroscience approach"
Specific aims: to apply structural and functional MRI methods to understand the neural bases of disrupted autobiographical memory among older adults.

College of Science, University of Arizona — Grilli (PI) — 08/30/2017 – 06/01/2018
Dean's Innovation and Education Fund
"Detecting the earliest signs of Alzheimer's disease"
Specific aims: to develop cognitive measurements for preclinical Alzheimer's disease.

Completed Research Support

P30 AG019610 — Grilli (PI) — 07/01/2016 – 06/30/2017
Arizona Alzheimer's Disease Core Center
"APOE status and emotional memory in cognitively healthy older adults"
Specific aims: determine whether emotional memory binding and detailed event retrieval are impaired in healthy middle-aged and older adult e4 carriers relative to non-carriers.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Oliveira, Daniela

eRA COMMONS USER NAME (agency login): DANIELAOLIVEIRA

POSITION TITLE: Associate Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Federal University of Minas	B.Sc.	03/1999	Computer Science
Federal University of Minas	M.Sc.	02/2001	Computer Science
University of California at Davis	Ph.D.	06/2010	Computer Science

A. Personal Statement

I have extensive experience with cyber-security research from the technical to the human factors side and bring expertise to this team in identifying cyber-security risks in vulnerable populations (e.g., the elderly) and development of protection tools and trainings. My goal as a researcher is to improve the security of computer systems and to protect computer users from online deception. Society is dependent on networked computer systems and software, from running the smart grid that powers homes to social networking with family and friends. This societal dependency requires sound methods and practices to protect computer systems from attacks and to protect users against threats created by ubiquitous computer systems. These methods and practices must consider both threats from attackers looking to compromise systems and human factors.

Over the last several years, Dr. Ebner and I have been collaborating on various projects (including across-site collaborations) and have developed the infrastructure used in the proposed work (e.g., Chen et al., 2016; Oliveira et al., 2017). I, together with Dr. Ebner, am affiliate faculty in the Florida Institute for Cyber Security Research (FICS) at the University of Florida (UF). In this context, I serve as Diversity Director. I have received the NSF CAREER award in 2012, the Presidential Early Career Award for Scientists and Engineers (PECASE) in 2014 from President Obama, and the UF International Educator of the Year Award for junior faculty. Further I was one of the five US researchers selected by NSF to represent the United States at the Science and Technology in Society (STS) Young Leader's Program in Kyoto, Japan in 2014, where I discussed cyber-security issues with a community comprising state ministers, university and academy of sciences presidents, and Nobel Laureates. I am also a National Academy of Sciences Kavli Fellow.

Together with Dr. Ebner, I will serve as the liaison between psychology and computer engineering. My responsibilities will be related to the cyber-security aspects of the study design as well as assurance of data security throughout the entire project. I will work on development of the automated warning solution. I will be actively involved in results interpretation and dissemination, including manuscript and report write-ups.

Representative Publications:

a. **Daniela Oliveira**, Harold Rocha, Huizi Yang, Donovan Ellis, Sandeep Dommaraju, Melis Muradoglu, Devon Weir, Adam Soliman, Tian Lin, **Natalie Ebner**. Dissecting spear phishing emails for older vs young adults: On the interplay of weapons of influence and life domains in predicting susceptibility to phishing. ACM CHI'17: ACM CHI Conference Proceedings on Human Factors in Computing Systems, 2017.

b. Chen, A, Brahma, P, Wu, DO, **Ebner, NC**, Matthews, B, Crandall, J, Wei, X, Faloutsos, M, **Oliveira, D.** Cross-layer personalization as a first-class citizen for situation awareness and computer infrastructure security. NSPW '16: Proceedings of the 2016 New Security Paradigms Workshop, 2016.
c. **Daniela Oliveira**, Jedidiah Crandall, Harry Kalodner, Nicole Morin, Megan Maher, Jesus Navarro and Felix Emiliano. An Information Flow-based Taxonomy to Understand the Nature of Software Vulnerabilities. 31st International Conference on ICT Systems Security and Privacy Protection – Springer IFIP SEC 2016.
d. **Daniela Oliveira**, Marissa Rosenthal, Nicole Morin, Martin Kuo-Chuan Yeh, Justin Cappos and Yanyan Zhuang. It's the Psychology Stupid: How Heuristics Explain Software Vulnerabilities and How Priming can Illuminate Developer's Blind Spots. Annual Computer Security Applications Conference (ACSAC) 2014. New Orleans, 8-12 December 2014.

B. Positions and Honors

Positions and Employment

2008	Research Intern, Microsoft Research Redmond
2009	Associate Instructor, University of California at Davis
2010 - 2014	Assistant Professor of Computer Science, Bowdoin College
2014 - present	Associate Professor, University of Florida

Other Experience and Professional Memberships

2011 - present	NSF panelist and reviewer
2013 - present	Program Committee member for the Annual Computer Security Applications Conference
2015 - present	Programmer Committee member for the USENIX ENIGMA Conference
2015 - 2016	Organizer – NAS Kavli Frontiers of Science Symposium
2015 - 2016	Organizer – NSF/Dept. of Homeland Security/Brazilian Ministry of Science and Technology US-Brazil Workshops on Cyber Security and Privacy
2015	Organizer NAE Frontiers of Engineering Symposium
2016	Florida Institute for Cyber Security Diversity Director
2017	CRA-W/ACSA Committee for the Scholarships for Women Studying Information Security (SWSIS) program

Honors

2012	NSF CAREER Awardee
2014	Presidential Early CAREER Award for Scientists and Engineers (PECASE) from President Obama
2014	NSF Young Leader Representative at the Science and Technology in Society (STS) *forum* in Kyoto, Japan
2014	NAS Kavli Fellow
2016	University of Florida International Educator of the Year - Junior Faculty Award

C. Contribution to Science

My research is highly interdisciplinary and my research philosophy is to discover and employ successful ideas from other fields (psychology, neuroscience, economics, biology, etc.) to make computer systems more secure and to protect computer users from online deception. My work has focused on operating system–hardware collaboration, leveraging and understanding uncertainty at the operating system level for system security and software resilience, understanding and combating software vulnerabilities and deception in cyber–social engineering attacks, and leveraging cross-layer personalization to better detect anomalous events. My research approach focuses on extending operating systems, writing large prototypes, and conducting computer user studies that are

either remote, placed in the real-world (e.g., at participants' homes) or comprise in-lab assessments.

1. Cyber Deception Susceptibility in Vulnerable Populations

Older adults are a vulnerable and likely targeted population for spear-phishing attacks. In psychology, there is broad evidence of age-related declines in cognitive abilities, including deception sensitivity, while self-reported trust increases. This renders older adults particularly vulnerable to be misled by false information. The potential vulnerability of this segment of the population to cyber deception has many implications for cyber security. First, the risk behavior of specific age groups will likely be considered by the next generation of social engineering methods. Second, older adults are the fastest-growing segment of the U.S. population, control over half of the financial wealth, and occupy many powerful positions in finance and politics. My research seeks to understand older adults' susceptibility to cyber social engineering attacks and create machine learning based tools to alert Internet users about cyber deception in a personalized way.

Representative Publications:

a. **Daniela Oliveira**, Harold Rocha, Huizi Yang, Donovan Ellis, Sandeep Dommaraju, Melis Muradoglu, Devon Weir, Adam Soliman, Tian Lin, **Natalie Ebner**. Dissecting spear phishing emails for older vs young adults: On the interplay of weapons of influence and life domains in predicting susceptibility to phishing. ACM CHI'17: ACM CHI Conference Proceedings on Human Factors in Computing Systems, 2017.

2. Understanding and Addressing Software Vulnerabilities from a Developer's Perspective

I seek to understand software vulnerabilities from two distinct angles. The first insight is that vulnerabilities cross layers of abstraction, and this could shed light on why mitigation approaches fail and why, year after year, we have been witnessing security reports documenting a rise in the number of vulnerabilities in software. The second insight is that the rise in the number and type of vulnerabilities might be caused by security not being part of developers' heuristic-based decision-making process, and that cueing developers will trigger a security mindset in them. I posit that security information is not part of a developer's heuristics, and the cueing of developers on the spot about specific vulnerabilities that might arise in their current coding context can change their attitude towards a security mindset, which will lead to more secure software being developed.

Representative Publications:

a. **Daniela Oliveira**, Jedidiah Crandall, Harry Kalodner, Nicole Morin, Megan Maher, Jesus Navarro and Felix Emiliano. An Information Flow-based Taxonomy to Understand the Nature of Software Vulnerabilities. 31st International Conference on ICT Systems Security and Privacy Protection – Springer IFIP SEC 2016.
b. **Daniela Oliveira**, Marissa Rosenthal, Nicole Morin, Martin Kuo-Chuan Yeh, Justin Cappos and Yanyan Zhuang. It's the Psychology Stupid: How Heuristics Explain Software Vulnerabilities and How Priming can Illuminate Developer's Blind Spots. Annual Computer Security Applications Conference (ACSAC) 2014. New Orleans, 8-12 December 2014.

3. Hardware-Software Collaboration for Systems Security

Today's computers do not collaborate and share intelligence to defend themselves against attacks. Many solutions focus on a single layer (application, operating system, or hardware) and fail to counter attacks that cross layers. This line of research involves building collaborative defense strategies encompassing intelligence from the operating system and hardware. The inspiration for this research was my observation of how the immune system works: it is distributed, with all layers cooperating and sharing intelligence to combat invaders, and it can coexist with untrustworthy but needed foreign

bodies. Remarkably, these successful immunity mechanisms have not been applied to computer systems security. The different players that make up a computer system, in particular the hardware and software, interact precariously with each other and do not cooperate, communicate, or learn from one another.

Representative Publications:

a. **Daniela Oliveira** and S. Felix Wu. *Protecting Kernel Code and Data with a Virtualization-Aware Collaborative Operating System*. Annual Computer Security Applications Conference (ACSAC). Honolulu, Hawaii. December 2009.
b. **Daniela Oliveira**, Jesus Navarro, Nicholas Wetzel, and Max Bucci. *Ianus: Secure and Holistic Coexistence with Kernel Extensions - A Immune System-inspired Approach.* ACM SAC (Symposium on Applied Computing) - Security Track. Gyeongju, Korea, March 2014.
c. **Daniela Oliveira**, Nicholas Wetzel, Max Bucci, Dean Sullivan and Yier Jin. Hardware-Software Collaboration for Secure Coexistence with Kernel Extensions. ACM Applied Computing Review Journal, Fall 2014 Issue, Volume 14, Number 3.

D. Research Support

Ongoing Research Support

09/01/15 - 08/31/19
National Science Foundation CNS 1513572
Oliveira, Daniela (PI)
TWC: Medium: Collaborative: Developer Crowdsourcing: Capturing, Understanding, and Addressing Security-related Blind Spots in APIs
This project captures developers' reasoning when faced with blind spots, and to identify common blind spot characteristics.

07/01/15 - 06/30/19
University of New Mexico
Oliveira, Daniela (PI)
FAROS: Beyond all-or-nothing DIFT via context-aware self-tuning operation.
The goal of this project is to develop the next generation of dynamic-information flow tracking systems.

09/01/16 - 08/31/17
National Science Foundation 1552059
Oliveira, Daniela (PI)
Workshop US-Brazil on Cyber Security Research
The goal of this workshop is to bring together, for the first time, American and Brazilian cyber security researchers to discuss the main challenges of the field, and to promote cross-collaboration and the building of ties among the attendees.

10/01/16 - 09/30/17
MIT PO NO 7000341318
Oliveira, Daniela (PI)
Enhanced Operating System Level User Profile Extraction
The goal of this project is to develop novel mechanisms for detection of insider threats using personalization.

Completed Research Support

03/01/12 - 02/28/17
National Science Foundation CNS 1464801
Oliveira, Daniela (PI)
CAREER: Bridging the Semantic Gap in Virtualization-Based Security via Collaboration between Guest OS and VI
The goal of this project is to develop an architecture where guest OS and a VM actively collaborate requesting services and exchanging data and information through special instructions protected from tampering.

09/15/14 - 08/31/17
National Science Foundation SES 1450624
Oliveira, Daniela (PI)
EAGER: Age Targeted Automated Cueing Against Cyber Social Engineering Attacks
This project investigates the influence of user age on the type and the effectiveness of social engineering attacks through user studies involving young and older adults.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Robert C. Wilson

eRA COMMONS USER NAME (credential, e.g., agency login): BOBWILSON

POSITION TITLE: Assistant Professor of Psychology and Cognitive Science

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Cambridge	B.A.	06/2002	Natural Sciences
University of Cambridge	M.Sci.	06/2002	Chemistry
University of Pennsylvania	M.S.E.	05/2003	Bioengineering
University of Pennsylvania	Ph.D.	05/2009	Bioengineering
Princeton University	Postdoc	12/2014	Psychology and Neuroscience

A. Personal Statement.

I am an expert in cognitive and computational neuroscience. I have modeled learning and decision making at a variety of levels – from low level neural networks to high level Bayesian inference – and have extensive experience linking theoretical models to behavioral and neural data. Most relevant to the current proposal is my work developing explore-exploit experiments (Wilson et al, JEP:General 2014), my work building cognitive models of complex tasks (Wilson, R. C., & Niv, Y., 2012), and my work linking models to behavioral and neural data (Wilson et al. Neuron 2014)

Wilson, R. C., Geana, A., White, J. M., Ludvig, E. A., & Cohen, J. D. (2014). Humans use directed and random exploration to solve the explore-exploit dilemma. *JEP:General, 143* (6), 2074-2081.

Wilson, R. C., & Niv, Y. (2012). Inferring relevance in a changing world. *Front Hum Neurosci, 5*:189

Wilson, R. C., Takahashi, Y. K., Schoenbaum, G. & Niv, Y. (2014). Orbitofrontal cortex as a cognitive map of task space. *Neuron, 81*(2), 267-279

Zajkowski, W., Kossut, M., & Wilson, R. C. (2017). A causal role for right frontopolar cortex in directed, but not random, exploration. *In revision at eLife*

B. Positions and Honors.

Chronology of Employment

2003-2009 Graduate Student, Department of Bioengineering, University of Pennsylvania
2009-2014 Postdoctoral Research Associate, Princeton Neuroscience Institute
2015-present Assistant Professor of Psychology and Cognitive Science, University of Arizona

C. Contributions to Science.

1. How humans and animals solve the explore-exploit dilemma

Many decisions in life involve a tradeoff between exploring new options for information and exploiting known options for reliable reward. For example, when dining at a favorite restaurant do you explore the new ravioli that is sure to be informative, or exploit the known pizza that is sure to be good? Beyond eating out, the explore-exploit dilemma occurs at all levels of decision making, from picking a TV show to watch or a person to marry, and there are real advantages to solving it well. Yet despite its importance, solving the dilemma optimally is intractable in all but the simplest settings and so the question arises as to how we balance

exploration and exploitation in practice. In recent work I have shown that humans use two distinct strategies for solving the explore-exploit dilemma: a directed strategy in which information seeking drives exploration by choice, and a random strategy in which behavioral variability drives exploration by chance. In addition, initial studies from my lab and my collaborators suggest that these two strategies rely on dissociable neural networks, with directed exploration dependent of frontal pole, correlating with blink rate and developing over the course of adolescence, while random exploration appears to be tied to norepinephrine. The identification of the two strategies, in addition to experiments with which to quantify them, is already having a significant impact on the field and versions of my task are currently being run in at least nine different labs around the world to study exploration in mental illness, across development, in animals and in response to drugs.

Wilson, R. C., Geana, A., White, J. M., Ludvig, E. A., & Cohen, J. D. (2014). Humans use directed and random exploration to solve the explore-exploit dilemma. *JEP:General, 143* (6), 2074-2081.

Somerville, L. H., Sasse, S. F., Garrad, M. C., Drysdale, A. T., Abi Akar, N., Insel, C., & Wilson, R. C. (accepted). Charting the Expansion of Strategic Exploratory Behavior During Adolescence. *JEP:General*

Krueger, P. K., Wilson, R. C., & Cohen, J. D. (accepted). Directed and random exploration in the domain of losses. *Judgment and Decision Making*

Zajkowski, W., Kossut, M., & Wilson, R. C. (in revision). A causal role for right frontopolar cortex in directed, but not random, exploration. *In revision at eLife*

2. Learning in the presence of abrupt change

Whether getting a new job or a new president, life is full of "change points" that cause the rules of the game to shift abruptly. Learning and making predictions in such circumstances can be challenging because change points can render much of the past irrelevant. In this work I developed a series of computational models to look at how humans and animals learn in the face of such environmental change points. These models ranged in scale from low level neural network models to high level cognitive models. All of these models made detailed experimental predictions some of which have been tested, and borne out, in experiments by my collaborators.

Wilson, R. C., & Finkel, L. H. (2009). A neural implementation of the Kalman filter. *Advances in Neural Information Processing Systems 22*, 2062-2070

Wilson, R. C., Nassar, M. R., & Gold, J. I. (2010). Bayesian online learning of the hazard rate in change-point problems. *Neural Computation, 22* (9), 2452-2476

Wilson, R. C., & Niv, Y. (2012). Inferring relevance in a changing world. *Front Hum Neurosci, 5*:189

Wilson, R. C., Nassar, M. R., & Gold, J. I. (2013). A Delta-rule approximation to Bayesian inference in change-point problems. *PLoS Comp Biol, 9* (7), e1003150

3. The role of orbitofrontal cortex in learning and decision making

Orbitofrontal cortex (OFC) has long been known to play an important role in learning and decision making. However, the exact nature of that role has remained elusive. I have recently proposed a new unifying theory of OFC function in which the OFC provides an abstraction of currently available information in the form of a labeling of the current task state. This "cognitive map" of "task space" in OFC is then used as a scaffold for learning and decision making throughout the brain. The theory accounts for many of the puzzling findings related to OFC such as its role in a number of behavioral tasks, as well as more recent findings showing the effect of OFC lesions on the firing of dopaminergic neurons in ventral tegmental area (VTA). This work has been well received by the field and has been cited over 100 times in just over two years.

Takahashi, Y. K., Roesch, M. R., Wilson, R. C., Toreson, K., O'Donnell, P., Niv, Y., & Schoenbaum, G. (2011). Expectancy-related firing of midbrain dopamine neurons depends on orbitofrontal cortex. *Nature Neuroscience, 14*, 1590-1597

Wilson, R. C., Takahashi, Y. K., Schoenbaum, G. & Niv, Y. (2014). Orbitofrontal cortex as a cognitive map of task space. *Neuron, 81* (2), 267-279

Links to a complete list of published work

- Lab website (also includes *in press* articles and conference papers)
  - http://www.u.arizona.edu/~bob/publications.html
- NCBI My Bibliography (published journal papers only)

- http://www.ncbi.nlm.nih.gov/sites/myncbi/robert.wilson.3/bibliography/48037481/public/?sort=date&direction=ascending

D. Research Support.

Current Research Support

2017-2018 **Principle Investigator** with Ying-hui Chou (co-I)
The neural substrates of explore-exploit decisions in old age
Arizona Alzheimer's Disease Core Center pilot grant (P30 AG019610)
Total direct costs: $30,000

2017-2018 **Principle Investigator**
The Neural Substrates of Exploration and Exploitation
University of Arizona, Faculty Seed Grant
Total direct costs: $10,000

2017-2018 **Principle Investigator**
The High-Throughput Psychophysiology Lab - A cognitive neuroscience resource for research, education and outreach
University of Arizona, Dean's Innovation and Education Fund
Total direct costs: $10,000

2017-2018 **Co-Investigator** with Kobus Barnard (PI)
Building capacity for inferring facial communication from video data
UA Improving Health TRIF
Total direct costs: $80,000

2017-2018 **Co-Investigator** with Mays Imad & David Kikuchi (PIs)
Integrative education mentoring in higher education
CIS Seed Grant
Total direct costs: $10,000

Completed Research Support
5T32 MH 65214 Cohen (PI) 04/1/12-9/30/13
Postdoctoral training grant

Application to the McKnight Inter-Institutional Cognitive Aging and Memory Intervention Core and Proposal for MBRF Funding

A Pilot Intervention with Near Infrared Stimulation: Revitalizing Cognition in Older Adults

A Collaborative Study across the University of Florida and the University of Arizona

10/16/2017

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A Pilot Intervention with Near Infrared Stimulation: Revitalizing Cognition in Older Adults

The proposed multi-site collaborative project will bring together research teams at the University of Florida (UF) and University of Arizona (UA) to test a novel, relatively low cost, low risk, though potentially high impact approach for a cognitive/mood intervention in older adults who are experiencing normal age-related memory and cognitive changes. The intervention involves transcranial and intranasal delivery of near infrared (NIR) light via light emitting diodes. Before describing the study design and hypotheses, we will briefly review the background and rationale for this unconventional, innovative approach and recent pilot data from 1 older adult.

Background: By history, current non-surgical device approaches to brain stimulation primarily involve magnetic (rTMS, TMS, deep TMS) or transcranial direct current stimulation (tDCS) which alter synaptic firing rates. In contrast, the ***underlying mechanism of near infrared (NIR)*** light stimulation is different. Application of light in red (630-700nm) and near-infrared wavelengths (808-904nm) appears to **improve mitochondrial function by promoting increased production of intracellular ATP**, important for cellular metabolism, respiration and oxygenation. It targets the cytochrome oxidase c integral membrane protein of the mitochondrial membrane (electron transport chain) and leads to increased intracellular levels of ATP (Mochizuka-Oda et al., 20002, Wong-Riley et al., 2005, Oron et al., 2007), increased expression of genes supporting cell proliferation and mitochondrial energy metabolism (Zhang et al., 2003), and decreased genes for pro-inflammatory proteins such as interleukin-1, interleukin10, and cytokine receptors (Whelan et al., 2003). Additionally, near infrared light may increase blood flow (Chung et al., 2012; Nawashiro et al., 2012) and up-regulate antioxidant genes (Chen et al., 2009). Thus, rather than directly modulating neural networks per se, application of NIR appears to create a supportive environment for optimal neuronal functioning that may lead to enhanced neural connectivity.

Recent animal and human studies have provided initial support for positive benefits of NIR stimulation on "brain and cognitive function". These studies include reports of reduced beta-amyloid load and neurofibrillary tangles in transgenic mice (APP/PSI and K3Tau) expected to develop Alzheimer's disease after exposure to real vs sham transcranial NIR stimulation (Purushothuman et al., 2013, 2014, Farfara et al., 2015). Others, using mouse and macaque models of Parkinson disease, have found that NIR stimulation via diodes implanted in the ventricles or midbrain protected dopaminergic neurons in the substantia nigra from MPTP-induced degeneration and also preserved locomotor activity (Moro et al, 2013, 2014, Reinhart et al., 2015; Darlot et al., 2016). Still others have reported that NIR stimulation attenuates post-stroke deficits in rabbits (Lapchak et al., 2007, 2010) and increases cortical metabolism and memory retention in healthy rats (Rojas et al., 2012). In human studies, NIR stimulation has been delivered via light emitting diodes (LED) directly to the scalp and is thought to penetrate 1-3 centimeters deep, with approximately 2-3% of the light reaching the cortex (Wan, 1981; Tedford et al., 2015). Positive effects of NIR stimulation have been observed in individuals with chronic aphasia due to focal stroke (Naeser et al., 2012, 2013), in individuals with TBI undergoing six weeks of intervention (Naeser et al., 2014), individuals with Alzheimer's disease (Saltmarche et al., 2017), and in younger healthy adults (Barrett et al., 2013; Blanco et al., 2017). Effect sizes on memory and executive tasks in these groups have ranged from modest to large. In addition, a neuroimaging study of a single case has reported pre-post changes in resting state functional connectivity MRI (rs-fcMRI) following real vs. sham NIR (Naeser et al., 2013).

Statement of Problem and Specific Aims

Prior research in cellular and animal models suggests that NIR exposure may be neuroprotective and increases energy available to neurons. In humans, several preliminary studies have been conducted in healthy young adults and those with aphasia due to stroke, traumatic brain injury, and Alzheimer's disease. While findings from these studies are promising, it remains unclear whether this novel, unconventional approach might be useful for modifying age-related cognitive symptoms, such as memory or executive functions in older adults. Careful prospective sham-controlled studies are critical to determine if this NIR intervention might be beneficial to normal elderly who are beginning to experience early age-related cognitive changes. At UF, we have NIR instrumentation (MedX MCT502 Rehab Console) and a unique 31-P MRI coil that can be used to detect changes in magnetic resonance spectroscopy (MRS) based markers of ATP function. Using this coil, we have obtained initial ***pilot imaging data*** from one normal older adult (age 72 yrs)

who underwent ***2 weeks of transcranial NIR stimulation (3 X a week)*** and showed ***changes in 2 of 3 markers of ATP function***, primarily over the frontal cortex (mean ATP change effect size *d* = .6).

In light of this pilot observation, we propose to conduct a randomized, sham-controlled study in generally healthy, community-dwelling older adults to investigate whether NIR stimulation has beneficial effects on cognition, mood, and brain function. Our ***overall hypothesis*** is that exposure to NIR stimulation will have positive effects on brain health via influence on mitochondrial function as measured by changes in MRS-based markers of ATP, neural network changes (rs-fMRI), and improved cognitive performance. To test this hypothesis, we plan to randomize older adults, including those with age-related cognitive complaints but not cognitive impairment, to sham or real treatment groups and evaluate neuroimaging and cognitive outcome measures, before and after an 8-week intervention involving transcranial and intranasal NIR. The protocol will involve both " lab" and " home-based" NIR stimulation.

We have three specific aims:

- ***Aim 1***: To evaluate whether NIR stimulation can enhance cognition in healthy aging. We hypothesize that NIR stimulation will result in greater pre-post intervention improvement on tasks of recent memory and executive function, relative to sham. This will be tested using novel tasks of recent memory that are sensitive to hippocampal function and amyloid load, including the LASSI-L (Curiel et al., 2013) and the Spatial Navigation Task (Thomas et al., 2001; Laczo et al., 2011). Executive function will be tested using composite scores from the NIH Examiner, a battery of executive function tests (Kramer et al., 2014) and traditional executive measures, the Trail Making Test (Reitan & Wolfson, 1985) and Stroop (Golden, 1978).
- ***Aim 2:*** To determine whether NIR stimulation can improve psychological well-being and mood in healthy older adults. We hypothesize that NIR stimulation will result in greater pre-post intervention improvements on measures of psychological well-being and negative affect. This will be tested using indices from the Emotion module of the NIH Toolbox (Salsman et al.,2013) and traditional measures of mood and emotion (Profile of Mood States, State-Trait Anxiety Inventory).
- ***Aim 3:*** To evaluate whether there are NIR intervention related changes in resting state functional connectivity in healthy aging. We hypothesize that NIR stimulation will show pre-post increases in functional connectivity in frontal and medial temporal lobe mediated resting state brain networks. We will also explore whether NIR stimulation leads to increases in MRS markers of ATP function, a presumed mechanism of NIR stimulation. This will be tested with rs-fcMRI and 31-P MRS.

Innovation: a) We are testing a novel intervention, NIR stimulation, for enhancing cognition in older adults with age-related cognitive changes; b) The proposed mechanism of change for NIR (i.e., ATP induced mitochondrial change) is promising in light of recent findings with animal models of Alzheimer's and Parkinson's disease; c) We have the unique opportunity to examine this potential mechanism in humans via use of MRS-phosphorous imaging, which targets changes in ATP and other metabolic markers. The use of rs-fcMRI enables us to identify intervention-related brain network changes in response to NIR intervention; d) Our primary cognitive outcomes include measures that are viewed as "cognitive biomarkers" due to their sensitivity to hippocampal function, amyloid burden, and early age-related cognitive changes; e) Methodologically, we have designed a randomized, blinded parallel group pilot study that includes a sham control group and will be carried out across 2 different McKnight Brain Institute sites (UF, UA). The multi-site design enables us to tease apart the potential influence of placebo and practice effects and examine reliability across sites, enhancing the impact of our findings; and f) The intervention is relatively low cost and low risk, and the technology used in this trial is safe, painless, and non-invasive. We expect that this pilot study will provide the basis for a larger scale NIH proposal; and if successful, this intervention could be ultimately adapted for 'in home' use.

Approach

Participants. Participants will include 52 healthy, community-dwelling older adults (age 65 yrs and older) who will be randomized to one of 2 intervention groups: a) active NIR stimulation (N=26) or (b) sham NIR (N=26). Half the participants (N=26) will be enrolled at the University of Florida and half at the University of Arizona. Participants can have subjective cognitive complaints (i.e., word finding, memory), as long as there is no psychometric evidence of impairment on cognitive screening measures.

Inclusion criteria: a) no evidence of dementia or MCI based on cognitive screening (i.e., MoCA scores within normal limits for age, education, and sex using the NACC Uniform Data Set (UDS) norms; age-

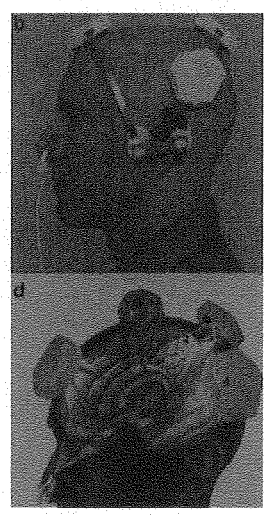
appropriate delayed story recall [WMS Logical Memory] and confrontation naming (Boston Naming Test); b) at least 8th grade education; c) willingness to be randomized to sham or real intervention; d) normal functional behaviors.

Exclusion criteria: a) history of brain abnormalities/neurological disorders affecting cognition (e.g., stroke, PD, MS, epilepsy, etc.); b) major psychiatric disturbance (e.g., schizophrenia, bipolar disorder, current major depression, current alcohol/substance abuse); c) use of psychotics, sedatives or other medications with anticholinergic properties; e) use of photosensitive medications within 15 days of intervention; d) active cancer diagnosis; and e) inability to undergo brain imaging due to metal, pacemakers, claustrophobia, etc.

Sample Size, Attrition, Power, and Intent to treat: We anticipate approximately 30% attrition rate for the 52 participants enrolled across the 2 sites, resulting in 36 participants who complete 8 weeks of intervention. With this sample (N=36), we expect to be able to detect a medium treatment effect on our primary cognitive/mood and brain imaging outcome measures with 83% power and $p = 0.05$, two tailed. Intent to treat analysis will be used to reduce selective attrition bias; participants who are unwilling/unable to continue with intervention will be encouraged to attend the post intervention testing, if possible.

Screening and Pre-Post Outcome Measures. Participants will be screened for inclusion/exclusion criteria, receive pre-post cognitive and imaging outcome measures before and after intervention. Resting state fMRI will be acquired at both sites (UF, UA), whereas MRS with a 31P coil will only be obtained at UF.

NIR Stimulation Intervention. We have previously used the MEDx console system for transcranial delivery of NIR light in pilot participants. Given the recent findings of Saltmarche et al. (2017), we have decided to use the Vielight system due to ease of standardizing LED clusters over the head and reduced cost. (See figure).



From Saltmarche et al.. 2017

Our NIR intervention protocol will span 8 weeks and includes:

a) *10 stimulation sessions in the laboratory* using the Vielight Neuro-Gamma system (Vielight, Inc); this system consists of a head frame holding 4 separate LED clusters plus 1 intranasal unit; each session will last approximately 1 hr and involves delivery of 810nm pulsed at 40 Hz for two 20 min periods; this results in total cranial dosage of 450j/cm^2 per session. During stimulation, participants will view clips from the BBC Life Series (Gunton, 2009) to standardize cognitive engagement. Following Saltmarche (2017), the lab sessions will occur twice a week during the initial 2 weeks and once a week thereafter.

b) *daily home use of an intranasal NIR* stimulator (Intranasal only 810) for 25 min/day. To increase adherence, participants will keep a daily home journal logging times and other comments. They will not self-stimulate on days they come to the laboratory.

Sham NIR Condition and Blinding: Participants in the sham group will undergo identical informed consent, screening, pre-post testing, and NIR intervention sessions. The only difference is that "sham" Vielight devices will be used. These are identical in all respects to real devices except that they do not deliver NIR. The research assistant administering the lab stimulation session will be aware of the participant's treatment status, but will have no role in pre- or post-intervention assessments. The research assistant involved in testing and neuroimaging acquisition will be blinded to the treatment status of the participant.

Imaging Protocol: Imaging will be performed on 3T Siemens MRI systems (Prisma at UF and Skyra at UA). The protocols will be optimized for standardized acquisition across scanners for T1-weighted volumetric MRI, rs-fcMRI to examine functional connectivity, and MRS using a 31P coil (currently available at UF only) to assess region specific changes in markers of ATP, one of the presumed mechanisms of NIR stimulation.

Resting State fcMRI: We will perform an fcMRI resting state block with eyes open and visual fixation using echoplanar BOLD imaging (EPI; TR=2500ms, TE=16ms, FOV=192^{2}mm, matrix=64^2, voxel size = 3.5mm^3). Processing and analyses will use Statistical Parametric Mapping (SPM12). We will present one ten-minute block of rs-fcMRI before and after intervention to test stimulation related change in functional networks. We will construct time series datasets implementing preprocessing methods to minimize physiological and motion artifact. Whole-brain voxel-wise multiple regression analysis will verify activation patterns in resting state networks. Appropriate covariates, such as movement, for each participant's brain voxels will be included using the variation

in BOLD signal over time. The CONN toolbox and local specialized software will be used to obtain temporal correlation values to assess functional connectivity between nodes for resting state networks, with particular focus on change in frontal and hippocampal regional connectivity. Primary dependent measures will be beta weights between resting state ROI's per participant. Beta values will compare intervention-related changes in functional connectivity. Multiple comparisons will be addressed with a false discovery rate (FDR) threshold of p=0.05.

Phosphorous MRS: A 31P-MRS pulse sequence will be acquired from two 6-cm^3 volumes centered in prefrontal cortex and left temporal lobe to assess region-specific change in phosphorous MRS-based markers of ATP function (TE=0.1ms; TR=4500ms; Spectral resolution=2.4 Hz/point; Spectral bandwidth=3000Hz; 7 min. duration). Spectra will be analyzed using jMRUI to give concentrations for the following phosphorous metabolites: nucleoside di- and tri-phosphate (gamma, alpha, beta-NTP), phosphoethanolamine (PEtn), phosphocholine (PCho), glycerophosphoethanolamine (GPEtn), glycerophosphocholine (GPCho), 2,3 diphospho-glyceride (DPG), inorganic-phosphate (Pi), membrane-bound phospholipid (MP), and phosphocreatine (PCr). The signal amplitudes of brain tissue and CSF will be derived (corrected for T2 decay), with brain water signal used to correct for partial CSF volume.

Outcomes: Change in performance on cognitive and mood measures and changes in imaging parameters (functional connectivity, MRS ATP markers) before and after intervention, relative to the sham control group. Intervention changes must exceed the effects of practice based on the sham control group.
Aim 1 examines memory and executive function.

- Co-Primary Outcome: Changes in pre-post scores on a verbal memory measure, the LASSI-L (Curiel et al., 2013) and the executive composite and domain scores from the NIH Examiner (Kramer, et al., 2014).
- Secondary Outcome: Changes in pre-post treatment scores on the Spatial Navigation Task, a human Morris Water Maze analog sensitive to hippocampal function and traditional neuropsychological measures of executive function, Trail Making Test (Reitan & Wolfson,1985) and Stroop (Golden, 1978).

Aim 2 examines well-being and mood variables.

- Primary outcome: Changes in pre-post treatment scores on the Negative Affect and Psychological Wellbeing scales from the emotion module of the NIH Toolbox (Gershon et al., 2013).
- Secondary outcome: Changes in pre-post treatment scores on traditional mood measures 1) State-Trait Anxiety Inventory (Spielberg, 1989), and 2) Profile of Mood States (POMS; Curan et al., 1995).

Aim 3 examines neuroimaging changes

- Primary outcome: Changes in frontal and medial temporal lobe mediated patterns of resting state functional connectivity.
- Secondary outcome: Changes in frontal and temporal lobe MRS, including markers of ATP function.

Limitations and Future Directions. There are several limitations. Ideally, we would like to follow participants for 3-6 months post intervention, but this is not possible given available resources. It is possible that we may find null cognitive/behavioral changes. This could arise because of inadequate penetrance of the signal through the skull and/or suboptimal dosing parameters. Currently, there are no standard empirically based guidelines for dosing in humans, and need exists for studies of dose-response relationships. However, we selected an 8 week intervention interval based on prior published findings and we observed MRS based changes in our initial preliminary findings with 1 older adult assessed over a 2 week interval. If results of this pilot study show efficacy in enhancing cognition and brain health, this technology could easily be used in larger trials and combined with other interventions; it represents an ideal approach because of its safety and limited side effects. Further, as a relatively inexpensive technology there is the potential for modifying NIR LED devices for widespread clinical use and/or as part of multimodal treatment programs. Because NIR light is applied with safe, non-thermal, and painless light emitting diodes (LEDs), this technology could also be modified for use by caregivers and patients at home. Based on the proposed mechanisms of action (i.e., neuroprotection, and increasing neuronal metabolism and blood flow), one possible outcome is that regular use of this technology may aid in altering the cognitive trajectory of age-related cognitive decline linked to structural and functional changes in the brain. Information learned from this study will be valuable in helping to establish the potential of this unique and innovative intervention as one of the first brain aging modifiers for healthy individuals at-risk for age-related cognitive decline with potential benefits for primary, secondary, and tertiary prevention in healthy and pathological aging

Multisite Collaboration

The University of Florida (Bowers/Woods) and University of Arizona (Alexander) will be equal partners in the proposed study. Drs. Bowers, Woods and Alexander together have extensive experience in the use of neuropsychological and neuroimaging measures to evaluate the effects of cognitive and brain aging, with the goal of identifying effective interventions for age-related cognitive decline. In the proposed study, participants will be enrolled similarly across both sites and undergo the same screening, baseline, and study intervention procedures. Similarly, pre-post imaging data will be collected from participants at both sites including structural and resting state fcMRI, thereby enabling examination of intervention related network changes. Only the UF site will collect pre-post MRS data due to the availability of a 31P coil for human use currently only at UF. We believe the proposed pilot project will provide the key information needed to support our plans for subsequent grant submissions. We anticipate frequent virtual meetings during the initial start up phase of this pilot study to ensure that all standardization and quality assurance procedures are in place; followed by biweekly to monthly meetings with at least one 'face to face' meeting at the yearly McKnight Inter-Institutional meeting. Moving forward, our ultimate goal is to obtain sufficient pilot data for submission of a multi-site NIH R01 application to more fully evaluate the potential impact of NIR stimulation as a promising intervention for the effects of brain aging, to enhance cognitive health and promote emotional well-being in the context of healthy aging.

References

Barrett, D. W., & Gonzalez-Lima, F. (2013). Transcranial infrared laser stimulation produces beneficial cognitive and emotional effects in humans. *Neuroscience*, *230*, 13–23.

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Total Budget - McKnight Near Infrared Intervention Project

Combined Sites (U Florida & U Arizona)

	Year 1			Year 2			Total
Personnel	UF	UA	Total	UF	UA	Total	
Site PI/MPI	0	0	0	0	0	0	0
Study Coordinator (10%)	5,000	5,450	10,450	5,000	5,450	10,450	20,900
Research Assistant (10%)	3,500	3,500	7,000	3,500	3,500	7,000	14,000
Student hrs per subject	1,300	1,300	2,600	1,300	1,300	2,600	5,200
Subtotal Personnel	**9,800**	**10,250**	**20,050**	**9,800**	**10,250**	**20,050**	**40,100**
Fringe Benefits							
Site MPI/PI	0	0	0	0	0	0	0
Study Coordinator	1,790	1,744	3,534	1,790	1,744	3,534	7,068
Research Assistant	357	1,120	1,477	357	1,120	1,477	2,954
Student	78	52	130	78	52	130	260
Subtotal Fringe Benefits	**2,225**	**2,916**	**5,141**	**2,225**	**2,916**	**5,141**	**10,282**
SUBTOTAL-PERSONNEL & BENEFITS	**12,025**	**13,166**	**25,191**	**12,025**	**13,166**	**25,191**	**50,382**
Supplies	UF	UA	Total	UF	UA	Total	Total
Supplies	500	1,418	1,918	2,100	3,290	5,390	7,308
NIR Device	3,036	3,036	6,072	1,164	1,164	2,328	8,400
Neuropsychology Tests	0	0	0	0	0	0	0
Subtotal Supplies	**3,536**	**4,454**	**7,990**	**3,264**	**4,454**	**7,718**	**15,708**
Operations	UF	UA	Total	UF	UA	Total	Total
MRI (30/60min scan each, pre & post)	10,400	5,980	16,380	10,400	5,980	16,380	32,760
Subject Pay ($250)	3,250	3,250	6,500	3,250	3,250	6,500	13,000
Advertising	789	2,500	3,289	1,061	2,500	3,561	6,850
Parking for Subjects	0	650	650	0	650	650	1,300
Subtotal Operations	**14,439**	**12,380**	**26,819**	**14,711**	**12,380**	**27,091**	**53,910**
Travel	UF	UA	Total	UF	UA	Total	Total
Travel	0	0	0	0	0	0	0
Subtotal Travel	**0**	**0**	0	**0**	**0**	0	0
TOTAL DIRECT COSTS	**30,000**	**30,000**	**60,000**	**30,000**	**30,000**	**60,000**	**120,000**

University Florida Site Budget

McKnight Near Infrared Intervention Project

	Year 1	Year 2	TOTAL
Personnel			
Site MPI--Dawn Bowers (no salary requested)	0	0	0
Site MPI - Adam Woods (no salary requested)	0	0	0
Study Coordinator (10%)	5,000	5,000	10,000
Research Assistant (10%)	3,500	3500	7,000
Students hrs per subject-10hrs/13subjects	1,300	1300	2600
Subtotal Personnel	**9,800**	**9800**	**19,600**
Fringe Benefits			
Site MPI-- Dawn Bowers	0	0	0
Site MPI - Adam Woods	0	0	0
Study Coordinator	1,790	1,790	3,580
Research Assistant	357	357	714
Student	78	78	156
Subtotal Fringe Benefits	**2,225**	**2,225**	**4,450**
SUBTOTAL OF PERSONNEL & BENEFITS	**12,025**	**12,025**	**24,050**
Supplies			
Supplies	500	2,100	2,600
NIR Device	3,036	1,164	4,200
Neuropsychology Tests	0	0	0
Subtotal Supplies	**3,536**	**3,264**	**6,800**
Operations			
MRI (60min scan each, pre & post)	10,400	10,400	20,800
Subject Pay ($250)	3,250	3,250	6,500
Advertising	789	1,061	1,850
Parking for Subjects	0	0	0
Subtotal Operations	**14,439**	**14,711**	**29,150**
Travel			
Travel	0	0	0
Subtotal Travel	**0**	**0**	**0**
TOTAL DIRECT COSTS	**30,000**	**30,000**	**60,000**

University of Florida
Budget Justification

Personnel:

Dawn Bowers, Ph.D., & Adam Woods, Ph.D., UF MPI (no salary support requested): Drs. Bowers and Woods will co-direct the project at the University of Florida and jointly supervise all aspects of the project. They will work closely with Dr. Alexander to ensure coordination across both the UF and UA sites. They will be jointly responsible for participant recruitment and insuring that the study complies with institutional, state, federal, and ethical guidelines. Together with Dr. Alexander, they will coordinate and prepare progress reports and work together to prepare manuscripts and complementary external grant proposals.

- *Dr. Bowers* will take the lead in providing oversight for personnel involved in subject recruitment, data collection, project management, and data analysis of behavioral/cognitive data. She will work closely with Dr. Alexander to ensure standardized implementation and administration of the near infrared (NIR) stimulation intervention across both sites. She will oversee procedures for participant screening and enrollment and will provide supervision for personnel performing screening, pre-post neurocognitive testing, and the intervention.

- *Dr. Woods* will take the lead in the neuroimaging aspects of this protocol, including MRI acquisition for all participants enrolled at UF. He will be responsible for the quality control of obtained scans, image processing and reduction, and all imaging analyses. He will work closely with Dr. Alexander at the UA site in terms of identifying site-specific imaging differences in data acquisition and analyses of the structural and functional imaging scans.

TBD, Study Coordinator (10% effort). The study coordinator will be responsible for coordinating and overseeing participant enrollment, scheduling, advertising, mailing, preparing fee payments, coordinating research assistant and student efforts, budget management, and arranging for project phone conferences and staff meetings. The Coordinator will assist with maintaining and supervising human subject certifications for the project and will work with Drs. Bowers and Woods to insure full compliance with university Institutional Review Board requirements and approvals. He/she will assist with project updates for preparation of status and progress reports and will generally assist and facilitate the day-to-day operations for data collection, data transfer, archiving, and data analysis for the study.

TBD, Project Research Assistant (10% effort). The research assistant (RA) will provide assistance in the overall operations of the study including scheduling, data entry, and maintaining participant records. S/He will schedule and perform the screening, baseline and post-intervention assessments and assist with quality control review of neuroimaging scans during the study. S/He will work with Dr. Bowers/Woods and the study coordinator to ensure that the blinded aspects of the intervention in the study are maintained. The RA will organize and review all outcome data for quality assurance and will work closely with other members of the study team to transfer data for central storage and processing for analyses.

TBD, Student Research Assistant (10 hours per subject). The student research assistants (RA) will assist by conducting phone screens, identifying participants, and scheduling study procedures. The student RA will administer the transcranial NIR intervention to study participants during the intervention visits according to the study protocol and will assist the participants in the use of the NIR stimulation procedures while at home during the intervention

study interval. They will assist with monitoring any adverse effects, should they occur, during the intervention session. They will not participate in post-intervention assessments.

Supplies

We request $6800 over the course of the project for project-related expenses and supplies needed for intervention, creating participant files/charts, computer hardware and software, and supplies for scientific posters and manuscripts. This amount also includes costs for the NIR device.

Transcranial NIR Stimulation Devices: We anticipate spending $3036 in year 1 of the project for the purchase of the Vielight NeuroGamma and 810 real and sham intranasal devices needed for the intervention. This amount includes $1164 for the purchase of 13 intranasal leads for each participant (cost 249.50 per lead with academic research discount.) In Year 2, we will purchase additional intranasal leads for enrolled participants at cost of $1164.

Operational Costs

MRI scans: 52 MRI scans (1 hr) @ $400 = $20,800. This includes time for structural and resting state fMRI, along with the MRS spectroscopy scans using the 31P coil.

Subject payment and fees: Subjects will receive $250 in compensation for their completion of the study.

Advertising & recruitment costs: Additional monies are requested for advertising, including ads in local newspapers for recruiting participants.

University of Arizona Site Budget

McKnight Near Infrared Intervention Project

	Year 1	Year 2	TOTAL
Personnel			
Site PI--Gene Alexander (no salary requested)	0	0	0
Study Coordinator-(10%)	5,450	5,450	10,900
Research Assistant (10%)	3,500	3,500	7,000
Students hrs per subject-10hrs/13subjects per year	1,300	1,300	2,600
Subtotal Personnel	**10,250**	**10,250**	**20,500**
Fringe Benefits			
Site PI - Gene Alexander	0	0	0
Study Coordinator	1,744	1,744	3,488
Research Assistant	1,120	1,120	2,240
Student	52	52	104
Subtotal Fringe Benefits	**2,916**	**2,916**	**5,832**
SUBTOTAL OF PERSONNEL & BENEFITS	**13,166**	**13,166**	**26,332**
Supplies			
Supplies	1,418	3,290	4,708
NIR Device & Leads	3,036	1,164	4,200
Neuropsychology Tests	0	0	0
Subtotal Supplies	**4,454**	**4,454**	**8,908**
Operations			
MRI (30min scan each, pre & post)	5,980	5,980	11,960
Subject Pay ($250)	3,250	3,250	6,500
Advertising	2,500	2,500	5,000
Parking for Subjects	650	650	1,300
Subtotal Operations	**12,380**	**12,380**	**12,800**
Travel			
Travel	0	0	0
Subtotal Travel	**0**	**0**	**0**
Total Direct Costs	**30,000**	**30,000**	**60,000**

University of Arizona
Budget Justification

Personnel:

Gene E. Alexander, Ph.D. UA Site Principal Investigator (no salary support requested). Dr. Alexander will be responsible for the supervision of all aspects of the project at the University of Arizona (UA). He will work closely with Drs. Bowers and Woods to ensure coordination of the project across both sites. He will provide oversight for personnel involved in human subject recruitment, data collection, project management, data storage, and analysis at the UA. Dr. Alexander will work closely with Drs. Bowers and Woods to ensure standardized implementation and administration of the transcranial near infrared (NIR) stimulation intervention at the UA. Dr. Alexander will oversee implementation of procedures for participant screening and enrollment and will provide supervision for personnel performing the neuropsychological testing, intervention, and MRI acquisition for all subjects enrolled at the UA. He will assure that the study fully complies with all institutional, state, federal, and ethical guidelines and will work with the other research team members to insure that all safety and human subject compliance protocols are maintained. Dr. Alexander will work with Drs. Bowers and Woods in the coordination and preparation of progress reports and on the preparation of manuscripts and complementary external grant proposals.

Cortney Jessup, M.P.A., Study Coordinator (10% effort). Ms. Jessup will assist Dr. Alexander with project coordination at the UA and will be responsible for coordinating and overseeing participant enrollment and scheduling, advertising to support participant recruitment, preparation of subject mailings and fee payments, coordinating research assistant and student efforts, budget management, and arrangements for project phone conferences and staff meetings. She will work with other members of the UA research team to obtain project updates for preparation of routine status and progress reports. She will maintain and supervise the human subject certifications for the project and will work with Dr. Alexander to insure full compliance with university Institutional Review Board requirements and approvals. Ms. Jessup will work closely with staff at the UA to assist and facilitate the day-to-day operations for data collection, data transfer, archiving, and data analysis for the study.

TBN, Project Research Assistant (10% effort). The research assistant will provide assistance in the overall operations of the study including scheduling, data entry, maintaining participant records, and performing assessments according to study protocol. S/He will schedule and perform the administration of screening and neuropsychological assessments and be responsible for the acquisition and QC review of neuroimaging scans during the study. S/He will work with Dr. Alexander and Ms. Jessup to ensure that the blinded aspects of the intervention in the study are maintained. S/He will organize and review all outcome data for quality assurance and will work closely with other members of the study team to transfer data for central storage and processing for analyses.

TBN, Student Research Assistant (10 hours per subject). The student research assistants will assist the project research assistant with conducting phone screens, identifying participants, and scheduling study procedures. The student research assistants will administer the transcranial NIR intervention to study participants during the intervention visits according to the study protocol and will assist the participants in the use of the NIR stimulation procedures while at home during the intervention study interval.

Supplies

Supplies: We request $4,708 over the course of the project for project-related supplies needed for intervention, creating participant files/charts, computer hardware and software, and supplies for scientific posters and manuscripts.

Transcranial NIR Stimulation Devices: During Year 1, we plan to purchase the Vielight NeuroGamma system and 810 real and sham devices. We also request $1164 in each of of year 1 and 2 for the purchase of individual intranasal leads for each subject.

Operational Costs

MRI scans: 52 MRI (30 min. session) scans @ $230ea = $11,960

Subject payment and fees: Subjects will receive $250 in compensation for their completion of the study.

Subject parking fees: We request $650 per year for the purchase of one leased parking space behind the Psychology Building for subject use during study visits.

Advertising & recruitment costs:

We request $2,500 per year for placing ads in local newspapers to recruit participants for the study.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Dawn Bowers, Ph.D.

eRA COMMONS USER NAME (credential, e.g., agency login): dbowers

POSITION TITLE: Professor, Clinical & Health Psychology, Neurology

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Emory University	--	1968-1970	Chemistry
University of Florida	B.S.	1972	Psychology
University of Florida	M.S.	1974	Clinical Psychology
Boston University	internship	1977	Neuropsychology
University of Florida	Ph.D.	1978	Clinical & Health Psychology
University of Florida	Post-Doc	1979	Behavioral Neurology

A. Personal Statement

I am a university professor, a cognitive neuroscientist, and a board certified clinical neuropsychologist. I have longstanding research and clinical expertise in cognitive and emotional changes that are associated with neurologic disease and aging, particularly apathy, depression, memory and executive function. I am the lead neuropsychologist for UF's internationally known Center for Movement Disorders and direct a NINDS-funded predoctoral T32 training grant. My current research focuses on emotion regulation and executive function in older adults, real time fMRI for modulating emotional responsivity, psychophysiologic signatures of apathy and depression, and interactive effects of cognitive training, mindfulness and novel therapies on mood and cognition in older adults. I have been funded by NIH for over 30 years. This has included support for several randomized clinical trials, one for treatment of apathy using rTMS, another for treatment of masked faces in Parkinson disease, and a 3rd involving combined cognitive training-exercise intervention with older adults. My laboratory has used various tools (startle, pupillometry, ERP, computational modeling, TMS and rTMS) to better understand neural mechanisms that underlie emotional and cognitive changes in older adults. As such, I have experimental tools/approaches and wealth of experience that can facilitate hypothesis driven research, both mechanistically and applied. The proposed project hopes to evaluate the viability of a novel noninvasive approach to cognitive enhancement and is designed to rigorously evaluate potential cognitive and neural benefits for older adults. The team assembled for this research project (Dr. Adam Woods from UF and Dr. Alexander from the University of Arizona), are leaders in the field in terms of age-related cognitive decline, intervention, neuroimaging, and brain stimulation and bring forth a wealth of experience and knowledge to this collaborative effort across two McKnight sites, the University of Florida and the University of Arizona.

B. Positions and Honors

Positions and Employment

1976-1977: Teaching Fellow in Neurology, Boston University College of Medicine
1976-1977: Internship in Clinical Psychology/Neuropsychology, Boston VAMC
1976-1977 Externship in Geriatric Neuropsychology, Framingham Heart Study, MA
1979 Post-doctoral Fellowship, Behavioral Neurology, UF College of Medicine
1980- 1998 Associate Professor in Neurology [Assistant 1980-85], UF College of Medicine

1984-1998	Neuropsychologist, State of Florida Memory Disorders Clinic
1998-	Professor of Clinical & Health Psychology [Associate 1998-2002]
2006-	Chief, Neuropsychology Division, Dept. Clinical & Health Psychology
2006-	Director, Neuropsychology Post-doctoral Program

Other Positions and Professional Memberships (abbreviated)

2011-12	Ad hoc Member, Special Emphasis Panel, Clinical and Imaging Translations Study Section (ZRG1 DTCS Y(81)].
2012-14	Chair & Vice Chair, Faculty Council, College of PHHP
2012-15	Board of Governors, International Neuropsychological Society
2012	Panel Member, NIH Review of LRP proposals
2013-17	Merit Review Panel for Mental Health and Behavioral Sciences-B, BLRD and SCR&D; Department of Veterans Affairs
2013-	Fellows Committee, Division 40, APA (Member 2013-16)-)
2016-	Chair, APA Division 40 Fellows Committee
2017	Panel Member, NINDS Review of T32 Programs, ZNS1 SRB 58
Membership	American Psychological Association (Divisions 12, 20, & 40), International Neuropsychology Society, American Academy of Clinical Neuropsypchology, Society for Neuroscience, Cognitive Neuroscience Society

Honors

2006-	UF Foundation Research Professor
2012	Fellow, American Psychological Association, Division 40
2013	Board Certification in Clinical Neuropsychology (ABBP/cn)
2014	Paul Satz Career Mentoring Award, International Neuropsychology Society
2014	Edith Kaplan Neuropsychology Award, Massachusetts Psychological Society
2015	Doctoral Mentoring Award, College of Public Health and Health Professions, UF
2015	Audrey Shumacher Teaching Award, Department of Clinical & Health Psychology
2015	Research Award, Department of Clinical & Health Psychology
2016	University of Florida Doctoral Mentoring Award
2017	University of Florida Term Professor Award

C. Contributions to Science

Apathy/depression in Parkinson Disease. Much of my research over the past decade has focused on cognitive and emotional sequelae of Parkinson disease. One line of research has supported the view that apathy is the primary neuropsychiatric signature in Parkinson disease. We and others have shown that apathy is distinct from depression, affects between 30-70% of PD patients in cross-sectional studies and progressively worsens with disease severity. In my lab, we have examined psychometric properties of different apathy scales and shown how depression and apathy differentially predict cognitive, physiologic, and trajectory of motor decline in Parkinson disease. An initial study published over a decade ago in Brain found that Parkinson patients had muted physiological reactivity to emotional materials, as indexed by blunted startle eyeblink responses; we proposed this was due to aberrant amygdala gating. Importantly, this blunting was associated with apathy but not depression. These findings were replicated and similar apathy-depression dissociations were observed in our ERP studies, trajectory of decline studies, and by the differential influence of depression and apathy on cognition. What has emerged is the view that depression is a mood disorder, whereas apathy is motivational disorder. The importance of this perspective relates to diagnosis and treatment, as pharmacologic therapy for depression with SSRI's actually worsens apathy. Current efforts relate to non-pharmacologic treatment approaches for apathy, ranging from motivational telehealth interventions to emotion regulation. Currently, we are completing an NINDS funded ERP study examining the ability of Parkinson patients to 'intentionally" upregulate their emotional reactivity and whether success in doing so is related to executive dysfunction.

- Bowers, D., Miller, K., Mikos, A., Kirsch-Darrow, L., Springer, S., Fernandez, H., Foote, K., Okun, M.S. (2006). Startling facts about emotion in Parkinson disease: Blunted reactivity to aversive stimuli. *Brain, 129,* 3345-3365.
- Kirsch-Darrow, L., Fernandez, H., Okun, M., Bowers, D. (2006). Dissociating apathy and depression in Parkinsons's disease. *Neurology.* 67(1), 20-27.

- Zahodne, L, Marsiske, M., Okun, M.S., Rodriguez, R., Malaty, I, Bowers, D. (2012). Mood and motor symptoms in Parkinson's Disease: a multivariate latent growth curve modeling. N*europsychology*, 26, 71-80. PMID: 22142359
- Renfroe, J.B., Bradley, M.M., Okun, M.S., Bowers, D. (2016). Motivational engagement in Parkinson disease: perception and preparation for action. *International Journal of Psychophysiology, 99,* 24-32. PMID:26659013
- Mangal, P., Lafo, P., Scott, B., Okun, M.S., Bradley, M., Bowers, D. (2017, February). Intentional enhancement of electrocortical responses to emotional pictures by Parkinson patients: Relation to executive function. Presented at the 44th annual meeting of the International Neuropsychological Society, Boston, MA. (Abstract: Journal of the International Neuropsychological Society
- Butterfield, L., Ciminio, C., Salazar, R., Lee, C., Haley, W., Sanchez-Ramos, J., Okun, M.S., Bowers, D. (2017).The Parkinson Active living (PAL) Program: A behavioral intervention targeting apathy in parkinson's disease. *J. Geriatric Psychiatry and Neurology*, 30, 11-25.

Vascular Comorbidities and Cognition in Parkinson Disease. Despite clinical lore that patients with Parkinson disease are impervious to effects of hypertension due to the blood pressure lowering effects of various dopamine medications, we have shown that those with hypertension and other vascular comorbidities 'take a hit' in terms of executive function, similar to that of non-PD older adults.

- *Jones, J.,* Malaty, I., Price CC, Okun, MS., Bowers, D. (2012) Health comorbidities and cognition in 1948 patients with idiopathic Parkinson disease. *Parkinsonism and Related Disorders.* 18 (10), 1073-1078 PMID:22776043
- *Jones, J.,* Jacobson, C., *Murphy, M.C.*, Price, C.E., Okun, M.S., Bowers, D. (2014). Influence of hypertension on neurocognitive domains in non-demented Parkinson's disease patients. *Parkinson's Disease, 2014, Article ID 507529,* [http://dx.doi.org/10.1144/2014/507529]. PMID: 24587937 PMCID: PMC3920751.
- Scott, B.M., Maye, J., Jones, J., Thomas, K., Mangal, P., Trifilio, E., Hass, C., Marsiske, M., Bowers, D. (2016). Post-exercise pulse pressure is a better predictor of executive function than pre-exercise pulse pressure in cognitively normal older adults. *Aging, Neuropsychology, and Cognition.* 23 (4), 464-476 PMID: 26629911
- *Jones, J.*, Price, CE, Tanner, J., Okun, M.S., Bowers, D. (2017). Is cognition more vulnerable to the effects of cardiovascular risk in Parkinson patients versus controls: A neuroimaging and neuropsychological study. *J. International Neuropsychology Society.* 23, 1-10 PMID:28162137

Retrosplenial Amnesia. This body of work described the first human case of a pure amnestic syndrome due to an isolated lesion of the left retrosplenial region, located beneath the posterior cingulum; it receives direct input from the fornix of the hippocampus, projects forward via the cingulum and serves as way station for input from the adjacent parietal region. We conceptualized the amnesia induced by this lesion as a 'disconnection' variant, and a neuroimaging study (PET) of this patient showed hypometabolism of the thalamus and hypermetabolism of the ipsilateral frontal lobe. We and others subsequently described other cases of retrosplenial amnesia. More recent research has implicated this region in Alzheimer's disease .

- Valenstein, E., Bowers, D., Verfaellie, M., Heilman, K., Day, A., and Watson, R. (1987). Retrosplenial amnesia. *Brain, 110*, 1631-1646.
- Bowers, D., Verfaellie, M., Valenstein, E., and Heilman, K. (1988). Impaired acquisition of temporal information in retrosplenial amnesia. *Brain and Cognition, 8,* 47-66
- Heilman, K.M., Bowers, D., Watson, R., Day, A., Valenstein, E., Hammond, E., and Duara, R. (1990). Frontal hypermetabolism and thalamic hypometabolism in a patient with abnormal orienting and retrosplenial amnesia. *Neuropsychologia, 28,* 161-170.
- McDonald, C., Crosson, B., Valenstein, E., and Bowers, D. (2001). Verbal encoding deficits in a patient with retrosplenial amnesia. *Neurocase, 7,* 407-17.

Cortical Contributions to Emotion. During an early phase of my academic career, my interests focused on cortical contributions to emotion. This was done primarily using a 'stroke" or 'lesion' model. Much of this work predated fMRI. Some key findings, that have been replicated over the years, were that that posterior focal hemisphere lesions (temporo-parietal) induced defective perception of emotional faces and prosody (tone of voice) that was not due to basic visuoperceptual disturbances . Instead I proposed a model which involved a nonverbal affective lexicon that was moreso lateralized to the right than left hemisphere. This was initially inspired by observations of patient with a callosal disconnection and an affect specific anomia (Bowers & Helman, 1984); this observation led to the development of *The Florida Affect Battery* which enabled us to parcellate out various processing disturbances. What we know now is that more anterior cortical systems play a more direct role in modulating the underlying limbic system, whereas the posterior cortical systems are involved in emotional interpretation that feeds forward to assist in goal selection, with lateralized involvement. .

- Bowers, D., Jones, J., Dietz, J. (2014). Assessment of emotion, mood, and affect associated with neurologic disorders. In Parsons, M. and Hammeck, T. (eds), Clinical Neuropsychology. *Pocket Handbook of Assessment.* American Psychological Press.
- Bowers, D., Bauer, R.M., and Heilman, K. (1993). The nonverbal affect lexicon: Theoretical perspectives from neuropsychological studies of affect perception. *Neuropsychology, 7(4)*, 433-444.
- Bowers, D., *Coslett, B.,* Bauer, R., Speedie, L., and Heilman, K.M. (1987). Comprehension of emotional prosody following unilateral brain damage: Processing versus distraction defects. *Neuropsychologia, 25*,317-328.
- Bowers, D., Bauer, R., Coslett, B., and Heilman, K. (1985). Processing of faces by patients with unilateral hemisphere lesions. I. Dissociation between judgments of facial affect and facial identity. *Brain & Cognition, 4,* 258-272.

Pseudoneglect. Early in my career, I described a mild asymmetry in spatial attention whereby normal individuals tend to favor the left side of space. I referred to this phenomenon as 'pseduoneglect', since the spatial error was opposite in direction to that observed in patients with right parietal strokes. Since the initial discovery, pseudoneglect (or spatial asymmetry) has been observed in 100's of studies ranging from judgements of brightness, numerosity, size, and representation to neuroimaging studies. The original study initially describing this phenomenon (Bowers & Heilman, 1980) has been cited almost 1000 times, and continues to be studied today.

- Bowers D, Heilman KM (1980) Pseudoneglect: effects of hemispace on a tactile line bisection task. Neuropsychologia 18: 491–498
- Heilman KM, Bowers D, Watson RT. (1984). Pseudoneglect in a patient with partial callosal disconnection. Brain. 107 (Pt 2):519-32.
- W atson RT, Heilman KM, Bowers D. (1985). Magnetic resonance imaging (MRI, NMR) scan in a case of caollosal apraxia and pseudoneglect. Brain, 108 (Pt 2):535-6

D. Research Support

Ongoing Research Support

R01 HD091658 PI: Hegland 2017-2020
Mechanisms of airway protection dysfunction in Parkinson's disease.
This project examines neural mechanisms underlying swallowing disorders in individuals with Parkinson disease, focusing on relationship between sensory signals and motor output.
Role: Co-I

NIH/R21-AG057200 MPI: Bowers/Ebner 2017-2019
Determining plasticity of brain-regulatory mechanisms related to emotion processing: A Neurofeedback approach in aging and Parkinson Disease
This project examines use of real time fMRI to provide neurofeedback for increasing limbic activation (anterior insula) and its influence cognitive and behavioral ratings.

T32- NS082168 MPI: Bowers & Vaillancourt 2015-2020
Interdisciplinary Training in Movement Disorders and Neurorestoration
This grant focuses on interdisciplinary training of predoctoral trainees across cognitive/movement science,

R03-MH109333 PI: Bowers 2017-2018
Dissociating Components of Anhedonia: Pilot Behavioral and fMRI Data for the Effort Expenditure for Rewards Task
The goal of this study is to examine the neural correlates of anhedonia in older and younger adults. (I took over this project when Dr. Dotson left UF)

ALZ67-State of Florida PI: Bowers 2016-2018
Pilot Intervention in Mild Cognitive Impairment: A Proof of Concept Study with Transcranial Near Infrared Stimulation
This pilot study will test in a randomized sham controlled trial whether a novel intervention, near infrared brain stimulation, has potential for improving cognitive symptoms in individuals with amnestic mild cognitive impairment.

NIH/ R01-NS096008 MPI: Okun/Gunduz 2016-2021
The Human Thalamocortical Network in Tourette.
The goal of this study is to develop a closed loop neuromodulation solution for Tourette syndrome and to explore the humanthalamocortical newtwork in Tourette syndrome
Role: Co-I

UH3-NS095553 MPI: Gunduz/Foote 2016-2021
NIH/NINDS
Closing the Loop on Tremor: A Responsive Deep Brain Stimulator for Treatment of Tremor
This project examines the thalamocortical neurophysiology of tremor.
Role: Co-I

ALZ-121 State of Florida PI: Wicklund 2016-2018
Consortium for Diagnostic Algorithm with Novel Markers in early Alzheimer's Disease
This Florida multisite study aims to 1) validate novel neuropsychological and imaging measures that are sensitive to the earliest cognitive changes associated with AD, and 2) develop algorithms for fitting patients into various diagnostic categories using multimodal clinical, neuropsychological, and neuroimaging data.
Role: Co-I

R01 NS082386 PI: Price 2013-2018
White Matter Connectivity and PD Cognitive Phenotype
This grant examines 3 cognitive subtypes of PD in relation to white matter connectivity using cognitive testing and multimodal imaging approaches (DTI, fMRI)
Role: CO-I

Michael J. Fox Foundation PI; Okun 2015-2017
A Closed Loop Neuromodulation Solution For Parkinson's Disease Related Freezing
Role: Co-I

Completed Research Support
R21NS079767 PI: Bowers 2012-2015
Emotion Regulation, Executive Function, and Parkinson Disease.
This grant tests whether Parkinson patients can learn to "upregulate" their emotional reactivity, as measured by electrophyysiologicall measures (LPP, ERP), and whether the ability to do so is related to executive functioning.

Village-UF Partnership MPI: Bowers & Marsiske 2014-2016
Vitality Mind-Brain Health: Re-Vitalize, Cedar, & Neuroadvantage
This project tests various hypotheses regarding the basis for cognitive improvement in older adults undergoing various cognitive and behavioral interventions i.e., mindfulness, exergames, etc.)

State of Florida PI: Lowenstein/Wicklund 02/2015-03/30/15
Novel Markers in Alzheimer's Disease,
This multi-site project across 5 institutions in Florida focused on novel experimental measures that might be more sensitive in detecting preclinical changes associated with early Alzheimer's disease.
Role: CO-I

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Woods, Adam Joshua

eRA COMMONS USER NAME (credential, e.g., agency login): AJWOODS

POSITION TITLE: Assistant Professor, Clinical & Health Psychology, Aging and Geriatric Research

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Alabama at Birmingham	B.S.	05/03	Psychology
George Washington University	Ph.D.	05/10	Cognitive Neuroscience
University of Pennsylvania	Post-Doctoral	06/13	Cognitive Neuroscience

A. Personal Statement

Dr. Adam J. Woods is an Assistant Professor in the Department of Clinical and Health Psychology and the Assistant Director of the Center for Cognitive Aging and Memory in the McKnight Brain Institute at the University of Florida. His active program of research investigates precursors and neuroimaging-based biomarkers of cognitive impairment in older adults. Dr. Woods has a strong background using multi-disciplinary neuroscience methodologies (MRI/fMRI, electrophysiology, non-invasive brain stimulation), extensive experience with aging-related disorders, and past research with neurological diseases. His background, experience, and training in analysis of magnetic resonance neuroimaging and execution of non-invasive brain stimulation clinical trials will be central to his role in the present proposal. Dr. Woods leads two of the largest Phase II and Phase III non-invasive electrical brain stimulation trials – funded by NIA. The ACT study is the first ever phase III trial of this type and the Stimulated Brain study is one of the largest Phase II trials currently underway for non-invasive electrical stimulation. Both of these trials specifically target enhancing cognition in older adults. His experience with non-invasive brain stimulation in older adults as a treatment modality will be a strong foundation for success of this application. In addition, Dr. Woods is also an expert in multimodal neuroimaging (fMRI, sMRI, FLAIR, DWI, MRS). In the context of this work, he has established a multimodal semi-automated neuroimaging pipeline using 1000 cores of the HiperGator super-computer at the University of Florida, specifically dedicated to the Center for Cognitive Aging and Memory. In addition, Dr. Woods pioneered whole head 31P MRS at the University of Florida, not only obtaining funding for this relatively unique imaging modality (~5 whole head 31P MRS coils exist across the country), but also worked closely with Philips to implement optimized 31P sequences at UF for acquisition of phosphorous based cerebral metabolites. In addition, he Dr. Woods has developed state of the art processing pipelines for this unique data and Drs. Bowers and Woods have worked closely together on prior and ongoing projects to implement this modality in older adults undergoing NIRS intervention. Thus, Dr. Woods' knowledge and expertise in neuroimaging and non-invasive brain stimulation will serve to facilitate the success of the project.

a. Bikson, M., Grossman, P., Thomas, C., Jiang, J., Adnan, T., Mourdoukoutas, P., Kronberg, G., Troung, D., Boggio, P., Brunoni, A., Charvet, L., Fregni, F., Fritsch, B., Gillick, B., Hamilton, R., Hampstead, B., Jankford, R., Kirton, A., Knotkova, H., Liebetanz, D., Liu, A., Loo, C., Nitsche, M., Richardson, J., Rotenberg, A., Turkeltaub, P., & Woods, A.J. Safety of transcranial Direct Current Stimulation (tDCS): evidence based update 2016. *Brain Stimulation. 9(5):* 641-661. PMCID: PMC5007190
b. Woods, A.J., Antal, A., Bikson, M., Boggio, P.S., Brunoni, A.R., Celnik, P. Cohen, L.G., Fregni, F., Herrmann, C.S., Kappenman, E., Knotkova, H., Liebetanz, D., Miniussi, C., Miranda, P.C., Paulus, W.,

Priori, A., Reato, D., Stagg, C., Wenderoth, N., Nitsche, M.A. (2016). A technical guide to tDCS, and related non-invasive brain stimulation tools. *Clinical Neurophysiology. 127(2):* 1031-1048. PMCID: PMC4747791

c. Porges, E.C., Woods, A.J., Edden, R., Harris, A., Chen, H., Garcia, A., Lamb, D., Williamson, J.W., Cohen, RA. (2017). Frontal GABA concentrations are associated with cognitive performance in older adults. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging. 2(1):* 38-44. PMCID: PMC5312683

d. Woods, A.J., Hamilton, R.H., Kranjec, A., Bikson, M., Minhaus, P., Yu, J., Chatterjee, A. (2014). Space, time, and causality in the human brain. *NeuroImage, 92, 285-297.* PMCID: PMC4008651

B. Positions and Honors

Positions and Employment

2010-2013	Post-Doctoral Fellow, Department of Neurology, University of Pennsylvania, Philadelphia, PA
2013-2016	Assistant Professor, Department of Aging and Geriatric Research, University of Florida, Gainesville, FL
2013-2014	Cognitive Aging and Memory Clinical Translational Research Program Scholar, University of Florida, Gainesville, FL
2013-2014	Pepper Scholar, Institute on Aging, University of Florida, Gainesville, FL
2014-	Assistant Director, Center for Cognitive Aging and Memory, Institute on Aging, University of Florida, Gainesville, FL
2016-	Assistant Professor, Department of Clinical and Health Psychology, University of Florida, Gainesville, FL

Academic and Professional Honors

2006-2009	National Science Foundation (NSF) Graduate Research Fellowship
2008	Research Enhancement Fund grant award for advanced dissertation research, GWU
2009-2010	Graduate Research Fellowship, GWU
2009-2010	Thelma Hunt Research Fellowship in Psychology, GWU
2010-2013	Post-Doctoral Fellowship, Intellectual and Developmental Disabilities Research Center, Children's Hospital of Philadelphia
2013-2015	Pepper Center/CAM-CTRP Scholar, Cognitive Aging and Memory Clinical Translational Research Program, University of Florida, Gainesville, FL
2014	Appointed Assistant Director of the Center for Cognitive Aging and Memory
2014	KL2 Scholar, Clinical Translational Science Institute
2014	Junior Fellow of the World Academy of Arts and Sciences
2015	Young Investigator Award in Neuromodulation, NYC Neuromodulation 2015, New York, NY, USA

C. Contribution to Science

Non-invasive Brain Stimulation. Over the past eight years, I have focused my research on the technical and basic science application of non-invasive electrical brain stimulation techniques as novel interventions for enhancement of cognitive function. This work includes both transcranial direct current stimulation, transcranial magnetic stimulation, and near infrared stimulation. To further the field, I co-founding a CME certified practical training course in transcranial electrical stimulation (tES) that has trained over 700 researchers and students to safely and consistently apply this method of non-invasive brain stimulation. I have published numerous papers aimed at enhancing replicability and safety for the method, in addition to exploring its impact on a variety of cognitive functions in the brain. In addition, I was awarded the 2015 NYC Neuromodulation Young Investigator Award for my technical and educational contributions to the field. Furthermore, I recently led a 20-author field consensus paper on technical and methodological standards in the field of tES, in addition to senior authorship on a 27 author field standards safety paper currently.

a. Minhas, P., Bikson, M., Woods, A.J., Rosen, A., Kessler, S. (2012). Transcranial direct current stimulation in the pediatric versus adult brain: A computational modeling study. *IEEE Xplore: EMBC, 63:* 859-862. PMCID: PMC3641645

b. Kessler, S., Minhas, P., Woods, A.J., Rosen, A., Bikson, M. (2013). Dose considerations for transcranial direct current stimulation in children: a computational modeling study. *PLoS ONE, 8(9): e76112.* PMCID: PMC3785412
c. Woods, A.J., Bryant, V., Sacchetti, D., Gervits, F., Hamilton, R. (2015). Effects of electrode drift on transcranial direct current stimulation. *Brain Stimulation. 8(3): 515-519.* PMCID: PMC4461479
d. Szynkowicz, S.M., McLaren, M.E., Suryadevara, U., Woods, A.J. (2016). Transcranial direct current stimulation use in the treatment of neuropsychiatric disorders: A brief review. *Psychiatric Annals, 46(11): 642-646.* PMCID: PMC5117191

Neuroimgaing. My work in neuroimaging has focused on understanding what brain networks underlie cognitive processes and how these processes are altered by age and medical disorders exacerbating aging of the human brain. This work has primarily used structural and functional magnetic resonance imaging and diffusion weighted imaging, but now includes magnetic resonance spectroscopy. Through multimodal neuroimaging, this work aims to identify markers predictive of cognitive decline in older adults, as well as markers of intervention effectiveness. This work has been central to identification of neural intervention targets for tES.

a. Dotson, V.M., Szymkowicz , S.M., Sozda, C.N., Kirton, J.W., Green, M.L., O'Shea, A., McLaren, M.E., Anton, S.D., Manini, T.M & Woods, A.J. (2015). Age differences in prefrontal thickness and volumes in middle aged to older adults. *Frontiers in Aging Neuroscience. 7:* 250. PMCID: PMC4717301
b. Seider, T., Gongvatana, A., Woods, A.J., Porges, E., Chen, H., Cummings, T., Kahler, C.W., Monti, P.M., Cohen, R.A. (2016). Age exacerbates HIV associated white matter abnormalities. *Journal of Neurovirology. 22(2): 201-212.* PMCID: PMC4783252
c. Szynkowicz, S.M., McLaren, M.E., Kirton, J.W., O'Shea, A., Woods, A.J., et al. (2016). Depressive Symptom Severity Is Associated with Increased Cortical Thickness in Older Adults. *International Journal of Geriatric Psychiatry. 31(4): 325-333.* PMCID: PMC4724336
d. O'Shea, A., Cohen, RA, Porges, E.C., Nissim, N., Woods, A.J. (2016). Cognitive aging and the hippocampus in older adults. *Frontiers in Aging Neuroscience, 8: 298.* PMCID: PMC5143675

Working Memory/Executive Function. One area of my work investigates the impact of aging and stroke on working memory and executive function. My recent work in age-related change in working memory/executive function includes both behavioral and neuroimaging based identification of therapeutic neural targets for tES. This work spans investigation of early development (age 2-18 years) to effects in later life (ages 60+) and following focal lesions to frontal and parietal brain systems.

a. Mark, V.W., Woods, A.J., Ball, K.K., Roth, D.L., Mennemeier, M. (2004). Disorganized search is not a consequence of neglect. *Neurology, 63(1),* 78-84.
b. Woods, A.J., Mark, V.W. (2007). Convergent validity of executive organization measures on cancellation. *Journal of Clinical and Experimental Neuropsychology, 29(7),* 719-723. PMCID: PMC3275913
c. Woods, A.J., Goksun, T., Chatterjee, A., Zelonis, S., Mehet, A., Smith, S. (2013). The development of organized visual search. *Acta Psychologica. 143(2),* 191-199. doi: 10.1016/j.actpsy.2013.03.008 PMCID: PMC3651801
d. Nissim, N., O'Shea, A., Bryant, V., Porges, E., Cohen, R., Woods, A.J. (2017). Frontal structural neural correlates of working memory performance in older adults. *Frontiers in Aging Neuroscience, 8: 328.* PMCID: PMC5210770

Attention. Over the past ten years, I have studied attentional processes in the brain using a variety of tES and attention research methods in spatial neglect following stroke and health cognitive populations to understand the relative contributions of frontal and parietal systems in attention.

a. Mennemeier, M., Pierce, C., Dowler, R., Chatterjee, A., Anderson, B., Jewell, G., Woods, A.J., Mark, V.W. (2005). Biases in attentional orientation and magnitude estimation explain crossover: neglect is a disorder of both. *Journal of Cognitive Neuroscience, 17,* 1194-1211.
b. Woods, A.J., Mennemeier, M., Garcia-Rill, E., Meythaler, J., Mark, V.W., Jewell, G.R., Murphy, H. (2006). Bias in magnitude estimation following left hemisphere injury. *Neuropsychologia, 44,* 1406-12.

c. Woods, A.J., Lehet, M., Chatterjee, A. (2012). Context modulates the contribution of time and space in causal inference. *Frontiers in Psychology, 3, 371*. doi: 10.3389/fpsyg.2012.00371 PMCID: PMC3498891
d. Woods, A. J., Mennemeier, M., Garcia-Rill, E., Huitt, T., Chelette, K. C., McCullough, G., Munn, T., Brown, G., Kiser, T. S. (2012). Improvement in arousal, visual neglect, and perception of stimulus intensity following cold pressor stimulation. *Neurocase, 18,* 115-122. PMCID: PMC3266979

Cognitive Aging Interventions. Much of my current and past work focuses on successful cognitive aging interventions, in a variety of populations. This work has evaluated not only the cognitive and functional consequences of aging and various disorders, but also improvement in these processes following intervention. This line of my research attempts to identify novel markers (e.g., neuroimaging, etc.) and methods for prevention (e.g,. tES, anti-inflammatory intervention) of age and disease related cognitive.

a. Mark, V.W., Woods, A.J., Mennemeier, M., Abbas, S., Taub, E. (2006). Cognitive assessment for CI therapy in the outpatient clinic. *Neurorehabilitation, 21*, 139-46.
b. Woods, A.J., Mark, V.W., Pitts, A., & Mennemeier, M. (2011). Pervasive cognitive impairment in acute rehabilitation patients "without" brain injury. *PM&R, 3(5),* 426-432. PMCID: PMC3275913
c. Woods, A.J., Cohen, R.A., Pahor, M. (2013). Cognitive frailty: frontiers and challenges. *Journal of Nutrition, Health, and Aging. 17, 741-743.* PMCID: PMC4471842
d. Anton, S., Woods, A.J., Ashizawa, T., Barb, D., Buford, T., et al., Successful aging: Advancing the science of physical independence in older adults. *Aging Research Reviews. 24, 304-27.* PMCID: PMC4661112

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/adam.woods.1/bibliography/45511051/public/?sort=date&direction=descending

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support
NIA R01AG054077 (Woods/Cohen/Marsiske; MPIs) 09/01/16-08/31/21
National Institutes of Health
Augmenting Cognitive Training in Older Adults (ACT)
This study is a Phase III definitive multi-site randomized clinical trial with an adaptive design that will establish the benefit of delivering adjunctive transcranial direct current stimulation (tDCS) with cognitive training in older adults to combat cognitive aging. This trial measures both trial success and intervention mechanisms using multimodal neuroimaging and magnetic resonance spectroscopy, as well as comprehensive neurocognitive and functional assessment.
Role: PI

NIA K01AG050707-A1 (Woods; PI) 09/30/16-05/31/21
NIH
Neuromodulation of Cognition in Older Adults
The goal of this study will be to investigate the ability of transcranial direct current stimulation to enhance the effectiveness of cognitive training targeting attention, speed of processing, and working memory function in older adults. Training will focus on cognitive aging interventions and advanced magnetic resonance imaging and spectroscopy methods.
Role: PD/PI

NIMH RF1MH114290-01 (Sadlier; PI) 07/19/17-07/18/21
National Institutes of Health
Mechanism and dosimetry exploration in transcranial electrical stimulation using magnetic resonance current mapping methods
The goal of this project is to pioneer an objective measure of current flow in the brain using state of the art magnetic resonance imaging methods combined with in scanner application of tDCS and tACS. This project

will also assess the relationship between activation in working memory related regions from an NBACK fMRI task and correspondence of change following F3-F4 in scanner tDCS.
Role: Co-I (overlap covered by K01)

NIA R21AG053736-01A1 (Clark; PI) 07/01/17-06/31/19
National Institutes of Health
Combining tDCS and neurorehabilitation to treat age-related deficits of mobility and cognition
The goal of this study is to obtain pilot data for a full-scale clinical trial combining transcranial direct current stimulation (tDCS) and complex walking intervention to enhance mobility in older adults.
Role: Co-I (overlap covered by K01)

Industry Sponsored Trial (Woods; PI) 07/01/16-06/31/18
Osato Research Institute
Impact of Fermented Papaya Product on brain energetics, neuroinflammation, and cognition: The Efficient Brain Study
The goal of this study is to perform a pilot clinical trial investigating the influence of Fermented Papaya Product on brain energetics, neuroinflammation, and cognition in older adults with elevated systemic inflammation using multimodal neuroimaging (fMRI, DWI) and spectroscopy (31P, 1H-MRS), as well as assessment of systemic inflammation and cognition. The project specifically focuses on enhancement of working memory function in older adults.
Role: PI

Recently Completed Research Support

CTSI KL2TR001429-01 (Woods; PI) 03/15/14-03/15/16
NIH & Clinical Translational Science Institute KL2 Career Award
Neuromodulation of working memory function in older adults.
The goal of this funding is to provide investigators with further training in clinical translational science. The funded project will involve a randomized clinical trial pairing transcranial direct current stimulation with cognitive training to enhance working memory function in older adults.
Role: PI

Ethel Moore Fund (Bowers, PI) 02/01/16-08/31/16
State of Florida
Pilot Intervention in Mild Cognitive Impairment: A proof of concept study with Transcranial Near Infrared Stimulation
The goal of this study is to obtain pilot data for effectiveness of TNIS in treatment of cognitive impairment in MCI, with acquisition of mechanistic phosphorous magnetic resonance spectroscopy (31P MRS) data investigating change in brain ATP metabolism.
Role: Co-I

2 P30 AG028740-06 (Pahor; PI) 04/15/12-03/31/17
National Institutes of Health
UF Claude D. Pepper Older Americans Independence Center (OAIC) KL2 Award:
A study of cross-cultural differences in analgesic effects of transcranial direct current stimulation (tDCS) in white and Asian older adults with chronic pain: KL2 awardee (Ahn).
Role: Co-Mentor

NIA K99AG048762 (Fazeli; PI) 09/15/14-05/31/16
National Institutes of Health
A novel neurorehabilitation approach for cognitive aging with HIV
The goal of this study is to investigate the efficacy of cognitive training paired with tDCS on remediation of cognitive deficits in HIV positive older adults. Dr. Fazeli will receive training in aging and tDCS research methods.
Role: Co-mentor

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Gene E. Alexander, Ph.D.

eRA COMMONS USER NAME (credential, e.g., agency login): alexander

POSITION TITLE: Professor of Psychology, Psychiatry, Neuroscience, and Physiological Sciences

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date	FIELD OF STUDY
Pomona College, Claremont, CA	B.A.	5/1983	Psychology
Loyola University of Chicago, Chicago, IL	M.A.	5/1987	Clinical Psychology
Loyola University of Chicago, Chicago, IL	Ph.D.	1/1992	Clinical Psychology

A. Personal Statement

Gene E. Alexander, Ph.D. is Professor in the Departments of Psychology and Psychiatry, in the Evelyn F. McKnight Brain Institute, and in the Neuroscience and Physiological Sciences Graduate Programs of the University of Arizona. He is Director of the Brain Imaging, Behavior and Aging Lab, a member of the Scientific Advisory Committee for the Arizona Evelyn F. McKnight Brain Institute, Chair of the Research Committee in the Department of Psychology, and a member of the BIO5 Institute and the MRI Operations Committee at the University of Arizona. Prior to coming to Arizona, Dr. Alexander was Chief of the Neuropsychology Unit in the Laboratory of Neurosciences in the Intramural Research Program at the NIA. Dr. Alexander is a Fellow of the American Psychological Association (Division 40) Society for Clinical Neuropsychology and the Association for Psychological Science. His research has been supported by grants from the National Institutes of Health, McKnight Brain Research Foundation, and the State of Arizona. Dr. Alexander has over 20-years experience as a neuropsychology and neuroimaging researcher on the effects of aging and risk factors for age-related neurodegenerative disease. He uses structural and functional magnetic resonance imaging (MRI) and positron emission tomography (PET) with novel network analyses to investigate the effects of multiple health and lifestyle factors on the cognitive and brain changes associated with healthy and pathological aging, with the goal of developing new interventions for the effects of cognitive aging. Dr. Alexander's experience in the use neuroimaging and neuropsychological assessment in the context of brain aging make him well suited to serve as the University of Arizona site PI for this inter-institutional collaborative project to evaluate the effects of near infrared stimulation as an intervention for cognitive aging.

1. Kern KC, Wright CB, Bergfield KL, Fitzhugh M, Chen K, Moeller JR, Nabizadeh N, Elkind MSV, Sacco RL, Stern Y, DeCarli C, & **Alexander GE**. (2017) Blood pressure control in aging predicts cerebral atrophy related to small-vessel white matter lesions. Frontiers in Aging Neuroscience, 9, 132.
2. Cohen RA & **Alexander GE**. Using the Telephone Interview for Cognitive Status and Telephone Montreal Cognitive Assessment for evaluating vascular cognitive impairment: Promising call or put on hold? Stroke, in press. (Invited editorial)
3. **Alexander GE**. (2017) An emerging role for imaging white matter in the preclinical risk for Alzheimer disease: Linking β-amyloid to myelin. JAMA Neurology, 74(1), 17-19. (Invited editorial)
4. Raichlen DA & **Alexander GE**. (2017) Adaptive Capacity: An evolutionary neuroscience model linking exercise, cognition, and brain health. Trends in Neurosciences, 40(7), 408-421.

B. Positions and Honors

Research and Professional Experience

1988-1989 Clinical Psychology Intern, Dept of Psychiatry & Behav Sci, Univ of Washington, Seattle, WA
1989-1992 Research Fellow, Dept. of Brain Imaging, NYSPI and Columbia University, NY, NY
1991-1993 Research Scientist I, Dept. of Brain Imaging, NYSPI and Columbia University, NY, NY
1993-1999 Staff Fellow to Sr. Staff Fellow, Laboratory of Neurosciences, NIA, NIH, Bethesda, MD
1993-1999 Chief, Neuropsychology Unit, Laboratory of Neurosciences, NIA, NIH, Bethesda, MD
1999-2003 Research Associate Professor, Dept. of Psychology, Arizona State University, Tempe, AZ
2001-2009 Director, Data Management and Statistics Program/Core, Arizona ADC, AZ
2003-2007 Assoc. Professor with Tenure to Professor, Psychology Dept., Arizona State University, Tempe, AZ

2007-Date Professor, Psychology Dept & Evelyn F McKnight Brain Institute, University of Arizona, Tucson, AZ
2007-Date Director, Brain Imaging, Behavior & Aging Lab, Psychology Dept, University of Arizona, Tucson, AZ
2007-Date Professor, Neuroscience Graduate Interdisciplinary Program, University of Arizona, Tucson, AZ
2008-Date Member, Scientific Advisory Board, Evelyn F. McKnight Brain Inst., University of Arizona, Tucson, AZ
2011-Date Professor, Physiological Sciences Graduate Interdisciplinary Program, University of Arizona, AZ
2017-Date Member, BIO5 Institute, University of Arizona, Tucson, AZ
2017-Date Professor, Department of Psychiatry, College of Medicine Tucson, University of Arizona, AZ

Selected Honors and Professional Activities

1995-Date Ad Hoc Reviewer, over 20 journals in Neuropsychology, Psychiatry, Neurology, and Neuroscience.
1996-1999 Staff Recognition Awards (annual), Laboratory of Neurosciences, IRP, NIA, NIH
2000-Date Reviewer, Alzheimer's Association Research Grant Program
2003-2007 Member, Study Section, Clinical Neuroscience and Disease, IRG, CSR, NIH
2003 Member, SEP, Women's Health Initiative Memory Study, Review Branch, NHLBI, NIH
2004 Member, Special Emphasis Panel, Alzheimer's Disease Center Grant Review, NIA, NIH
2004-2009 External Advisor, Aging Brain: Vasculature, Ischemia & Behav. Prog. Proj., UCSF/Davis
2005-2007 Member, Specialist Review Cmte, Psychology: Exp/Clinical, Fulbright Scholar Program
2006 Chair, SEP, Clinical Neuroscience & Disease, ZRG1 BDCN-E, IRG, CSR, NIH
2008 Member, SEP, Prog Proj Review Group, Recovery from Illness, ZAG1 ZIJ-8 O1, NIA, NIH
2008 Member, Study Section, Brain Injury & Neurovasc. Path., ZRB 1 BDCN-L (07), CSR, NIH
2008 Member, SEP, SPRINT Center Review, ZHL1 CCT-B C2 1, NHLBI, NIH
2008-Date Member, Neuroimaging Workgroup, International Conf. on Alzheimer's Disease/ISTAART
2009 Reviewer, SEP, Challenge Grant Panel #10, ZRG1 BDA-A 58 R, CSR, NIH
2009 Member, SEP, P30 Faculty Recruitment in Biomedical Research Core Centers, NIA, NIH
2009 Member, SEP, RC2 Grand Opport. Grants in Genetics, Epigenetics & Genomics, NIA, NIH
2009 Member, SEP, Program Project Review Group, Brain Dopamine, ZAG1 ZIJ-8 J3, NIA, NIH
2009 Member, SEP, Prog. Proj. Rev. Group, Neuroimaging and Aging, ZAG1 ZIJ-5 JF, NIA, NIH
2010 Member, Neurological Sciences & Disorders K Review Committee, NSD-K, NINDS, NIH
2010-2012 Member, Neuroscience of Aging Review Committee, NIA-N, NIA, NIH
2010 Member, SEP, Prog. Proj. Rev., Exercise, Motor Deficits, & Aging, ZAG1-ZIJ-9, NIA, NIH
2010 Member, SEP, Prog. Proj. Rev., Dopaminergic Dysfunct. Aging, ZAG1 ZiJ-6 J3, NIA, NIH
2011 Chairperson, Member Special Emphasis Panel, ZAG1 ZIJ-7 (J1), NIA, NIH
2011-2014 Advisory Editor, *Neurobiology of Aging*, Elsevier.
2011 Member, VA MHBB Merit Review Subcommittee, Veterans Administration
2011 Member, SEP, Biobehav Res Award Innovat New Scientists (BRAINS), ZMH1ERBL04, NIMH, NIH
2011-Date Reviewer, Alzheimer's Disease Pilot Grant Program, Arizona Alzheimer's Disease Center
2011-Date Fellow, Association for Psychological Science
2012 Member, Neurological Sciences & Disorders K Review Committee, NSD-K, NINDS, NIH
2012-Date Member, Cognitive Workgroup, Evelyn F. McKnight Brain Institute
2012-Date Member, MRI Standardization Workgroup, Evelyn F. McKnight Brain Institute
2012-Date Co-Director, Annual Conference on Successful Aging, University of Arizona
2013 Member, SEP, Neurodegen. & Neurodevelopmental Dis., ZRG1BDCN-Y(02), NIA, NIH
2013 Member, SEP, Psychol. Health, Development & Aging, 10 ZRG1 BBBP-D (02), NIA, NIH
2013 Member, Alzheimer's Disease Research Centers Review, ZAG1ZIJ4J1, NIA, NIH
2013-2019 Member, Neuroscience of Aging Review Committee, NIA-N, NIA, NIH
2014 Member and Chairperson, Biobehav & Behav. Processes Rev. Group, ZRG1BBBPY04, CSR, NIH
2015-Date Guest Assoc. Editor, Neuroimaging Approaches to Cognitive Aging, *Frontiers Aging Neuroscience*
2015-Date Chair, Research Committee, Department of Psychology, University of Arizona
2016 Member, SEP, Alzheimer's Disease Center Review, ZAG1 ZIJ-1 M1, NIA, NIH
2016 Member, SEP, Prevention Trial Review, ZAG1 ZIJ-1 M2, NIA, NIH

C. Contribution to Science

1. Brain Imaging and Cognitive Effects of Age-Related Dementia: My early research interests focused on understanding brain-behavior relationships in the context of Alzheimer's dementia with the use of functional and structural neuroimaging methods combined with measures of cognition and demographic characteristics (e.g., 1.b). My initial work in this area, with Dr. Yaakov Stern (1.a), led to the first functional neuroimaging findings to suggest the potential for a brain-based, cognitive reserve against the effects of Alzheimer's disease. My research then expanded to include measures of cerebral metabolism with PET, further supporting the

concept of cognitive reserve (1.c) and the use of PET as a method to evaluate treatments to delay or diminish declines in cerebral metabolism over time in Alzheimer's dementia (1.d).

a. Stern Y, **Alexander GE**, Prohovnik I, Mayeux R. (1992). Inverse relationship between education and parietotemporal perfusion deficit in Alzheimer's disease. Ann Neurol, 32, 371-5.
b. **Alexander GE**, Prohovnik I, Stern Y, Mayeux R. (1994). WAIS-R subtest profile and cortical perfusion in Alzheimer's disease. Brain and Cognition, 24, 24-43.
c. **Alexander GE**, Furey M, Grady CL, Pietrini P, Brady D, Mentis MJ, Schapiro MB. (1997). Association of premorbid function with cerebral metabolism in Alzheimer disease: Implications for the cognitive reserve hypothesis. Am J Psychiatry, 154, 165-172. (Article featured in journal editorial)
d. **Alexander GE**, Chen K, Pietrini P, Rapoport SI, Reiman EM. (2002). Longitudinal PET evaluation of cerebral metabolic decline in dementia: A potential outcome measure in Alzheimer's disease treatment studies. Am J Psychiatry, 159, 738-745. (Article featured on journal cover & editorial)

2. Brain Imaging and Cognitive Effects of Healthy Aging: In more recent years, my research program has focused on the effort to better understand heterogeneity across the spectrum from successful to pathological aging. This work includes studies of healthy aging across the adult age range using structural and functional brain imaging methods combined with standardized and computerized measures of cognition. Additionally, I have an interest in extending my research in humans to non-human animal models of aging (e.g., 2.c; 3.d) and age-related disease. The following publications provide examples of my work using both univariate and novel multivariate network analysis methods to evaluate patterns of brain structure in older adults (2.a; 2.b), as well as functional brain regions (2.d) and cognitive processes (2.c) impacted by brain aging.

a. **Alexander GE**, Chen K, Merkley TL, Reiman EM, Caselli RJ, Aschenbrenner M, Santerre-Lemmon L, Lewis DJ, Pietrini P, Teipel SJ, Hampel H, Rapoport SI, Moeller JR. (2006) Regional Network of MRI Gray Matter Volume in Healthy Aging. NeuroReport, 17, 951-6.
b. Bergfield KL, Hanson KD, Chen K, Teipel SJ, Hampel H, Rapoport SI; Moeller JR, **Alexander GE**. (2010) Age-related networks of regional covariance in MRI gray matter: Reproducible multivariate patterns in healthy aging. NeuroImage, 49, 1750-9.
c. **Alexander GE**, Ryan L, Bowers D, Foster TC, Bizon JL, Geldmacher DS, Glisky EL. (2012) Characterizing Cognitive Aging in Humans with Links to Animal Models. Frontiers in Aging Neuroscience, 4, 21.
d. Ryan L, Cardoza JA, Barense MD, Kawa KH, Wallentin-Flores J, Arnold WT, **Alexander GE**. (2012) Age-related impairment in a complex object discrimination task that engages perirhinal cortex. Hippocampus, 22, 1978-89.

3. Method Development, Evaluation, and Implementation for Neuroimage Analysis Approaches: My work also includes the development, evaluation, and implementation of novel analysis methods for neuroimaging data. Early in the course of my research, I recognized the importance of applying analysis methods that have the potential to more fully capture the rich regional information obtained within functional and structural brain images. My work in this area has focused on the application of novel multivariate network analysis methods to characterize regional patterns of covariance in brain scans to better understand the effects of brain aging and age-related disease. I have applied this approach to PET cerebral metabolism (e.g., 3.a), functional MRI (3.c) and multimodal approaches that combine across imaging modalities (e.g., 3.b). I have also performed the first application of this approach to structural MRI in both humans and in a non-human primate model of aging (e.g., 2.a; 3.d). The example publications below illustrate my research efforts in this area.

a. **Alexander GE**, Moeller JR. (1994) Application of the Scaled Subprofile Model to functional imaging in neuropsychiatric disorders: A principal component approach to modeling regional patterns of brain function in disease. Human Brain Mapping, 2, 79-94. (Article featured on journal cover)
b. Chen K, Reiman EM, Zhongdan H, Caselli RJ, Bandy D, **Alexander GE**. (2009) Linking functional and structural brain images with multivariate network analyses: A novel application of the partial least square method. Neuroimage, 47, 602-10.
c. Smith JF, Chen K, Johnson SC, Morrone-Strupinsky J, Reiman EM, Nelson A, Moeller JR, **Alexander GE** (2006) Network analysis of single-subject fMRI during finger opposition task. Neuroimage,32,325-32.
d. **Alexander GE,** Chen K, Aschenbrenner M, Merkley TL, Santerre-Lemmon LE, Shamy JL, Skaggs WE, Buonocore MH, Rapp PR, Barnes CA. (2008) Age-related regional network of magnetic resonance imaging gray matter in the rhesus macaque. Journal of Neuroscience, 28, 2710-8.

4. Large Multi-Institutional Collaborative Projects: Additionally, my research has included participation in several large multi-institutional collaborative research projects that have had a significant impact on the field, including supporting efforts to identify imaging methods for the evaluation of treatments, to aid diagnosis, and

to enhance prevention research for Alzheimer's disease and dementia. These projects have included the Alzheimer's Disease Neuroimaging Initiative (ADNI), for which I served as a member of the MRI (e.g., 4.b; 4.d) and PET Cores, as well as other multi-institutional projects on APOE risk (e.g., 4.c) and pathology confirmed dementia (4.a). Examples of some of my collaborative publications are illustrated below.

a. Silverman DHS, Small GW, Chang CY, Lu CS, Kung de Aburto MA, Chen W, Czernin J, Rapoport SI, Pietrini P, **Alexander GE**, Schapiro MB, Jagust WJ, Hoffman JM, Welsh-Bohmer KA, Alavi A, Clark CM, Salmon E, de Leon MJ, Mielke R, Cummings JL, Kowell AP, Gambhir SS, Hoh CK, Phelps ME. (2001) Neuroimaging in evaluation of dementia: Regional brain metabolism and long-term outcome. JAMA, 286, 2120-7. (Article featured in press release)
b. Jack CR Jr, Bernstein MA, Fox NC, Thompson P, **Alexander G**, Harvey D, Borowski B, Britson PJ, L Whitwell J, Ward C, Dale AM, Felmlee JP, Gunter JL, Hill DL, Killiany R, Schuff N, Fox-Bosetti S, Lin C, Studholme C, DeCarli CS, Krueger G, Ward HA, Metzger GJ, Scott KT, Mallozzi R, Blezek D, Levy J, Debbins JP, Fleisher AS, Albert M, Green R, Bartzokis G, Glover G, Mugler J, Weiner MW. (2008) The Alzheimer's Disease Neuroimaging Initiative (ADNI): MRI methods. J Magn Reson Imaging, 27, 685-91.
c. Reiman EM, Chen K, Liu X, Bandy D, Yu M, Lee W, Ayutyanont N, Keppler J, Reeder SA, Langbaum JB, **Alexander GE**, Klunk WE, Mathis CA, Price JC, Aizenstein HJ, DeKosky ST, Caselli RJ. (2009) Fibrillar amyloid-beta burden in cognitively normal people at 3 levels of genetic risk for Alzheimer's disease. Proceedings of the National Academy of Sciences U S A,106, 6820-5.
d. Leow AD, Yanovsky I, Parikshak N, Hua X, Lee S, Toga AW, Jack CR, Bernstein MA, Britson PJ, Gunter JL, Ward CP, Borowski B, Shaw LM, Trojanowski JQ, Fleisher AS, Harvey D, Kornak J, Schuff N, **Alexander GE**, Weiner MW, Thompson PM; for the ADNI study. (2009) Alzheimer's Disease Neuroimaging Initiative: A one-year follow up study using tensor-based morphometry correlating degenerative rates, biomarkers and cognition. Neuroimage, 45, 645-55.

5. Health, Lifestyle, and Genetic Risk Factors for Pathological Aging: A major focus of my current research interests includes integrating health status, lifestyle characteristics, and genetics with brain imaging and cognitive testing to investigate healthy and pathological brain aging. For example, my work was the first demonstrate an interaction between age and hypertension on brain volume in aging (5.a), and has contributed to our understanding of how the APOE ε4 allele impacts cognition and brain structure over the adult lifespan (5.b; 5.c). I have also recently proposed a new hypothesis suggesting that demands for exercise may have interacted with APOE status to influence the evolution of the human lifespan (5.d), which was recently featured on the cover of *Trends in Neurosciences*.

a. Strassburger TL, Lee HC, Daly E, Szczepanik J, Krasuski JS, Mentis MJ, Salerno JA, DeCarli C, Schapiro MB, **Alexander GE**. (1997) Interactive effects of age and hypertension on structural brain volumes. Stroke, 28, 1410-1417. (Article featured in journal editorial & AHA press release)
b. **Alexander GE**, Bergfield KL, Chen K, Reiman EM, Hanson KD, Lin L, Bandy D, Caselli RJ, Moeller JR. (2012) Gray matter network associated with genetic risk for Alzheimer's disease in young to early middle-aged adults. Neurobiology of Aging, 33, 2723-32.
c. Caselli RJ, Reiman EM, Osborne D, Hentz JG, Baxter LC, Hernandez JL, **Alexander GE**. (2004) Longitudinal changes in cognition and behavior in asymptomatic carriers of the APOE ε4 allele. Neurology, 62, 1990-5.
d. Raichlen DA, **Alexander GE**. (2014) Exercise, APOE genotype, and the evolution of the human lifespan. Trends in Neurosciences, 37, 247-55. (Article featured on journal cover)

Publications above selected from over 143; Complete list of published work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/gene.alexander.1/bibliography/41140485/public/?sort=date&direction=ascending **[Google Scholar H-Index = 65]**

D. Research Support

Ongoing Research Support

NIA R01 AG049464-01 Alexander, Barnes, Coleman (MPIs) 8/1/14-3/31/20
Epigenetic, Neuroimaging and Behavioral Effects of Hypertension in the Aging Brain
The goal is to determine epigenetic changes induced by hypertension in brain regions important for cognition.
Role on Project: Dr. Alexander is Contact PI.

McKnight Brain Research Foundation Alexander, Cohen, Levin, Wadley (MPIs) 9/1/15-12/31/18
McKnight Inter-Institutional Cognitive Aging Assessment Core
The goal is to provide standardized clinical and cognitive measures for multi-institutional brain aging research.
Role on Project: Dr. Alexander is a PI.

McKnight Brain Research Foundation Alexander, Cohen, Rundek, Visscher (MPIs) 1/1/15-12/31/18
McKnight Inter-Institutional Neuroimaging Core and Brain Aging Registry
The goal to establish neuroimaging acquisition and a multi-site brain aging registry to study brain aging.
Role on Project: Dr. Alexander is a PI.

NIA R01 AG054077-01 Cohen, Marsiske, Woods (MPIs) 9/1/16-8/31/21
Augmenting Cognitive Training in Older Adults – The ACT Grant
This multi-site RCT will evaluate cognitive training and transcranial direct current stimulation for brain aging.
Role on Project: Dr. Alexander is PI of the UA Field Center and UA subcontract.

State of Arizona/Banner Health Subcontract Alexander (PI), 7/1/11-6/30/18
Risk Factors for Brain Aging and Cognitive Health (Continuing Annual State Appropriation)
The goal is to study cerebrovascular risks for brain aging and cognitive health in humans and animal models.
Role on Project: Dr. Alexander is PI.

NIA R03 AG055020-01 Su (PI) 7/15/17-4/30/19
Ultra-sensitive and label-free detection of Alzheimer's disease biomarkers
This goal is to evaluate a highly sensitive method to identify Alzheimer's biomarkers in fluid samples.
Role on Project: Dr. Alexander is Co-Investigator.

NIA P30 AG019610-17 Reiman (PI) 7/1/16-6/30/21
Arizona Alzheimer's Disease Core Center
This center provides core resources to support Alzheimer's disease research in the Arizona region.
Role on Project: Dr. Alexander is Co-Investigator and member of the Data Management and Statistics Core.

NIH 3 R01 AG031581 Reiman, Caselli (MPIs) 4/1/14-3/31/19
Brain Imaging, APOE & the Preclinical Course of Alzheimer's disease
The goal is to characterize the brain changes in those at risk for Alzheimer's disease with the APOE e4 allele.
Role on Project: Dr. Alexander is Co-Investigator and PI of the UA subcontract.

NIH R01 AG049465-01 Barnes (PI) 8/1/14-3/31/19
Neural System Dynamics and Gene Expression Supporting Successful Cognitive Aging
The goal is to use cognitive, neurobiological and molecular methods to test reserve in a rodent model of aging.
Role on Project: Dr. Alexander is Co-Investigator.

UA15-011 Alexander, Raichlen (MPIs) 2/5/15-12/31/17
Tech Launch Arizona Wheelhouse
Evaluation of the aerobic training system for enhancing cognitive performance in older adults
The goal of this project is to evaluate the benefits of exercise on cognitive function in healthy aging
Role on Project: Dr. Alexander is a PI.

Selected Completed Recent Research Support

NIH 1 R01 AG025526 Alexander (PI) 4/1/07-7/31/14
Neuroanatomical substrates of aging & cognitive decline (w/ NCE)
The goal is to study how health status and genetic risk for AD affect the brain and cognitive changes in aging.
Role on Project: Dr. Alexander is the project PI.

NIMH/NIA 2 R01 MH57899-01A1 Reiman (PI) 7/1/98 – 6/30/13
PET, APOE, & the Preclinical Course of Alzheimer disease
The goal is to characterize the brain changes in individuals at risk for Alzheimer's disease with APOE e4.
Role on Project: Dr. Alexander is Co-Investigator and PI of the UA subcontract.

NIA 1 UO1 AG024904-01 Weiner (PI) 10/1/04-9/30/10
Alzheimer's Disease Neuroimaging Initiative (ADNI)
The goals are to test the ability of MRI and PET to track the brain changes in MCI and Alzheimer's dementia.
Role on Project: Dr. Alexander is Co-Investigator, member of MRI and PET Cores, and PI for UA subcontract.

McKnight Brain Research Foundation

Historical Gifts

Fiscal years 2000 - 2024

Commitments	University of Alabama $5,000,000 (5/15/2004) $1,000,000 (10/19/2005) $6,000,000 (8/3/2009)	University of Arizona $5,000,000 (10/17/2006) $300,000 (7/10/2008) $5,600,000 (5/1/2014)	University of Florida $15,000,000	University of Miami $5,000,000 (7/3/2003) $2,000,000 (date tbd)**	FNIH $5,000,000 (5/6/2008) $5,000,000 (10/2013)	American Brain Foundation $1,650,000 (6/1/2017)	Cognitive Test Battery Working Group	MRI Standardization Working Group	Epigenetic Working Group	Inter-Institutional Bioinformatics Core $300,000 (9/1/2013) $300,000 (9/1/2014)	Inter-Institutional Neuroimaging $339,623 (1/1/2015) $415,159 (9/1/2016) $176,977 (1/1/2017)	Inter-Institutional Cognitive Assessment Core $400,000 (9/1/2015) $400,000 (9/1/2015)	IOM Study $87,713 (7/2012) $700,000 (2/1/2013)	Brain & Cognitive Health Working Group
7/1/99 -6/30/00			$15,000,000											
7/1/00 -06/30/01														
7/1/01 - 06/30/02														
7/1/02 - 6/30/03														
7/1/03 - 6/30/04				$1,500,000										
7/1/04 - 6/30/05	$2,000,000			$875,000										
7/1/05 - 6/30/06	$1,000,000			$875,000										
7/1/06 - 6/30/07	$1,000,000	$1,000,000		$875,000										
7/1/07 - 6/30/08	$1,000,000	$1,000,000		$875,000										
7/1/08-6/30/09	$1,000,000	$1,300,000												
7/1/09-6/30/10	$1,500,000	$1,000,000			$1,000,000									
7/1/10-6/30/11	$1,500,000	$1,000,000			$1,000,000									
7/1/11-6/30/12	$1,000,000				$1,000,000		$22,756.59							
7/1/12-6/30/13	$1,000,000				$1,000,000		$4,273.80	$20,403.05	$18,915.98				$87,713	
7/1/13-6/30/14	$1,000,000				$1,000,000			$1,094.20		$52,000 UA				
7/1/14-6/30/15		$200,000		$1,000,000	$1,000,000					$94,795.73 UF $121,343.35 UA	$45,000 UM		$350,000	
7/1/15-6/30/16		$1,200,000		$500,000	$2,000,000 **					$102,284.26 UA $153,050.17 UF	$33,409.04 UA $95,000 UM	$102,735 UM $5,991.48 UF $11,516.32 UA $7,451.05 UAB	$350,000	
7/1/16-6/30/17		$1,200,000		$500,000	$1,000,000					$250.00 UA	$8,175.01 UA $70,000 UM $2,319.99 UF	$67,678.50 UAB $66,545.99 UA $89,770 UM $1,655.87 UF		$10,454.20
7/1/17-6/30/18		$1,000,000			$1,000,000						$3,817.77 UF $17,868.28 UA	$59,504.57 UAB $33,949.83 UF $18,308.60		
7/1/18-6/30/19		$1,000,000				$165,000								
7/1/19-6/30/20		$1,000,000				$330,000								
7/1/20-6/30/21						$330,000								
7/1/21-6/30/22						$330,000								
7/1/22-6/30/23						$330,000								
7/1/23-6/30/24						$165,000								
Total	$12,000,000	$14,500,000	$15,000,000	$7,000,000	$8,000,000	$1,650,000	$27,030.39	$21,497.25	$18,915.98	$600,000	$931,759	$800,000	$787,713	$10,454.20
Balance	$0	$2,000,000	$0	$0	$1,000,000	$1,650,000	$0	$0	$0	$76,276.49	$650,177.43	$334,892.79	$0	$0.00

Total Gift Commitments*
$58,150,000

Remaining Balance of Commitments*
$4,650,000

Total Special Project Commitments
$3,197,370.42

Remaining Balance of Special Project Commitments
$1,061,346.71

* through February 7, 2018

** payment date has been changed from 7/1 to 5/1 so in the 7/1/2015 - 6/30/2016 FY they will receive two payments: 7/1/2015, 5/1/2016

McKnight Brain Research Foundation

Minimum Distribution Calculation

Fiscal years 2000 - 2017

Market Value Dec 1999 -$69,126,583	*Tax Year*	*Distributable Amount*	*Qualifying Distributions*	*Excess Distributions Carryover*	*Undistributed Income*
$51,867,213	7/1/03 - 6/30/04	$2,352,435	$1,665,404	$5,266,241 (last year we could carryover gift to UF	$0.00
$51,898,266	7/1/04 - 6/30/05	$2,450,345	$3,026,049	$575,704	$0.00
$55,777,369	7/1/05 - 6/30/06	$2,620,008	$2,036,659	$0	$7,645.00
$62,782,831	7/1/06 - 6/30/07	$2,843,725	$3,299,931	$448,561	$0.00
$54,753,484	7/1/07- 6/30/08	$2,817,569	$3,110,508	$292,939	$0.00
$39,447,094	7/1/08-6/30/09	$2,016,762	$2,517,340	$500,578	$0.00
$39,991,364	7/1/09-6/30/10	$1,952,550	$3,789,616	$1,837,066	$0.00
$44,648,921	7/1/10-6/30/11	$2,058,313	$3,983,492	$1,925,179	$0.00
$41,206,393	7/1/11-6/30/12	$1,973,938	$2,615,808	$641,870	$0.00
$43,820,218	7/1/12 -6/30/13	$2,020,034	$2,434,496	$414,462	$0.00
$50,408,385	7/1/13-6/30/14	$2,246,743	$2,298,603	$51,860	$0.00
$50,025,982	7/1/14 - 6/30/15	$2,309,295	$3,190,468	$881,173	$0.00

Market Value Dec 1999 -$69,126,583	Tax Year	Distributable Amount	Qualifying Distributions	Excess Distributions Carryover	Undistributed Income
$43,374,433	7/1/15 - 6/30/16	$2,156,876	$4,896,096	$2,739,220	$0.00
$45,020,486	7/1/16 - 6/30/17	$2,197,291	$3,463,554 (estimate)	$1,266,263 (estimate)	$0.00
$50,255,268	7/1/17 - 6/30/18	$2,419,164	$3,275,053 (estimate)	$855,889 (estimate)	$0.00
			$60,973,416.13	$5,794,405	(estimated total excess carryover)

McKnight Brain Research Foundation

Projected Minimum Investment Return Calculations

(As of 10/16/2017 for fiscal year ending 6/30/2018)

Average Fair Market Value	$49,120,093.14
Less:	
Cash held for charitable purposes (1 1/2 %)	($736,801.40)
Net value of non-charitable use assets	$48,383,291.75
Minimum Investment Return (5%)	$2,419,164.59

Net Minimum Investment Return Calculation:

Minimum investment return	$2,419,164.59
sub total Qualifying Distributions	($3,275,053.79)
	($855,889.20)
Excess distribution carryover (actual for '14, '15,'16, '17 estimate)	$4,938,516.00
(estimate for '18)	$855,889.20
	$5,794,405.20

McKnight Brain Research Foundation

Upcoming Dates/Events
2018

2018

MBRF Board of Trustees Meeting ***Inter-Institutional Meeting*** **University of Alabama at Birmingham** **April 4 - 6, 2018** April 4, 2018 12:00 p.m. - 5:00 p.m. Trustee's Meeting followed by social reception April 5, 2018 8:00 a.m. - 5:00 p.m. Scientific Program April 6, 2018 8:00 a.m. - 12:00 p.m. Scientific Program	***MBRF Board of Trustees Meeting*** **Orlando, FL** **July - August 2018 ???**	***Society for Neuroscience*** ***Poster Session/Reception*** **San Diego, CA** **November 4, 2018** venue to be determined 5:00 p.m. to 7:00 pm.

Proposal
McKnight Brain Research Foundation
Poster Reception
San Diego, California
November 4, 2018

Background

Since 1971, the Society for Neuroscience (SfN) has sponsored an annual convention giving members an opportunity to gather and share their research with others. The meeting has grown and now has an annual attendance of thousands. It consists of poster sessions, symposia, and lectures presenting the latest findings on topics ranging from molecular signaling in the brain to systems neuroscience and neurodegenerative disorders. In the evening hours, the Society sponsors themed social events. These socials provide a casual atmosphere in which researchers interested in a particular topic can network and discuss ideas.

Beginning in 2008, the McKnight Brain Research Foundation decided to join forces with SfN and sponsor a poster reception in conjunction with SfN. The event gives investigators from the McKnight Brain Institutes located at the University of Arizona, the University of Florida, the University of Miami and the University of Alabama at Birmingham (UAB), an opportunity to display their research and share their findings in a casual setting.

2017 Progress Report – Washington, DC

The 10th Annual McKnight Brain Research Foundation Poster Reception was held at the Embassy Suites Convention Center Hotel on Sunday, November 12, from 5:00 – 7:00 p.m. While the 2017 event was not an official function of SfN, it still had the benefit of attracting attendees already planning to attend, while eliminating the administrative fees required by SfN.

There were 200 registered guests, along with 70 registered posters. Abstracts received prior to the deadline were included in a poster competition. Those submitting after the deadline were allowed to present their posters at the reception but were not included in the judging. The University of Florida was awarded all 3 cash prizes with 1st Place going to Sean Martin; 2nd Place to Abigail Hernandez; and 3rd Place to Caesar Hernandez. Honorable mention certificates were awarded to Benjamin Boros from UAB along with the University of Arizona's Alison Comrie and Adele Kapellusch.

Registered posters included representation from the various McKnight Brain Institutes and abstracts for the submissions, can be found at:
http://www.uab.edu/medicine/neurobiology/images/Booklet_2017.pdf

Attendees included scientists, researchers, clinicians, postdoctoral fellows, graduate, and undergraduate students. Prominent scientists from the National Institutes of Aging as well as neuroscientists at different stages of their careers interested in investigating age-related memory loss were also in attendance. Posters were displayed around the outside room perimeter with refreshments centrally located. The event fulfilled its goal of showcasing McKnight research being conducted at all levels and provided a venue where neuroscientists were able to network and discuss ideas centered on normative aging. Establishing new collaborations is always a possibility when researchers gather to discuss their projects.

Proposal

SfN's annual meeting rotates between Washington, DC, San Diego, California, and Chicago, Illinois. The 2018 annual meeting will be held in San Diego, California, on November 3 – 7, 2018. This proposal is to organize a poster reception for the McKnight Brain Research Foundation. Pending budget approval, an event will be planned at one of the local venues. Though the reception will be held in conjunction with SfN, the McKnight Poster Session will not be considered an official SfN event, thus eliminating administrative fees SfN previously required.

Venue

The McKnight Brain Research Foundation poster session will take place at a local venue in San Diego, California. The date of Sunday, November 4, 2018 will be requested, from 5:00 – 7:00 p.m. Posters will be on display and researchers will be available to discuss projects with guests. Tables located throughout the room will facilitate group discussions. Additionally, a selection of beverages and hor d'oeuvres will be available.

Records

Attendees will be required to sign-in and note the institute/organization they represent. Upon signing-in, attendees will receive two tickets for two free drinks. Using the ticket method, will encourage everyone to sign-in and will ultimately provide documentation needed to verify attendance. The tickets will also allow the event planner to monitor expenses associated with beverage purchases, thus ensuring the bar tab does not exceed the budget.

Budget

Venues normally charge rental fees for conference rooms, however, the room rental fee can normally be waived for large events with a (pre-tax and service) minimum food/beverage commission. It will be necessary to rent poster boards from an outside vendor. Food and beverage costs have been broken down into three options. Caterer will be consulted and the best menu will be selected at a cost that is within the budget. As noted above, each attendee will receive 2 tickets for beverages thus providing a system to monitor beverage expenses. Using the approved budget, the catering expenses will be closely monitored to make sure no overages are incurred. The Appendix provides a 3-tiered budget proposal for consideration.

Appendix

	Tier 1	Tier 2	Tier 3
Standing podium and microphone set-up	$ 600	$ 600	$ 600
Rental of Poster Boards 35 Double sided boards Size 4'x6' Price includes delivery, set up and removal	$ 6,000	$ 6,000	$ 6,000
Printing of Scientific Booklets & Signs	$ 600	$ 600	$ 600
Subtotal Miscellaneous Costs	$ 7,200	$ 7,200	$ 7,200
Food Catering	Hot and cold appetizers	Hot and cold appetizers	Hot and cold appetizers
Beverage Catering	Small selection of beer and wine	Large selection of beer and wine	Open bar with wine, beer, and liquor
Subtotal Catering fees including service and tax	$13,000	$15,000	$17,000
Estimated Grand Total	$20,200	$22,200	$24,200

Evelyn F. McKnight Brain Research Foundation

Period Ending December 31, 2017

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Executive Summary

Executive Summary

Asset Allocation

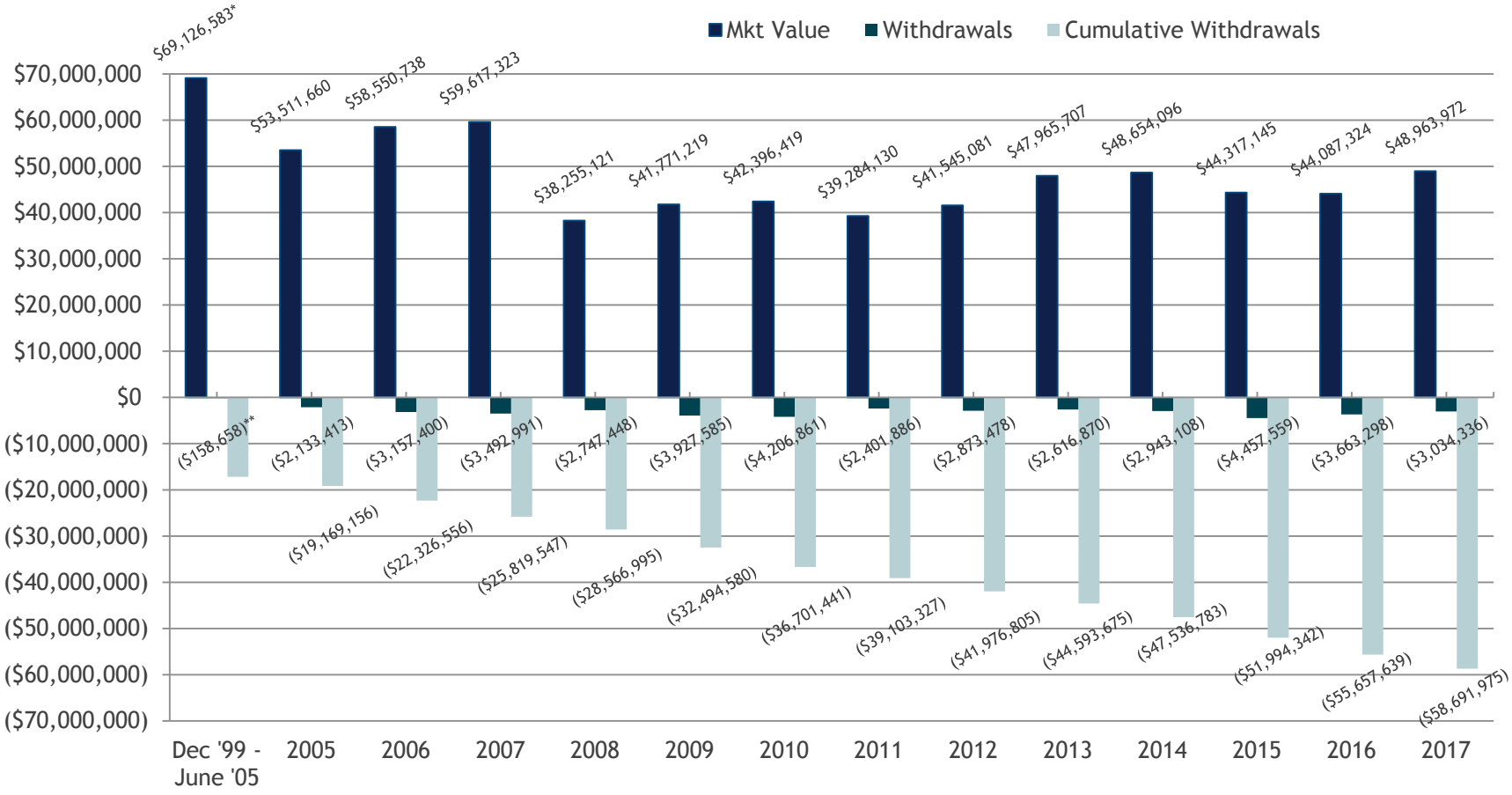
- The Foundation has a 69.5% target to public equity, a 7.5% target to fixed income (including cash) and a 23.0% target allocation to alternative assets (including a 7.5% allocation to private equity).
- As of quarter end, the public equity allocation was 69.3%, the allocation to fixed income (including cash) was 8.2% and the allocation to alternative investments was 22.5%.

Portfolio Performance

- For the quarter period ending December 31, 2017 the total return for the portfolio was 4.56% versus 4.58% for the Investment Policy Statement Index.
- For the year period ending December 31, 2017 the total return for the portfolio was 18.48% versus 17.97% for the Investment Policy Statement Index.

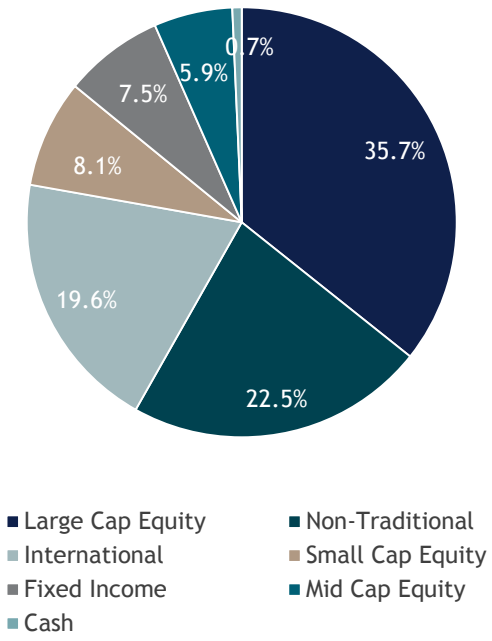
Investment Review

Historical Market Values and Distributions



Source: First Rate Advisor
** As of December 1999*
*** From December 2004 – June 2005*

Portfolio Composition



Period Ending December 31, 2017							
Assets	**Current Market Value**	**Current Allocation**	**Prior Qtr Allocation**	**Δ in Allocation**	**Target Allocation**	**Range**	**Variance from Target**
Total Portfolio	**$48,963,972**	**100.0%**	**100.0%**		**100.0%**		
Total Equities	**$33,943,371**	**69.3%**	**68.6%**	**0.7%**	**69.5%**		**-0.2%**
Large Cap Equities	**$17,496,161**	**35.7%**	**35.0%**	**0.7%**	**34.5%**	**30-60%**	**1.2%**
T. Rowe Price Large Cap Growth	$5,360,372	10.9%	10.7%	0.3%			
iShares Russell 1000 Value	$2,442,659	5.0%	5.0%	0.0%			
DFA US Large Cap Value I	$3,010,267	6.1%	6.0%	0.2%			
Vanguard Institutional Index	$4,443,807	9.1%	8.9%	0.2%			
iShares Russell 1000 Growth	$2,239,055	4.6%	4.4%	0.1%			
Mid Cap Equities	**$2,908,356**	**5.9%**	**5.9%**	**0.1%**	**6.0%**	**5-14%**	**-0.1%**
iShares Russell Mid Cap Growth	$1,474,824	3.0%	3.0%	0.1%			
iShares Russell Mid Cap Value	$1,433,532	2.9%	2.9%	0.0%			
Small Cap Equities	**$3,935,361**	**8.1%**	**8.1%**	**(0.0%)**	**8.0%**	**0-15%**	**0.1%**
iShare Russell 2000 Growth	$1,989,289	4.1%	4.1%	0.0%			
Vulcan Value Partners Small Cap	$1,946,073	4.0%	4.0%	(0.0%)			
International Developed Equities	$5,100,923	10.4%	10.5%	(0.1%)	11.0%		-0.6%
Artisan International Value Advisor	$2,403,284	4.9%	5.0%	(0.1%)			
DFA International Core Equity I	$2,697,639	5.5%	5.5%	0.0%			
International Small Cap	$1,189,886	2.4%	2.5%	(0.1%)	3.0%		-0.6%
Brandes International Small Cap	$455,876	0.9%	1.0%	(0.1%)			
iShares MSCI EAFE Small-Cap	$734,010	1.5%	1.5%	(0.0%)			
International Emerging	$3,312,684	6.8%	6.6%	0.1%	7.0%		-0.2%
DFA Emerging Markets Core	$1,724,198	3.5%	3.4%	0.1%			
Vanguard Emerging Markets	$1,588,486	3.2%	3.2%	0.0%			
Total Fixed Income	**$3,657,017**	**7.5%**	**7.9%**	**(0.4%)**	**7.5%**	**0-20%**	**-0.0%**
iShares iBoxx High Yield Bond	$752,618	1.5%	1.7%	(0.1%)			
Western Asset Core Plus Bond I	$2,904,400	5.9%	6.2%	(0.3%)			
Total Non-Traditional	**$11,039,859**	**22.5%**	**23.3%**	**(0.8%)**	**23.0%**	**10-30%**	**-0.5%**
Hedge	$9,031,538	18.4%	18.9%	(0.5%)	15.5%	10-30%	2.9%
Lighthouse Global Long/Short	$3,414,748	7.0%	7.1%	(0.1%)			
Lighthouse Diversified	$3,353,975	6.8%	7.0%	(0.2%)			
Lighthouse Credit Opportunities	$2,262,815	4.6%	4.8%	(0.2%)			
Private Equity	$2,008,321	4.1%	4.4%	(0.3%)	7.5%	0-10%	-3.4%
Hall Capital	$1,110,719	2.3%	2.4%	(0.2%)			
Spring Harbour 2013	$346,764	0.7%	0.8%	(0.1%)			
HarbourVest 2015	$282,391	0.6%	0.6%	(0.0%)			
HarbourVest 2016	$203,978	0.4%	0.4%	(0.0%)			
HarbourVest 2017	$64,469	0.1%	0.1%	0.0%			
Total Cash	**$323,724**	**0.7%**	**0.2%**	**0.4%**			

Source: First Rate Advisor

Investment Performance

Period Ending December 31, 2017				
Assets	**Quarter**	**1 Year**	**3 Years**	**5 Years**
Total Portfolio	**4.56%**	**18.48%**	**8.74%**	**11.18%**
2017 Efficient Frontier Target[1]	*4.58%*	*17.97%*	*8.06%*	*10.15%*
Spending Policy Benchmark	--	*8.6%*[2]	*8.3%*[3]	*8.2%*[4]
65% Russell 3000 / 35% Barclays Agg	*4.23%*	*14.71%*	*8.08%*	*10.82%*
Total Equities	**5.96%**	**23.80%**	**10.64%**	**13.78%**
Domestic Equities	6.43%	22.89%	11.24%	15.46%
International Equities - Developed	3.76%	26.11%	9.70%	9.09%
International Equities - Emerging	6.81%	32.32%	6.78%	4.78%
International Equities - Small	3.77%	18.27%	--	--
Total Fixed Income	**0.36%**	**6.78%**	**3.09%**	**2.30%**
Total Non-Traditional	**1.90%**	**8.13%**	**5.40%**	**7.40%**
Private Equity (As of 9/30/2017)	4.27%	14.58%	18.31%	17.72%

(1) 2017 Efficient Frontier Target consists of: 34.5% S&P 500 / 6% Russell MidCap / 8% Russell 2000 / 11% MSCI EAFE / 3% MSCI EAFE Small Cap / 7% MSCI Emerging Markets / 7.5% BBgBarc US Aggregate TR / 23% HFRI Fund of Funds Composite Index

(2) Average 1 Year BRDPI Inflation of 2.6% + 5% Distribution + 1% Expenses = 8.6%

(3) Average 3 Year BRDPI Inflation of 2.3% + 5% Distribution + 1% Expenses = 8.3%

(4) Average 5 Year BRDPI Inflation of 2.2% + 5% Distribution + 1% Expenses = 8.2%

Source: First Rate Advisor and Morningstar. Returns greater than one year are annualized

Manager Performance

Period Ending December 31, 2017						
Assets	**Ticker Symbol**	**Allocation**	**Quarter**	**1 Year**	**3 Years**	**5 Years**
Large Cap Equity		35.7%				
T Rowe Price Large Cap Growth	TRLGX	10.9%	7.29%	37.82%	15.99%	19.63%
iShares Russell 1000 Growth	IWF	4.6%	7.81%	29.96%	13.59%	17.11%
Russell 1000 Growth			*7.86%*	*30.21%*	*13.79%*	*17.33%*
Vanguard Institutional Index	VINIX	9.1%	6.63%	21.79%	11.38%	15.76%
S&P 500			*6.64%*	*21.83%*	*11.41%*	*15.79%*
iShares Russell 1000 Value	IWD	5.0%	5.28%	13.47%	8.47%	13.81%
DFA US Large Cap Value I	DFLVX	6.1%	7.47%	18.97%	10.93%	16.09%
Russell 1000 Value			*5.33%*	*13.66%*	*8.65%*	*14.04%*
Mid Cap Equity		5.9%				
iShares Russell Mid-Cap Growth	IWP	3.0%	6.75%	24.98%	10.08%	15.07%
Russell Mid Cap Growth			*6.81%*	*25.27%*	*10.30%*	*15.30%*
iShares Russell Mid-Cap Value	IWS	2.9%	5.45%	13.10%	8.77%	14.42%
Russell Mid Cap Value			*5.50%*	*13.34%*	*9.00%*	*14.68%*
Small Cap Equity		8.1%				
iShares Russell 2000 Growth	IWO	4.1%	4.59%	22.24%	10.42%	15.35%
Russell 2000 Growth			*4.59%*	*22.17%*	*10.28%*	*15.21%*
Vulcan Value Partners Small Cap	VVPSX	4.0%	3.97%	11.46%	7.79%	12.33%
Russell 2000			*3.34%*	*14.65%*	*9.96%*	*14.12%*

Source: Morningstar & First Rate Advisor

Manager Performance

Period Ending December 31, 2017						
Assets	**Ticker Symbol**	**Allocation**	**Quarter**	**1 Year**	**3 Years**	**5 Years**
International Equity		19.6%				
DFA International Core Equity I	DFIEX	5.5%	4.69%	28.05%	10.42%	9.33%
MSCI ACWI ex US			*5.00%*	*27.19%*	*7.83%*	*6.80%*
Artisan International Value Admiral	APDKX	4.9%	2.73%	23.97%	8.83%	10.82%
MSCI EAFE			*4.23%*	*25.03%*	*7.80%*	*7.90%*
Brandes International Small Cap	BISMX	0.9%	1.45%	11.78%	9.13%	10.15%
S&P Developed Ex US Small			*6.25%*	*32.37%*	*13.32%*	*12.12%*
iShares MSCI EAFE Small-Cap	SCZ	1.5%	5.81%	32.51%	14.00%	12.70%
MSCI EAFE Small Cap			*6.05%*	*33.01%*	*14.20%*	*12.85%*
DFA Emerging Markets Core Equity I	DFCEX	3.5%	7.71%	36.55%	9.32%	4.73%
MSCI Emerging Markets			*7.44%*	*37.28%*	*9.10%*	*4.35%*
Vanguard Emerging Markets	VWO	3.2%	6.28%	31.38%	7.52%	3.50%
FTSE Emerging Markets			*6.96%*	*32.08%*	*8.08%*	*4.22%*

Source: Morningstar & First Rate Advisor

Manager Performance

Period Ending December 31, 2017						
Assets	**Ticker Symbol**	**Allocation**	**Quarter**	**1 Year**	**3 Years**	**5 Years**
Fixed Income		7.4%				
Western Asset Core Plus Bond I	WACPX	5.9%	0.60%	7.10%	4.37%	3.91%
Bloomberg Barclays US Aggregate Bond			*0.39%*	*3.54%*	*2.24%*	*2.10%*
iShares iBoxx High Yield Bond	HYG	1.5%	0.03%	6.09%	4.51%	4.28%
iBoxx Liquid High Yield			*0.11%*	*6.34%*	*5.21%*	*4.73%*
Non-Traditional		18.4%				
Lighthouse Global Long/Short LTD		7.0%	2.41%	6.00%	4.17%	7.35%
Standard Deviation			--	*2.88%*	*3.80%*	*4.14%*
Lighthouse Credit Opportunities LTD		4.6%	1.36%	4.32%	-0.57%	1.98%
Standard Deviation			--	*2.68%*	*4.52%*	*4.45%*
Lighthouse Diversified LTD		6.8%	1.60%	4.96%	3.07%	5.61%
Standard Deviation			--	*1.48%*	*2.61%*	*2.88%*
MSCI ACWI			*5.73%*	*23.97%*	*9.30%*	*10.80%*
Standard Deviation			--	*2.84%*	*10.51%*	*9.93%*
Bloomberg Barclays US Aggregate Bond			*0.39%*	*3.54%*	*2.24%*	*2.10%*
Standard Deviation			--	*1.52%*	*2.81%*	*2.85%*

Source: Morningstar & First Rate Advisor

Private Equity Summary

Period Ending September 30, 2017											
Assets	**Commitment**	**Cumulative Takedown**	**Cumulative Distributions**	**Residual Value (RV)**	**Total Value (TV)**	**Unfunded Commitment**	**DPI**	**RVPI**	**TVPI**	**% Funded**	**IRR**
Private Equity	**$3,000,000**	**$1,765,000**	**$476,431**	**$2,209,393**	**$2,685,824**	**$1,235,000**	**26.99%**	**125.18%**	**152.17%**	**58.83%**	**17.11**
Hall Capital 2011	$1,000,000	$900,000	$310,007	$1,247,103	$1,557,110	$100,000	34.45%	138.57%	173.01%	90.00%	16.55
SpringHarbour 2013	$500,000	$370,000	$132,309	$406,592	$538,901	$130,000	35.76%	109.89%	145.65%	74.00%	16.44
HarbourVest 2015	$500,000	$260,000	$25,764	$287,251	$313,015	$240,000	9.91%	110.48%	120.39%	52.00%	21.15
HarbourVest 2016	$500,000	$175,000	$8,351	$203,978	$212,329	$325,000	4.77%	116.56%	121.33%	35.00%	48.40
HarbourVest 2017	$500,000	$60,000	$0	$64,469	$64,469	$440,000	0.00%	107.45%	107.45%	12.00%	--

Period Ending December 31, 2017											
Assets	**Commitment**	**Cumulative Takedown**	**Cumulative Distributions**	**Residual Value (RV)**	**Total Value (TV)**	**Unfunded Commitment**	**DPI**	**RVPI**	**TVPI**	**% Funded**	**IRR**
Private Equity	**$3,000,000**	**$1,777,500**	**$621,649**	**--**	**--**	**$1,222,500**	**34.97%**	**--**	**--**	**59.25%**	**--**
Hall Capital 2011	$1,000,000	$900,000	$395,007	--	--	$100,000	43.89%	--	--	90.00%	--
SpringHarbour 2013	$500,000	$370,000	$175,167	--	--	$130,000	47.34%	--	--	74.00%	--
HarbourVest 2015	$500,000	$262,500	$33,124	--	--	$237,500	12.62%	--	--	52.50%	--
HarbourVest 2016	$500,000	$185,000	$18,351	--	--	$315,000	9.92%	--	--	37.00%	--
HarbourVest 2017	$500,000	$60,000	$0	--	--	$440,000	0.00%	--	--	12.00%	--

Total Value = Residual Value + Distributions
Distributed to Paid in (DPI) = Distributions / Takedowns
Residual Value to Paid in (RVPI) = Residual Value / Takedowns
Total Value to Paid in (TVPI) = Total Value / Takedowns
% Funded = Takedowns / Commitment

Active Manager Peer Group Comparison

Period Ending December 31, 2017						
Assets	**Ticker**	**Morningstar Category**	**Benchmark**	**1 Year**	**3 Year**	**5 Year**
Large Cap Growth						
T. Rowe Price Large Cap Growth	TRLGX	Large Cap Growth	*Russell 1000 Growth – Total Return*	4	1	2
Russell 1000 Growth – Total Return		Large Cap Growth		35	13	16
Large Cap Value						
DFA US Large Cap Value	DFLVX	Large Cap Value	*Russell 1000 Value – Total Return*	18	6	2
Russell 1000 Value – Total Return		Large Cap Value		77	48	30
Small Cap Blend						
Vulcan Value Partners Small Cap	VVPSX	Small Cap Blend	*Russell 2000 - Total Return*	61	72	68
Russell 2000 - Total Return		Small Cap Blend		24	32	33
Large Cap International						
Artisan International Value	APDKX	International Large Cap Core	*MSCI ACWI Ex USA*	75	20	3
DFA International Core Equity	DFIEX	International Large Cap Core	*MSCI ACWI Ex USA*	20	6	10
MSCI ACWI Ex USA		International Large Cap Core		28	44	64
Small / Mid Cap International Value						
Brandes International Small Cap	BISMX	Small / Mid Cap International	*S&P Developed Ex US Small Cap*	93	72	39
S&P Developed Ex US Small Cap		Small / Mid Cap International		41	11	22
Emerging Markets						
DFA Emerging Markets Core Equity	DFCEX	Emerging Markets	*MSCI Emerging Markets – Gross Return*	48	37	43
MSCI Emerging Markets – Gross Return		Emerging Markets		44	41	50
Intermediate-Term Bond						
Western Asset Core Plus Bond	WACPX	Intermediate-Term Bond	*Barclays Capital US Aggregate*	1	2	2
Barclays US Aggregate		Intermediate-Term Bond		57	48	47

Attribution Analysis

Period Ending December 31, 2017										
		Weights (%)		Asset Quarterly Returns						
Assets	Benchmark	Target	Active[1]	Index	Style Index[3]	Portfolio	Weight vs. Target	Allocation	Style Allocation	Selection
Large Cap Equities	***S&P 500 Index***	34.5	35.4	6.6	6.8	6.9	0.86	0.02	0.04	0.10
T. Rowe Price Large Cap Growth	*Russell 1000 Growth Index*		10.8	7.9		7.3			0.13	-0.06
iShares Russell 1000 Growth	*Russell 1000 Growth Index*		4.5	7.9		7.8			0.06	0.00
Vanguard Institutional Index	*S&P 500 Index*		9.0	6.6		6.6			0.00	0.00
DFA Large Cap Value	*Russell 1000 Value Index*		6.1	5.3		7.5			-0.08	0.13
iShares Russell 1000 Value	*Russell 1000 Value Index*		5.0	5.3		5.3			-0.07	0.00
Mid Cap Equities	***Russell MidCap Index***	6.0	5.9	6.1	6.2	6.1	(0.09)	0.00	0.01	0.00
iShares Russell Mid Cap Growth	*Russell MidCap Growth Index*		3.0	6.8		6.8			0.02	0.00
iShares Russell Mid Cap Value	*Russell Midcap Value Index*		2.9	5.5		5.5			-0.02	0.00
Small Cap Equities	***Russell 2000 Index***	8.0	8.1	3.3	4.0	4.3	0.07	0.00	0.05	0.08
iShares Russell 2000 Growth	*Russell 2000 Growth Index*		4.1	4.6		4.6			0.05	0.00
Vulcan Value Partners Small Cap	*Russell 2000 Index*		4.0	3.3		4.0			0.00	0.03
International Equities	***International Blend***[6]	21.0	19.6	5.6	5.7	4.9	(1.38)	-0.01	0.03	-0.13
Artisan International Value	*MSCI EAFE*		5.0	4.2		2.7			-0.07	-0.07
DFA International Core Equity	*MSCI ACWI Ex US*		5.5	5.0		4.7			-0.03	-0.02
Brandes International Small Cap	*S&P Developed Ex US Sm*		1.0	6.3		1.5			0.01	-0.05
iShares MSCI EAFE Small Cap	*MSCI EAFE Small Cap*		1.5	6.1		5.8			0.01	0.00
DFA Emerging Markets Core	*MSCI Emerging Mkts Index*		3.5	7.4		7.7			0.07	0.01
Vanguard Emerging Markets	*FTSE Emerging Markets*		3.2	7.0		6.3			0.05	-0.02
Hedge Funds	***HFRI FoF Composite***	23.0	22.9	2.0	2.1	1.5	(0.07)	0.00	0.01	-0.12
Lighthouse Global Long/Short	*HFRX Equity Hedge*		7.1	2.7		2.4			0.05	-0.02
Lighthouse Credit Opportunities	*HFRI Distressed Restructuring Index*		6.9	2.9		1.4			0.06	-0.10
Lighthouse Diversified	*HFRI FoF Diversified*		4.7	1.8		1.6			-0.01	-0.01
Hall Capital			2.4							
Spring Harbour			0.8							
HarbourVest 2015			0.6							
HarbourVest 2016			0.4							
HarbourVest 2017			0.1							
Fixed Income (including cash)	***Barclays Aggregate***	7.5	8.1	0.4	0.3	0.5	0.62	-0.03	-0.01	0.01
iShares iBoxx High Yield Corporate Bond	*iBoxx Liquid High Yield*		1.6	0.1		0.0			0.00	0.00
Western Asset Core Plus Bd	*Barclays Aggregate*		6.1	0.4		0.6			0.00	0.01
Cash Equivalent	*91 Day T-Bill*		0.5	0.3		0.2			0.00	0.00
Period End Static Return[4]		100.0	100.0	4.6		4.5 [2]		**-0.02**	**0.13**	**-0.06**
						0.1				
Total Return[5]				4.6		4.6				

Notes:
(1) Portfolio active weights are an average of beginning and ending quarter percentages
(2) Portfolio return is estimated using a weighted average and does not take into account the timing of cash flows; therefore, it may not exactly match the actual return.
(3) The Style Index is the portfolio's fund weight x benchmark style index within each asset class
(4) Index and Portfolio Period End Return is calculated based on an average of beginning and ending quarter weightings and does not take into account flows
(5) Index Total Return is Target Policy Return; Portfolio Return is GIPS compliant return for the period
(6) International Policy Index = 52% MSCI EAFE, 33% MSCI Emerging Markets, 15% MSCI EAFE Small Cap

Economic Overview

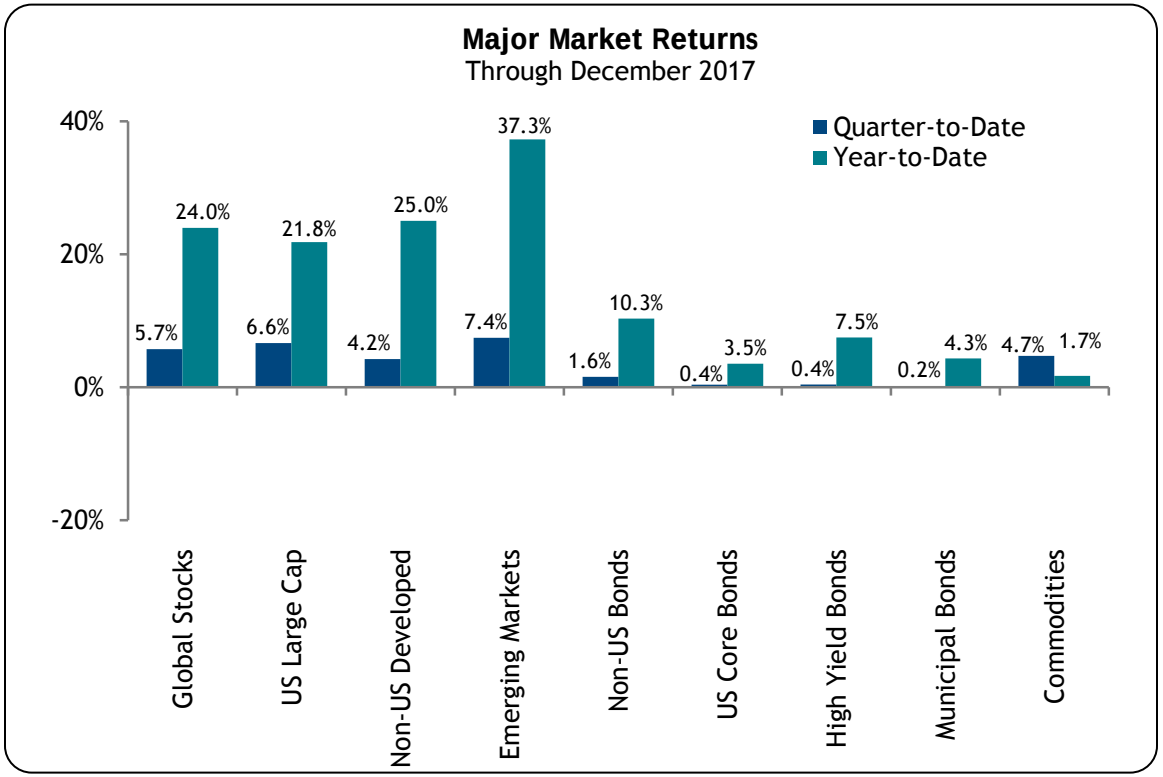
Market Overview

Stock and bond markets finish a strong year

Global stocks capped their best year since 2009 with emerging markets capturing the top spot for 2017 while US stocks had their best quarterly showing in eight quarters.

The majority of bond indices rose for December with US core bonds achieving gains for the fourth quarter and climbing for a fourth consecutive year. Corporate bonds, including high yield, and longer-dated bond sectors were among the stars of 2017, as well as non-US, unhedged bonds .

Commodities posted small gains for December, the quarter and the year.



Returns represented by the following indices: MSCI ACWI Index, S&P 500 Index, MSCI EAFE Index, MSCI Emerging Markets Index, Citi WGBI NonUSD USD, Bloomberg Barclays Aggregate Bond Index, ICE BofAML US High Yield Master II Index, Bloomberg Barclays Municipal Bond 1-15 Index, Bloomberg Commodity Index.

Data source: Morningstar

Key Investment Themes

What we are focused on in early 2018

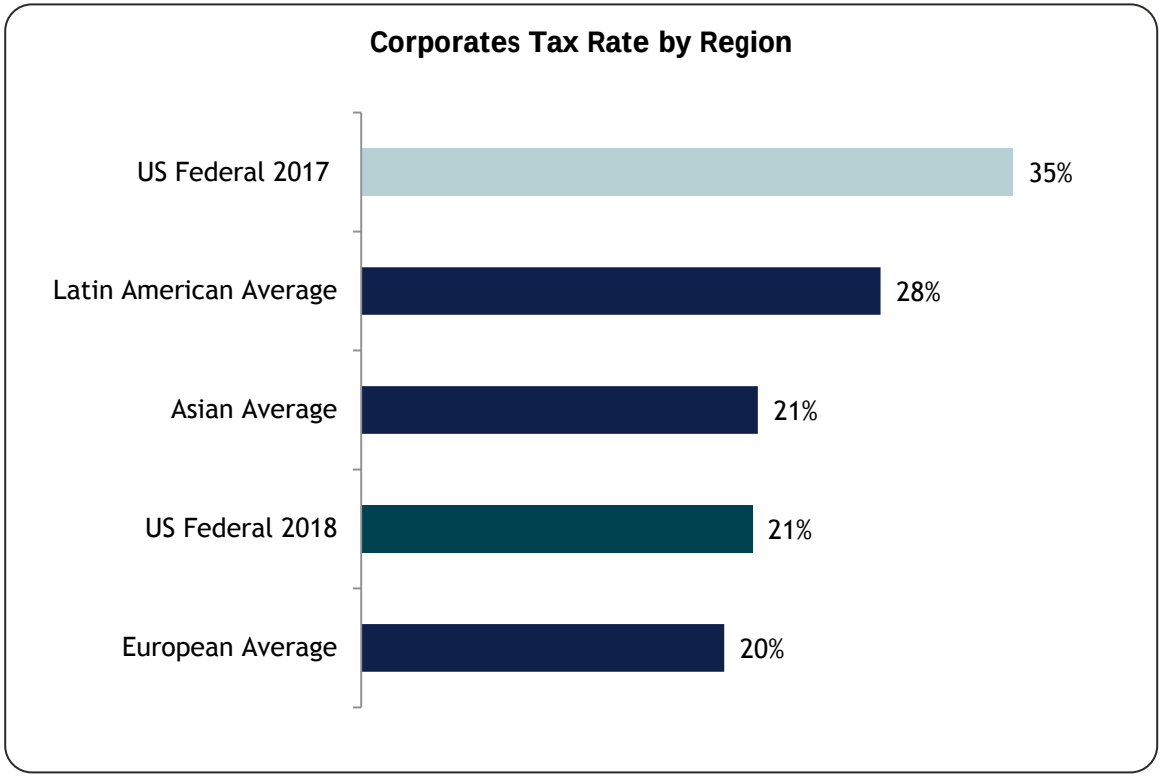
- The developed bloc economies—such as the US, Japan, and the Eurozone, have considerable economic momentum heading into the new year.
- In the US, we expect fiscal stimulus to allow the uptick in growth seen over recent quarters to carry into 2018, and translate into higher corporate profits to support equities.
- US Treasury yields are biased to the upside; we anticipate that the Fed will raise the Fed Funds target two or three times in 2018. Globally, monetary policies remain accommodative, which should keep interest rates in check.
- Relative interest rates and inflation will be key to determining the direction of the US dollar; our current outlook is for relative stability, with the bias toward a stronger rather than a weaker dollar.
- Prices for key commodities such as oil and industrial metals are rising, but interest rates and supply and demand dynamics still constrain the investment opportunity from real assets.
- The shift toward Passive Investments has dampened the Price Discovery mechanism and may have created longer term opportunities for Active and Alternative fund managers to exploit.

New Corporate Tax Reform Makes U.S. More Competitive

A key part of the tax reform package was a radical shift in corporate taxes, aligning the US with the rest of the world.

Lowering the corporate tax rate and moving to a territorial tax system should have a lasting impact on the US economy.

These changes remove barriers for US companies to bring home foreign profits, which should increase capital investments, and encourage firms to shift production back to the US.

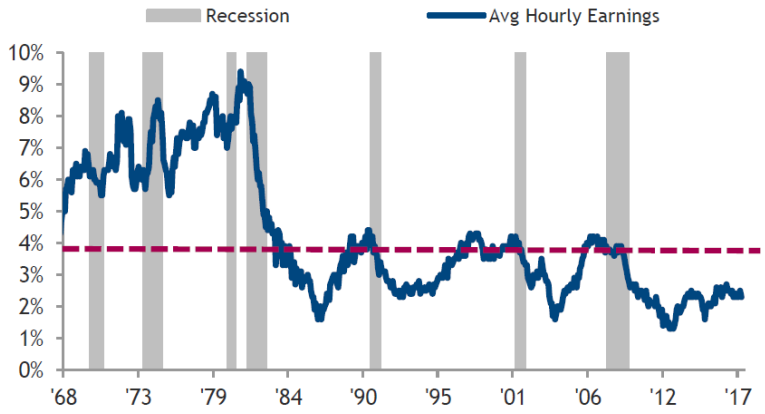


Data Source: KPMG, SunTrust IAG. Regional averages list 2017 corporate tax rates.

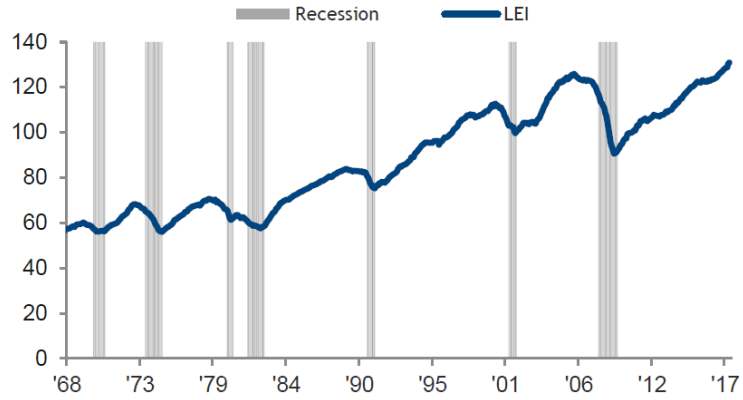
Recession Risks Remain Low

The conditions that have preceded recessions are currently largely absent.
For example, preceding past economic downturns…

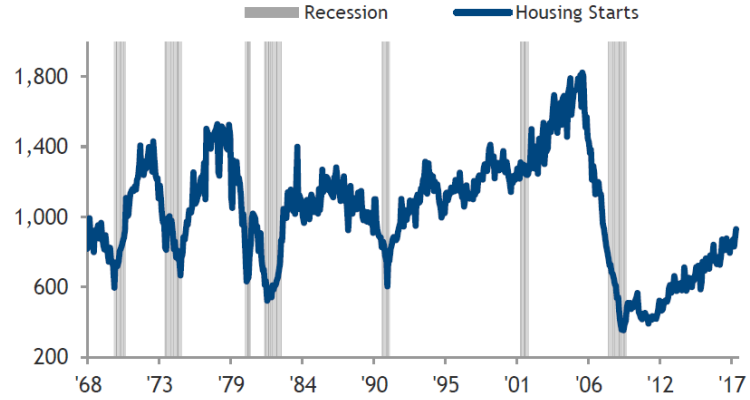
…average hourly earnings have exceeded 3.8%



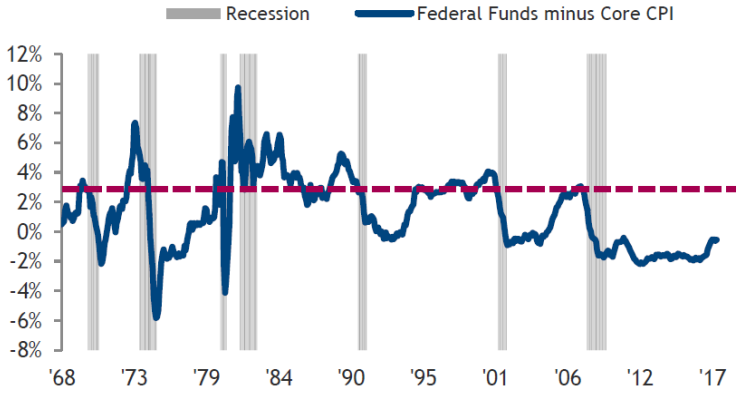
…the Conference Board's Leading Economic Index (LEI)* has peaked on average 14 months prior to recession



…housing starts have peaked on average 16 months prior to recession



…real interest rates have tended to exceed 3%

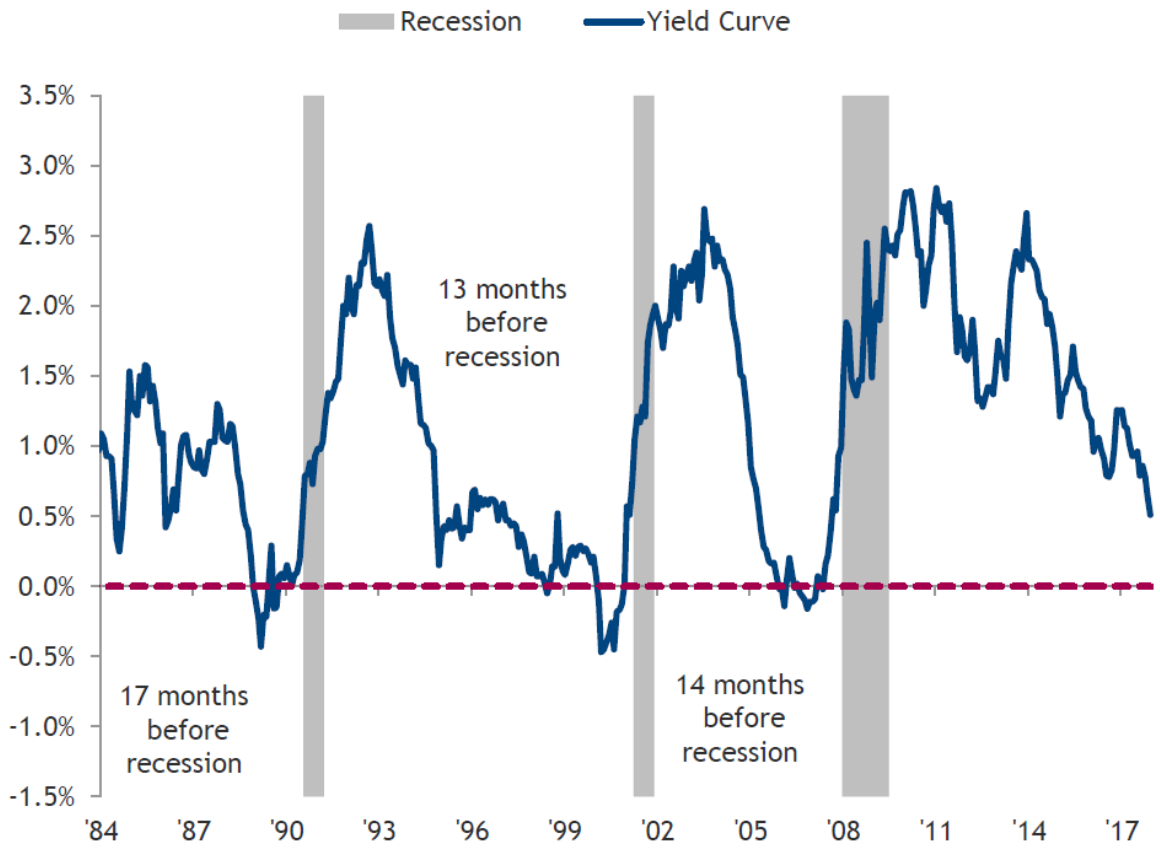


*The LEI is comprised of 10 important indicators, including unemployment claims, the interest rate spread, a gauge of credit, manufacturing activity, and the stock market.
Data Sources: US Department of Labor, US Census Bureau, Bloomberg, St. Louis Fed, FactSet

Yield Curve Tends to Invert Well Before Recessions

Although we expect the yield curve to continue to flatten slightly, fears that the current level foreshadows a recession appear overdone.

Following the last three yield curve inversions, it took an average of 15 months before the US tipped into recession.

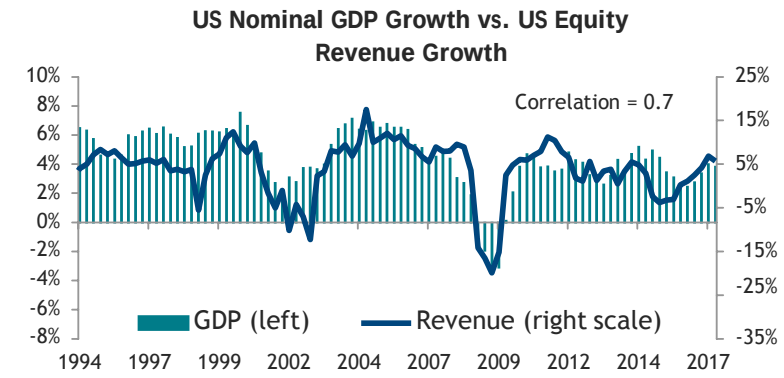


Data Source: Haver, SunTrust IAG

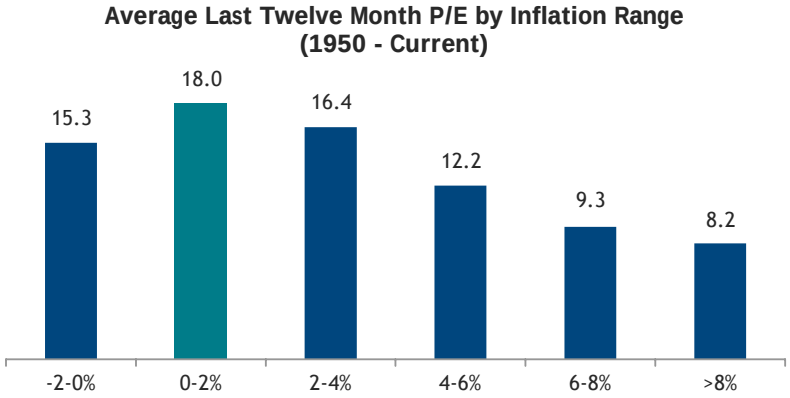
Past performance is not a guarantee of future results. Please see Disclosure slides for important information.

Key Components of Our Outlook for US Equity Returns

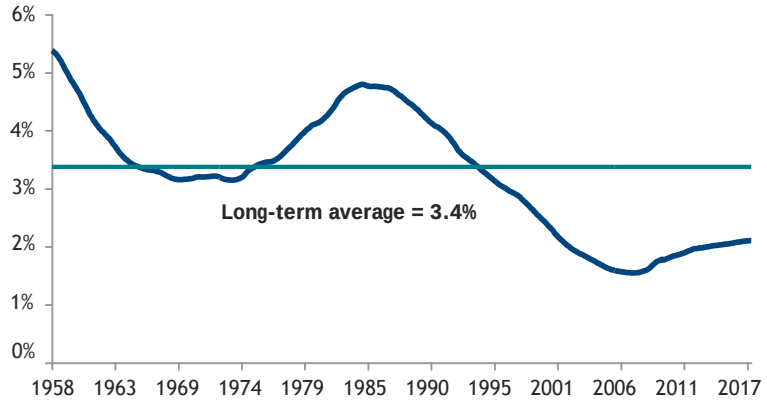
Lower economic trends should lead to slower revenue and earnings growth relative to history



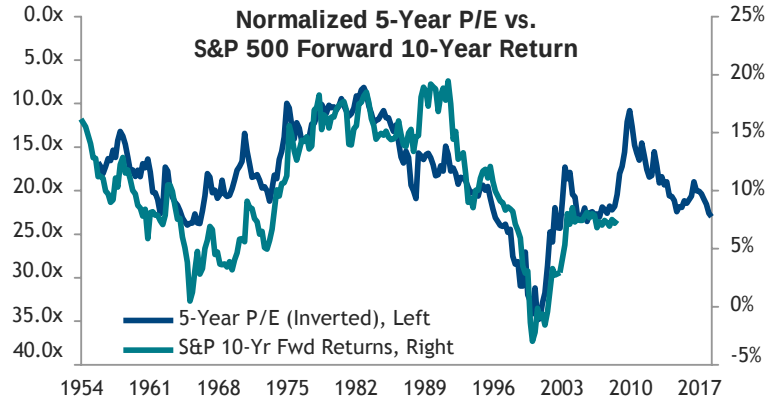
Lower inflation supports a premium price-to-earnings ratio for stocks



Dividends are expected to remain near current levels



Long-term market valuations suggest equity returns in the 6 – 7% range

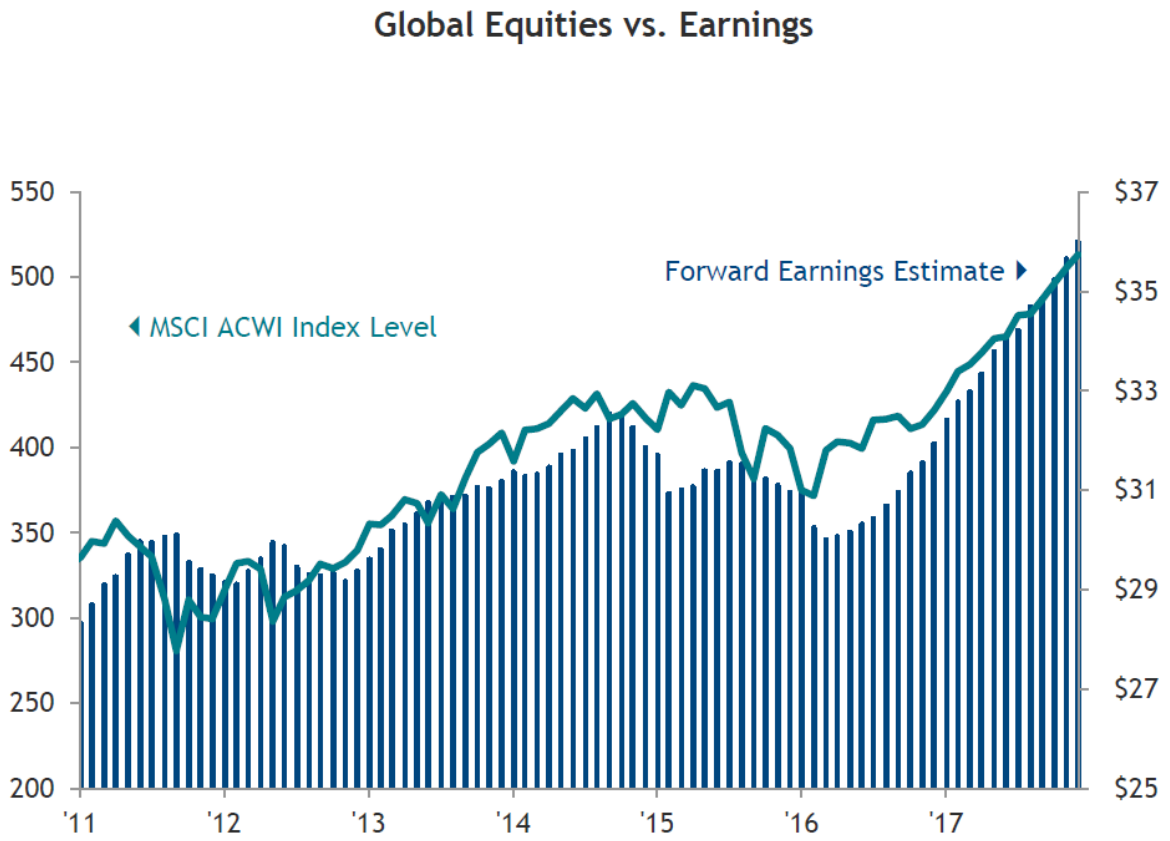


Source: FactSet, S&P, Shiller, Strategas Research Partners, SunTrust Portfolio & Market Strategy Group. Asset classes are represented by the following indices: US Equity = S&P 500.

Rising Global Profits Continue To Support Equities

A powerful rebound in profits, aided by the broadest global economic recovery in a decade, has supported stocks over the past year.

As the acceleration phase of the economic recovery transitions to one of stability, earnings and stock returns should moderate but stay positive.

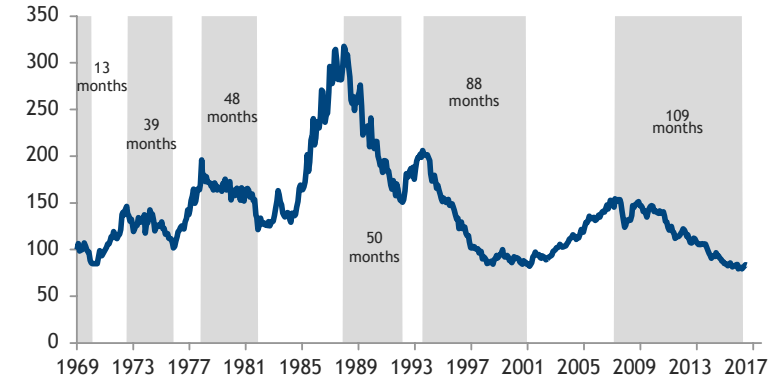


Data Source: FactSet, MSCI, SunTrust IAG

Past performance is not a guarantee of future results. Please see Disclosure slides for important information.

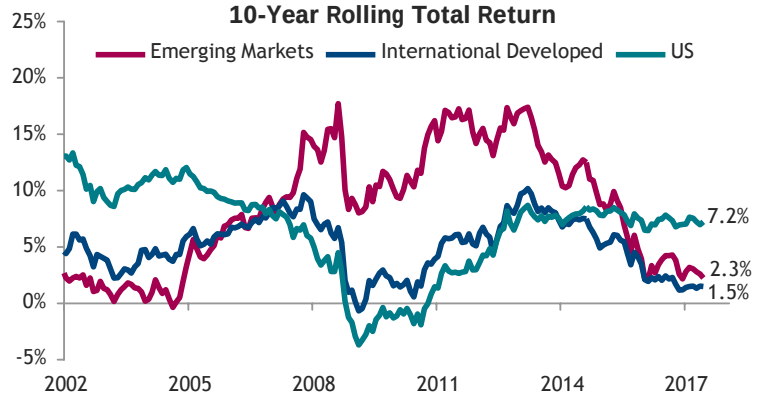
Key Components of Our Outlook for International Equity Returns

International markets' underperformance cycle relative to US is long by historical standards



US (MSCI USA) relative to international developed equity (MSCI EAFE) through December 1987; therefore, relative to global equity x USA (MSCI ACWI x USA) which includes international developed and emerging markets.

Depressed long-term returns for international markets leave room for catch up

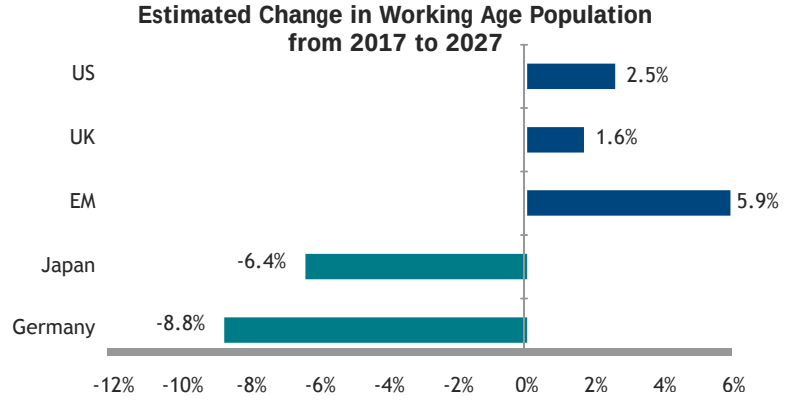


Lower valuations in international markets over the US imply relative upside

Data as of 6/30/2017

Source: Morningstar, MSCI, FactSet, US Census Bureau, SunTrust Portfolio & Market Strategy

More challenging demographic trends in the international developed world vs US and EM



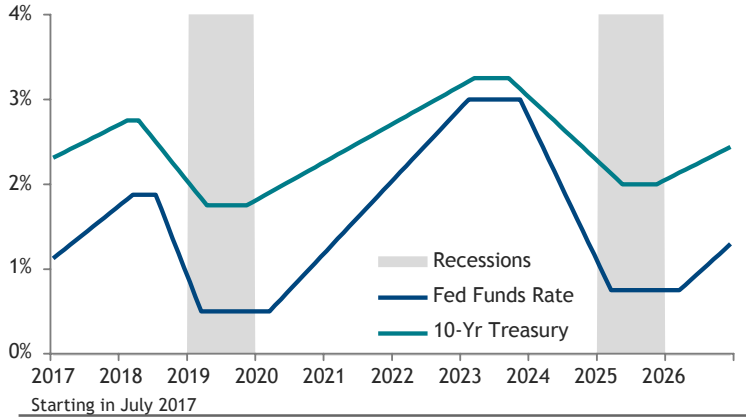
Data Source: SunTrust IAG, US Census Bureau

Group. Asset classes are represented by the following indices: International

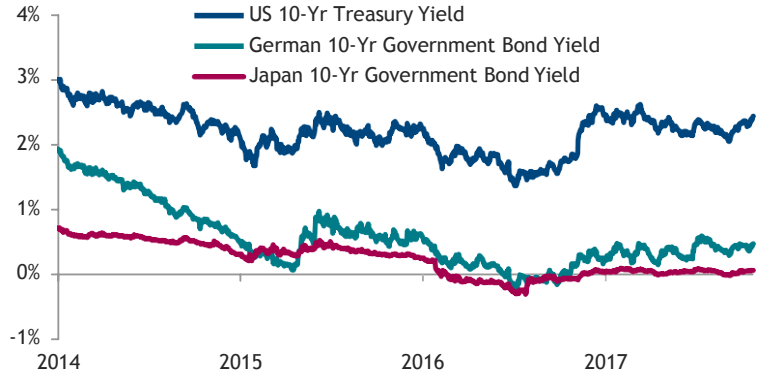
Past performance is not indicative of future results.

Key Components of Our Outlook for Fixed Income Returns

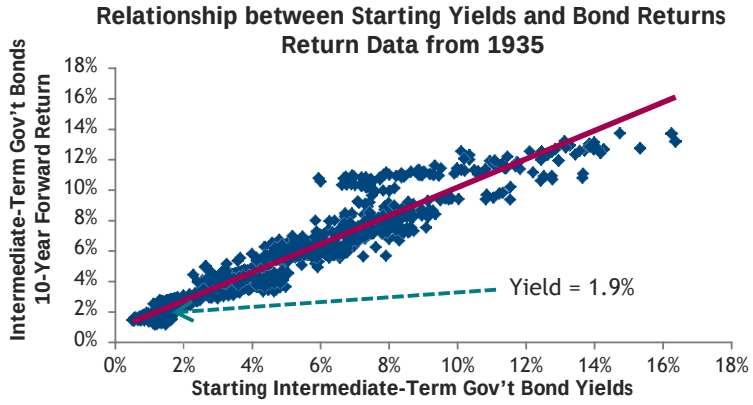
Our expected path of interest rates illustrates our assumption that yields will remain relatively low



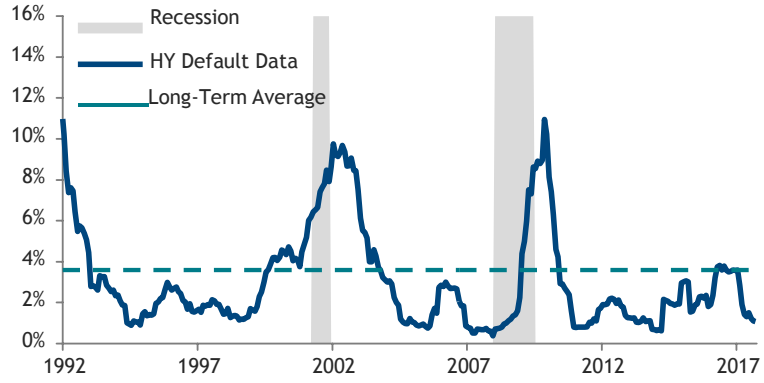
US interest rates have been impacted by global forces and will likely continue to be restrained



Lower starting yields have meant lower future bond returns



High-yield bond default rates are expected to eventually move into a higher range



Source: FactSet, Morningstar, Haver, JP Morgan, SunTrust Portfolio & Market Strategy Group

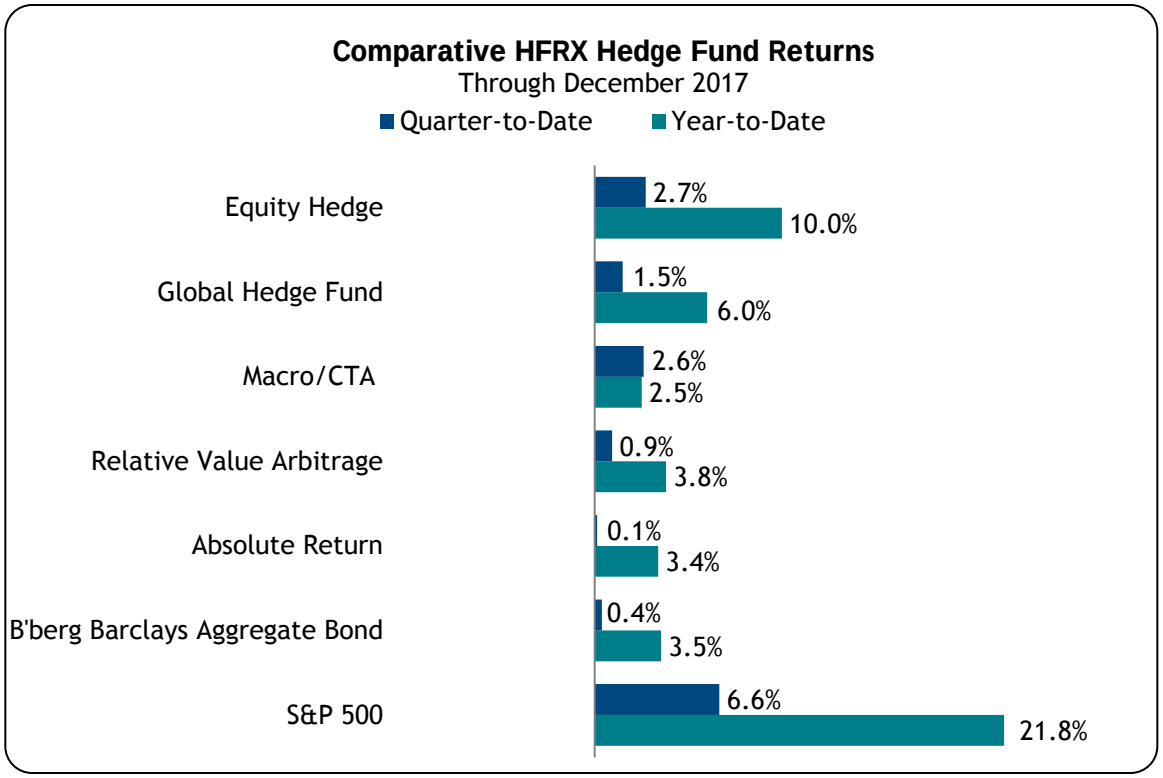
US Intermediate bond yield represented by IA SBBI U.S. Intermediate-Term Government Bond Index as of 6/30/17.

Non-Traditional Investments Overview

Hedge funds can not keep up with surging stocks

Most global hedge fund strategies notched good returns for December and the fourth quarter, but lagged surging US stock indices.

Equity hedge strategies posted solid returns for December, finishing with good returns for 2017. Yet many sub-strategies had mediocre results for the month, continuing underwhelming trends for the year.

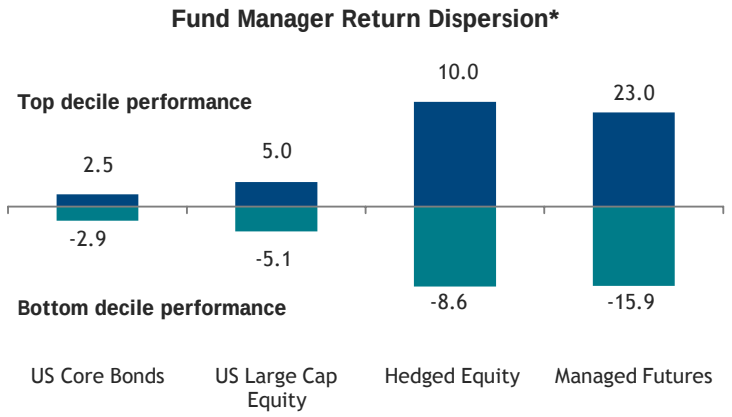


Data sources: Hedge Fund Research, FactSet

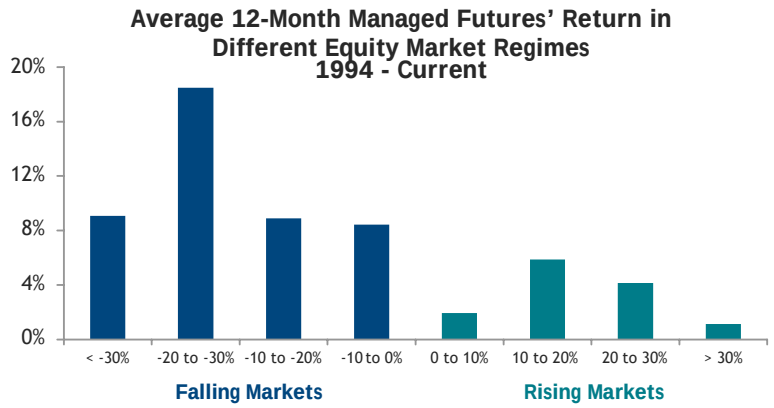
Hedge fund investing involves substantial risks and may not be suitable for all clients. Hedge funds are intended for sophisticated investors who can bear the economic risks involved. Hedge funds may engage in leveraging and speculative investment practices that may increase the risk of investment loss, can be illiquid, and are not required to provide periodic pricing or valuation information to investors. Hedge funds may involve complex tax structures, have delays in distributing tax information, are not subject to the same regulatory requirements as mutual funds and often charge higher fees.

Key Components of Our Non-Traditional and Private Investment Outlook

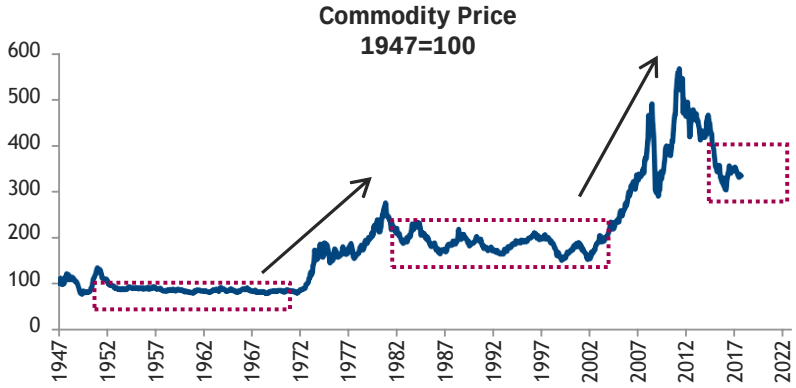
Wide dispersion among hedge fund performance supports manager selection value-add opportunity



Managed futures should provide ballast when equity markets face elevated downside risks

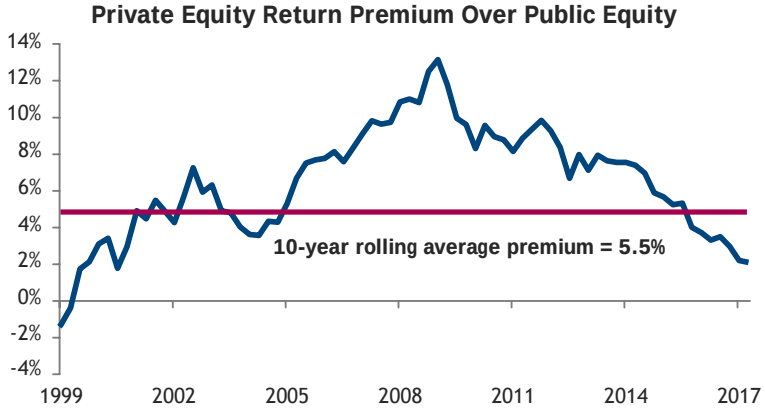


With the collapse in recent years, commodity prices are expected to remain muted



Index: KR-CRB Spot Commodity Price Index: All Commodities through 12/1959; thereafter, Thomson Reuters Continuous Commodity Index. The Thomson Reuters Equal Weight Commodity Total Return Index is a broad based commodity index reflecting the price movement of 17 exchange traded future contracts. Investing in commodities is speculative and involves a high degree of risk and not suitable for all investors. You could lose all or a substantial portion of your investment.

We expect the private to public equity premium to further moderate due to higher valuations



Source: FactSet, Haver, Hedge Fund Research, Morningstar, Barclay Hedge and BlackRock. Hedge fund manager dispersion is for the period 2005 – 2014. Investing in commodities is speculative, involves a high degree of risk and is not suitable for all clients. You could lose all or a substantial portion of your investment. Hedge fund investing involves substantial risks and may not be suitable for all clients. Hedge funds may engage in leverage and speculative investing that may increase the risk of investment loss, can be illiquid, and are not required to provide periodic pricing or valuation information to investors. Hedge funds may involve complex tax structures, have delays in distributing tax information, are not subject to the same regulatory requirements as mutual funds and often charge higher fees.

Performance Summary Through December 2017

Index Performance (%)	MTD	QTD	YTD	1 Yr	3 Yr	5 Yr
MSCI ACWI (net)	1.61	5.73	23.97	23.97	9.30	10.80
MSCI World (net)	1.35	5.51	22.40	22.40	9.26	11.64
MSCI EAFE LCL (net)	1.20	3.66	15.23	15.23	8.54	11.44
MSCI EAFE USD (net)	1.61	4.23	25.03	25.03	7.80	7.90
MSCI Emerging Markets LCL (net)	2.56	1.72	25.56	30.55	10.51	7.98
MSCI Emerging Markets USD (net)	3.59	7.44	37.28	37.28	9.10	4.35
Dow Jones Industrial Average	1.92	10.96	28.11	28.11	14.36	16.37
S&P 500	1.11	6.64	21.83	21.83	11.41	15.79
NASDAQ Composite	0.43	6.27	28.24	28.24	13.38	17.98
Russell 1000	1.11	6.59	21.69	21.69	11.23	15.71
Russell 1000 Growth	0.78	7.86	30.21	30.21	13.79	17.33
Russell 1000 Value	1.46	5.33	13.66	13.66	8.65	14.04
Russell MidCap	0.93	6.07	18.52	18.52	9.58	14.96
Russell Mid Cap Growth	0.54	6.81	25.27	25.27	10.30	15.30
Russell Mid Cap Value	1.24	5.50	13.34	13.34	9.00	14.68
Russell 2000	(0.40)	3.34	14.65	14.65	9.96	14.12
Russell 2000 Growth	0.12	4.59	22.17	22.17	10.28	15.21
Russell 2000 Value	(0.95)	2.05	7.84	7.84	9.55	13.01
FTSE NAREIT All Equity REITs	(0.29)	2.48	8.67	8.67	6.67	9.83
Bloomberg Commodity Index	2.99	4.71	1.70	1.70	(5.03)	(8.45)
Bloomberg Barclays Aggregate	0.46	0.39	3.54	3.54	2.24	2.10
Bloomberg Barclays Intermediate Govt & Credit	0.11	(0.20)	2.14	2.14	1.76	1.50
Bloomberg Barclays U.S. MBS Index	0.33	0.15	2.47	2.47	1.88	2.04
ICE BofAML US Treasury Master	0.35	0.11	2.43	2.43	1.47	1.37
ICE BofAML US Treasuries Inflation-Linked	1.01	1.44	3.33	3.33	2.12	0.17
Bloomberg Barclays US Treasury Bellwethers (2 Yr)	(0.03)	(0.33)	0.25	0.25	0.43	0.45
Bloomberg Barclays US Treasury Bellwethers (10 Yr)	0.26	(0.25)	2.14	2.14	0.96	0.99
Bloomberg Barclays Municipal Bond Blend 1-15 Year	0.83	0.15	4.33	4.33	2.37	2.46
ICE BofAML US Corporate Master	0.85	1.12	6.48	6.48	3.88	3.50
ICE BofAML High Yield Master	0.29	0.41	7.48	7.48	6.39	5.80
Citigroup Non-USD WGBI (USD)	0.08	1.57	10.33	10.33	1.99	(0.29)
Citigroup Non-USD WGBI (USD) Hedged	(0.10)	1.10	2.06	2.06	2.90	3.94
JP Morgan GBI-EM Global Diversified	2.02	0.82	15.21	15.21	2.53	(1.55)

Rates (%)	12/29/17	12/29/17	9/29/17	6/30/17	3/31/17	12/30/16
US Fed Funds Rate	1.50	1.50	1.25	1.25	1.00	0.75
European Central Bank Rate	0.00	0.00	0.00	0.00	0.00	0.00
Bank of England Rate	0.50	0.50	0.25	0.25	0.25	0.25
Bank of Japan Rate	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
USA LIBOR - 3 Month	1.69	1.69	1.33	1.30	1.15	1.00
TED Spread (bps) - 3 Month	0.31	0.31	0.27	0.28	0.40	0.50
2 Yr US Treasury	1.88	1.88	1.47	1.38	1.26	1.20
10 Yr US Treasury	2.41	2.41	2.33	2.30	2.39	2.44
10-2 yr slope	0.53	0.53	0.86	0.92	1.13	1.24
Bloomberg Barclays Municipal Bond Blend 1-15 Year (YTW)	2.14	2.14	1.90	1.94	2.10	2.32
ICE BofAML High Yield Master (YTW)	5.78	5.78	5.43	5.68	5.88	6.13
ICE BofAML Corporate Master (YTW)	3.27	3.27	3.17	3.23	3.35	3.37

Currencies	12/29/17	12/29/17	9/29/17	6/30/17	3/31/17	12/30/16
Euro ($/€)	1.20	1.20	1.18	1.14	1.07	1.05
Yen (¥/$)	112.65	112.65	112.57	112.36	111.43	116.64
GBP ($/£)	1.35	1.35	1.34	1.30	1.25	1.24

Commodities	12/29/17	12/29/17	9/29/17	6/30/17	3/31/17	12/30/16
Light Crude Oil ($/barrel)	60.42	60.42	51.67	46.04	50.60	53.72
Gold ($/ozt)	1,309.30	1,309.30	1,284.80	1,242.30	1,251.20	1,151.70

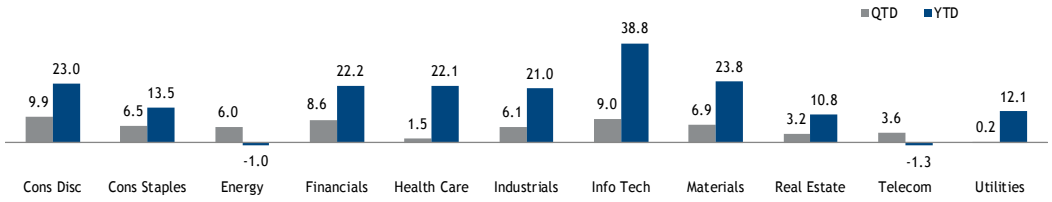
CBOE Volatility Index	12/29/17	12/29/17	9/29/17	6/30/17	3/31/17	12/30/16
CBOE VIX	11.04	11.04	9.51	11.18	12.37	14.04

Hedge Fund Performance (%)	MTD	QTD	YTD	1 Yr	3 Yr	5 Yr
HFRX Global Hedge Fund Index	0.73	1.50	5.99	5.99	1.54	2.12
HFRX Equity Hedge Index	1.03	2.72	9.98	9.98	2.45	3.92
HFRX Macro/CTA	0.82	2.61	2.51	2.51	(0.82)	0.16
HFRX Distressed Securities Index	0.92	0.69	3.14	3.14	3.14	3.04
HFRX Absolute Return Index	0.28	0.13	3.39	3.39	2.18	2.17

U.S. Style % Total Returns (Russell Indexes)

	QTD			YTD		
	Value	Core	Growth	Value	Core	Growth
Large	5.33	6.59	7.86	13.66	21.69	30.21
Mid	5.50	6.07	6.81	13.34	18.52	25.27
Small	2.05	3.34	4.59	7.84	14.65	22.17

S&P 500 Sector % Total Returns



Data source: FactSet

It is not possible to invest directly in an index.

Past performance is not a guarantee of future results. Please see Disclosure slides for important information.

McKnight Brain Research Foundation Amended and Restated Investment Policy

Adopted at 07/25/2017 Trustee Meeting

McKnight Brain Research Foundation
Amended and Restated Investment Policy

The McKnight Brain Research Foundation (the "MBRF")

The MBRF is a Florida trust that, for federal income tax purposes, is an exempt organization (IRC § 501(c)(3)), and classified as a private foundation (IRC § 509(a)). The only tax paid by the MBRF is the annual IRC § 4940 excise tax of 2% (or 1%) of investment income. All of the MBRF assets were contributed by Mrs. Evelyn F. McKnight and no additional contributions are expected. At the present time, it is anticipated that the MBRF will make grants to carry out its charitable purpose. The specific purpose for which the MBRF was established is "to provide support for medical research of the brain to accomplish alleviation of memory loss of the aging". The MBRF expects to exist in perpetuity. The only required distribution is the 5% of fair market value IRC § 4942 annual distribution.

Governance

The MBRF is a Florida charitable trust. The MBRF is governed by eight Trustees. There are seven individual Trustees and one Corporate Trustee.

Introduction

This policy presents the investment process of the MBRF. The Trustees have prepared this policy in consultation with its investment consultants and legal counsel. For purposes of investing assets, the Trustees have looked to the Corporate Trustee as its investment consultant and any references herein to investment counsel are references to the Corporate Trustee.

Prudent Investor Rule

The Trustees have adopted this Investment Policy to evidence compliance with the Florida Prudent Investor rule. §§518.10-14 FLA.STATS. The Investment Policy will be interpreted and implemented consistent with the prudent investor rule. The Trustees have delegated certain investment function to the Corporate Trustee as allowed by and in accordance with the requirements of §518.112 FLA.STATS.

Investment Goals

The investment goal is to provide a long term real total rate of return that will increase the purchasing power of MBRF assets net of expenses and distributions. In order to achieve its investment goal, the MBRF will adopt a strategic asset allocation that will achieve its long term return goal with acceptable volatility.

Long Term Investor

The MBRF will exist in perpetuity. As such, it is a long term investor who seeks a high rate of return consistent with reasonable volatility. The MBRF understands that volatility can be reduced by allocating assets among asset classes, among investment styles and strategies within asset classes. The MBRF will adopt strategic targets for each asset class and will, from time to time, rebalance between asset classes, investment styles and strategies to maintain its strategic targets.

Target Rate of Return

The Trustees will adopt a target rate of return that incorporates the MBRF investment goals and spending policy. It is recognized that the target rate of return, investment goals and volatility are interrelated and must be viewed as such. It is also recognized the investment horizon of the MBRF is long term (perpetuity) and the target rate of return will reflect that long term view. The target rate of return will change from time to time and is set forth on Appendix A.

Spending Policy

The MBRF will adopt a spending policy that balances a realistic achievable rate of return, expenses, and its investment goals. Appendix A is the current spending policy adopted by the MBRF. The spending policy will be reviewed annually at a minimum.

Income, Appreciation and Gains

The Trustees recognize that the MBRF pays only a 2% excise tax on investment income and, therefore, the investments are not tax sensitive. Its distributions are not limited by income and, therefore, the Trustees will ignore income and principal analysis when implementing its investment goals and implementing its spending policy.

Cash Flow

Because it will exist in perpetuity, its only cash flow needs will be to cover expenses (and tax) and the annual IRC § 4942 5% of fair market value distribution. It is recognized that additional spending can be controlled and that the MBRF from time to time may distribute more than the minimum required by tax laws.

Performance/Style Measurement

The Trustees have adopted a market driven benchmark for each asset class and management style. For the portfolio as a whole, the Trustees will adopt a benchmark that consists of a suitable passive index for each asset class weighted in accordance with the strategic asset allocation. The Trustees will also adopt appropriate peer group data to measure the performance of each managed portfolio and passive investment. The Trustees expect performance of each managed portfolio to be in the top one-third of the peer group data base for that particular management style or strategy. The peer group data base is set out in Exhibit B. The Trustees will evaluate ongoing investment performance over a three to five year period, anticipating it will not make changes on the basis of short term (less than two years) results. However, the

Trustees recognize there are factors, including, but not limited to, changes in personnel, that would require immediate attention and action.

Performance should be measured in a manner consistent with the standards of the CFA Society.

The performance measurement will include an analysis of managers adherence to the investment styles set forth in Exhibit B.

The Foundation recognizes enhanced performance results from asset allocation, as well as selection of particular managers and passive investments. Therefore, the Foundation will compare portfolio returns and the benchmark portfolio, as well as compare individual manager returns and the designated index, as shown on Exhibit B.

Investment Preference

The Foundation prefers, but does not require, that managers avoid investment in companies whose primary or significant (greater than 30% of gross revenue) businesses are the growing, cultivation, manufacture, or distribution of tobacco or tobacco products. This shall not apply to investments in indexed or mutual funds.

Security Voting

The Corporate Trustee will vote on securities when a vote is requested. The Trustees will receive an annual report of voting decisions.

Specific Functions of the Board of Trustees

1. Establish investment objectives for the portfolio.

2. Establish and review its spending policy.

3. Set strategic asset allocation for the Trust.

4. Establish and continue to update the investment policy.

5. Establish, monitor and update the investment process.

6. Review investment performance in accordance with its performance measurement policy.

7. Review at least quarterly investment activity to insure compliance with the investment policy and adherence to investment style.

8. Terminate managers and passive investments in accordance with this investment policy.

Specific Functions of the Corporate Trustee

1. The Corporate Trustee shall review regularly all investments of the MBRF.

2. The Corporate Trustee shall recommend to the Board of Trustees such investment and investment related policies, including strategic asset allocations, as it deems appropriate, and as may be requested.

3. The Corporate Trustee shall make periodic investment performance reports (no less than quarterly) to the Board of Trustees.

4. The Corporate Trustee shall implement the investment policy, including selecting and terminating managers and passive investments in accordance with this investment policy.

5. The Corporate Trustee may, in its discretion, "tilt" the strategic asset allocation within the applicable range, as set forth in Exhibit B.

Asset Allocation

1. To achieve its investment objective, the Foundation's assets shall be allocated among various asset classes, including, but not limited to, equity, cash/cash equivalents, fixed income and alternative investments/hedge funds. The current strategic asset allocation adopted by the Board is contained in Appendix B. The strategic asset allocation and asset classes will change periodically based upon monitoring and objective analysis of changes in the economy.

2. The Foundation investments will be allocated among asset classes and diversified within asset classes. Within each asset class, securities, for example, will be allocated further by economic sector, industry, quality and size. The purpose of allocation and diversification is to provide reasonable assurance that no single security or class of securities will have a disproportionate impact on performance of the total fund. As a result, the unsystematic risk (volatility associated with diversification risk) level associated with the portfolio should be significantly reduced.

3. In any asset class, no more than 5% at investment cost or 10% at market may be held in the securities of a single issuer.

4. Allocation by investment style is also an important step in reducing the risk (volatility) of the Foundation's portfolio. Investment styles within equity asset classes are defined in Appendix C.

Custodian

The Corporate Trustee will be the custodian for the MBRF. The Corporate Trustee shall recommend to the Board appropriate policies and procedures for custodianship and access to securities held by the Foundation as it may deem appropriate.

Soft Dollars

The Corporate Trustee will annually review the "soft dollar" policy and activity of each actively managed portfolio and report the findings to the Trustees. Each active manager is expected to enter into equity transactions on a best execution basis. The Trustees may designate certain brokers by which commissions may be recaptured or provide for the payment of services rendered to the MBRF.

Guidelines for Corrective Action

Corrective action will be taken during the review of active management. The following are instances where immediate corrective action, or termination of active management, may be in order:

- Organizational and/or personnel changes in the active manager. Failure to notify the MBRF of such changes is grounds for immediate termination.

- Violation of terms of any investment management agreement between the Trustees and an active manager.

- Change by an active manager in the management style for which the manager was selected. The MBRF, through the Corporate Trustee, will closely track the investments of each active manager to insure adherence to management style for which the active manager was retained.

Corrective action ordinarily will be taken by all of the Trustees. If, in an emergency, it is not feasible to contact one or more of the Individual Trustees, action may be taken by the Corporate Trustee acting alone.

Rebalancing Procedure

Should the range for a particular management style be violated by reason of gains, losses, changes in an active management, or any other reason, the Trustees will meet or conference to

decide whether to rebalance the assets to the target class and style allocation policies. In addition, the Trustees shall review the actual allocations at each quarterly meeting in order to insure conformity with the adopted strategic allocation. The assets will not be automatically rebalanced on any set schedule.

APPENDIX A

Spending Policy of McKnight Brain Research Foundation

Expenses as Permitted	1.0%
Allowance For Inflation**	2.7%
Distribution From Foundation	5.0%
Target Total Return	8.7%

** Real inflation is Biomedical Research and Development Price Index ("BRDPI") published by the U.S. Bureau of Economic Analysis for FY 2018 (the 12 months ended 09/30/2018).

APPENDIX B

McKnight Brain Research Foundation
Portfolio Guidelines

Asset Class	2017 Efficient Frontier	Range	Benchmark	Peer Group*
Large Cap Equity	34.5%	30% - 60%	S & P 500	Pure Large Cap Core
Mid Cap Equity	6.0%	5% - 14%	Russell Mid Cap	Mid Cap
Small Cap Equity	8.0%	0% - 15%	Russell 2000	Broad Small Cap
International Developed	11.0%	5%-15%	MSCI - EAFE	Broad Int'l Equity
International Developed – Small Cap	3.0%		MSCI – EAFE (small cap)	Int'l Small Cap
International Emerging	7.0%	3%-10%	MSCI – Emerging Mkts	
Hedge Funds	15.5%	10%- 30%	HFR Fund of Funds Index	
Commodities	0%	0-5 %	Dow Jones UBS Commodity Index	
Real Estate – U.S.	0%	0% - 10%	NAREIT Equity	
Real Estate – Non U.S.	0%	0% - 10%	DJW Global ex-U.S. Real Estate	
Private Equity	7.5%	0% - 10%	Cambridge Associates U.S. Private Equity	
Fixed Income	7.5%	0% - 20%	Barclays Agg Index	
Cash	0.3			
	100%			

Static Benchmark #1		Spending Policy Benchmark	
Russell 3000 Index	65%	Distribution	5.0%
Barclays U.S. Aggregate Index	35%	Expenses	1.0%
	100%	Inflation**	2.7%
			8.7%

*Universes for peer group comparison – recommended by SunTrust and adopted by Trustees on 7/12/00. SunTrust advises there are no Alt/Hedge Fund, Real Estate or International Fixed Income Peer Groups.

**Real inflation is Biomedical Research and Development Price Index ("BRDPI") published by the U.S. Bureau of Economic Analysis for FY 2018 (the 12 months ended 09/30/2018).

APPENDIX C

Market Capitalization – Market value of a corporation calculated by multiplying the number of shares outstanding by the current market price. The classification* of the capitalization ranges is as follows:

* Large Capitalization Classification – Market cap of $10 billion and greater
* Mid Capitalization Classification – Market cap of $2 billion to $10 billion
* Small Capitalization Classification – Market cap of $50 million to $2 billion

International Equity – International equity investments are permitted in listed equity securities traded on developed non U.S. markets. Developed markets are defined as those included in the Morgan Stanley Capital International, Inc. Europe Asia Far East (MSCI EAFE) Index plus Canada. American depository receipts (ADRs) traded on major U.S. markets are considered to be domestic securities.

Growth Equity Style – Investment in companies that are expected to have above average prospects for long term growth and earnings and profitability.

Value Equity Style – Investment in companies believed to be undervalued or possessing lower than average price/earnings ratios, based on their potential for capital appreciation.

Core Equity Style – Investment in companies whose characteristics are similar to that of the broader market as represented by the Standard's & Poor's 500 Index, with the objective of adding value over and above the Index, typically from sector or issue selection. The core portfolio exhibits similar risk characteristics to the broader market as measured by low residual risk with Beta and R-squared values close to 1.00.

Alternative Investments/Hedge Funds – Hedge funds are strategies utilized by professional money managers or group of managers that permit the management of a private, unregistered investment pool of capital and/or securities, and investments in a variety of investment techniques normally prohibited in other types of funds. Hedge funds are typically skill-based investment strategies attempting to provide "absolute" return based on the specialized strategy of the trader or manager and offer diversification and reduce systematic risk due to a low correlation to traditional asset classes. The following are some of the hedge fund strategies utilized by managers:

> *Direct Hedge* - Hedging one asset, such as common stock, with another asset that has similar price movements and trades similarly. Example: using call options to hedge a common stock position.
>
> *Cross Hedge* - Hedging an investment with an unlike instrument. Example: Buying stocks and hedging the position with Treasury futures.
>
> *Static Hedge* - Hedging out every dollar of a portfolio in an effort to eliminate risk.

* From Morningstar Analytical Services, Inc.

Dynamic Hedge - Changing the amount of puts in a position over time as the market changes.

Market Neutral - As a long/short strategy, equal amounts of capital are invested long and short in an attempt to neutralize market risk. The goal is to purchase undervalued securities and short overvalued securities.

Market Timing - Anticipates market movements and allocates assets by switching between stocks, bonds and cash as the market and economic outlook change.

Short Selling - Identifying overvalued securities and "shorting" or selling these stocks. This involves borrowing the stocks to sell them, in the hope of buying them back later at a lower price.

Growth Fund - Investing in growth stocks with the basic goal of capital appreciation. This may include hedging by short selling or using options.

Distressed Securities - Investing in securities of a company in bankruptcy or facing it. These securities are purchased inexpensively and with the hope that they will appreciate as the company emerges from bankruptcy.

Sector Funds - Concentrated investments in various sectors. May involve long and short investments and options.

Emerging Markets - Investing in securities of companies in emerging or developing countries. This could involve purchasing government or corporate debt and/or equity.

Global Fund - Investing in shifts in global economies. Derivatives may be used to speculate on interest rate and currency movements. These funds search for and exploit opportunistic investment possibilities wherever they may arise.

Opportunistic - Using a variety of strategies as opportunities arise. Several strategies could be used simultaneously.

Glossary

Glossary

BarCap Aggregate Bond Index: The broadest measure of the taxable U.S. bond market, including most Treasury, agency, corporate, mortgage-backed, asset-backed, and international dollar-denominated issues, all with investment-grade ratings (rated Baa3 or above by Moody's) and maturities of one year or more.

BarCap US Corporate High Yield: The U.S. Corporate High-Yield Index the covers the USD-denominated, non-investment grade, fixed-rate, taxable corporate bond market. Securities are classified as high-yield if the middle rating of Moody's, Fitch, and S&P is Ba1/BB+/BB+ or below. The index excludes Emerging Markets debt.

BarCap US Treasury Long Index: includes public obligations of the US Treasury with maturities of 10 years or more.

CBOE VIX: The CBOE Volatility Index® is a key measure of market expectations of near-term volatility conveyed by S&P 500 stock index option prices. Since its introduction in 1993, VIX has been considered by many to be the world's premier barometer of investor sentiment and market volatility. VIX is often referred to as the "investor fear gauge".

Dow Jones Wilshire RESI Index: designed to provide measures of real estate securities that serve as proxies for direct real estate investing, in part by excluding securities whose value is not always closely tied to the value of the underlying real estate. To be included, a company must be both an equity owner and operator of commercial and/or residential real estate. A company must have a minimum total market capitalization of at least $200 million at the time of its inclusion, and at least 75% of the company's total revenue must be derived from the ownership and operation of real estate assets.

MSCI All-Country World ex-US Index: is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed and emerging markets, ex-US equities.

MSCI All Country World Index: is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed and emerging markets.

MSCI EAFE Index: The MSCI EAFE Index® comprises 21 MSCI country indices, representing the developed markets outside of North America: Europe, Australasia and the Far East.

MSCI Emerging Markets Index: is a free float-adjusted market capitalization index that is designed to measure equity market performance of emerging markets. As of May 27, 2010 the index consisted of the following 21 emerging market country indices: Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, and Turkey.

Note: Indexes are unmanaged. An investor cannot invest directly in an index. They are shown for illustrative purposes only and do not represent the performance of any specific investment.

Glossary

The MSCI Europe Index is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of the developed markets in Europe. As of June 2007, the Index consisted of the following 16 developed market country indices: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Russell 2000 Index: is comprised of 2000 smaller company stocks and is generally used as a measure of small-cap stock performance.

S&P 500 Index: The S&P 500 Index is comprised of 500widely-held securities considered to be representative of the stock market in general.

S&P Equal Weight Index (S&P EWI). The index is the equal-weight version of the widely regarded S&P 500. The index has the same constituents as the capitalization weighted S&P 500, but each company in the index is allocated a fixed weight of 0.20% at each quarterly rebalancing.

Barclays U.S. Municipal Index: covers the USD-denominated long-term tax exempt bond market. The index has four main sectors: state and local general obligation bonds, revenue bonds, insured bonds, and pre-refunded bonds.

DJ-UBS Commodity Index is composed of futures contracts on physical commodities. It currently includes 19 commodity futures in seven sectors. The weightings of the commodities are calculated in accordance with rules that ensure that the relative proportion of each of the underlying individual commodities reflects its global economic significance and market liquidity.

MSCI BRIC Index is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of the following four emerging market country indices: Brazil, Russia, India and China.

The MSCI AC (All Country) Asia ex Japan Index is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of Asia, excluding Japan. As of January 2009 the Index consisted of the following 10 developed and emerging market country indices: China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand

MSCI Germany: every listed security in the market is identified. Securities are free float adjusted, classified in accordance with the Global Industry Classification Standard (GICS®), and screened by size, liquidity and minimum free float.

Note: Indexes are unmanaged. An investor cannot invest directly in an index. They are shown for illustrative purposes only and do not represent the performance of any specific investment.

Glossary

MSCI China: every listed security in the market is identified. Securities are free float adjusted, classified in accordance with the Global Industry Classification Standard (GICS®), and screened by size, liquidity and minimum free float.

MSCI Brazil: every listed security in the market is identified. Securities are free float adjusted, classified in accordance with the Global Industry Classification Standard (GICS®), and screened by size, liquidity and minimum free float.

Citi World Broad Investment Grade (BIG) Bond Index: includes investment grade global bonds with a fixed coupon and maturity longer than one year and a minimum credit rating of Baa3 by Moody's or BBB- by S&P.

Generally, when interest rates rise, bond values fall, values rise when interest rates decline. If interest rates fall, it is possible that issuers of callable securities with high interest coupons will "call" (or prepay) their bonds before maturity date. Credit risk refers to the possibility that the issuer of a security will be unable and/or unwilling to make timely interest payments and/or repay the principal on its debt, which may adversely affect the value of the security.

As a new kind of bond offering, **Build America Bonds (BAB)** are subject to liquidity risk, there is a risk that not enough interested buyers will be available to permit an investor to sell at or near the current market price. BABs are also subject to Federal subsidy risk, the risk that the federal government would eliminate or reduce the subsidies for BABs in the future. Some BABs have been issued with provisions that allow state and local governments to "call" the bonds back and refinance if the federal government stops paying subsidy on the interest."

Note: Indexes are unmanaged. An investor cannot invest directly in an index. They are shown for illustrative purposes only and do not represent the performance of any specific investment.

Glossary

MPT STATISTICS/OTHER MEASUREMENTS

Alpha - is defined as the difference between the average realized return of a portfolio manager with private information and the expected return of the passive strategy based upon public information with equal systematic risk.

Beta – is a measure of an investment's volatility, relative to an appropriate asset class.

R-Squared – a statistical measure of how well a regression line approximates real data points; an r-squared of 1.0 (100%) indicates a perfect fit. r-squared measures how well the Capital Asset Pricing Model predicts the actual performance of an investment or portfolio.

Sharpe Ratio - also known as Reward-to-Volatility-Ratio, indicates the excess return per unit of risk associated with the excess return. The higher the Sharpe Ratio, the better the performance.

Standard Deviation – a statistical measurement of dispersion about an average, which, for a mutual fund, depicts how widely the returns varied over a certain period of time.

PORTFOLIO CHARACTERISTICS DEFINITIONS

30 Day SEC Yield – is calculated by dividing the net investment income per share for the 30 days ended on the date of calculation by the offering price per share on that date. The figure is compounded and annualized.

5 Year EPS Growth – is the five-year reported earnings per share growth rate for each company in percent per year.

Price-to-Book – is used to compare a stock's market value to its book value. This ratio gives some idea of whether you're paying too much for what would be left if the company went bankrupt immediately.

P/E (12 months trailing) – is the price of a stock divided by its historical earnings per share.

Return on Equity – is a measure of a corporation's profitability, calculated by taking a company's net income and dividing it by the shareholder's equity.

Appendix

Lighthouse Global Long/Short Fund Limited

100% managed accounts

FIRM AUM
$10.4 billion†

STRATEGY
Long/Short Equity

FUND INCEPTION
July 2004

FUND AUM
$1.8 billion††

CLASS A

MANAGEMENT FEE
1.5% per annum

PERFORMANCE FEE
None

WITHDRAWAL TERMS
Two options:
(1) Quarterly: 60 days written notice
(2) Monthly: 90 days written notice

DOMICILE
Cayman Islands

AUDITOR
PricewaterhouseCoopers

ADMINISTRATOR
SS&C Fund Services (Cayman) Ltd.[4]

BLOOMBERG CODE
LHGLSLD KY

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Return summary[1,2]

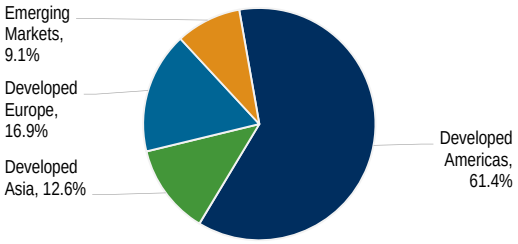
	December 2017	One Year	Three Year	Five Year
Lighthouse Global Long/Short Fund Limited (net)	1.00%*	6.00%	4.17%	7.35%
HFRX Equity Hedge (Total) Index[2]	1.03%	9.98%	2.45%	3.92%
MSCI AC World Index	1.65%	24.63%	9.90%	11.40%

Performance characteristics[1,2,3]

	One Year	Three Year	Five Year
Annualized Compound Return	6.00%	4.17%	7.35%
Annualized Standard Deviation	2.88%	3.80%	4.14%
Sharpe Ratio (annualized)[3]	1.75	0.99	1.67
% positive months	64%	66%	71%
Maximum Drawdown	-0.85%	-4.70%	-4.70%
Beta to HFRX Equity Hedge (Total) Index[2]	0.13	0.44	0.54
Beta to MSCI AC World Index	0.07	0.17	0.20

Portfolio composition[5]

Geography Weightings



Portfolio composition[5]

Sector Weightings

	Gross	Net
Consumer Discretionary	53.6%	1.4%
Consumer Staples	18.2%	0.8%
Energy	15.1%	0.9%
Financials	44.1%	9.5%
Healthcare	31.2%	4.0%
Industrials	32.5%	4.9%
Technology	39.9%	4.1%
Materials	17.2%	7.8%
Real Estate	23.7%	0.1%
Telecommunications	3.1%	-0.5%
Utilities	2.6%	0.2%
Other	4.7%	0.9%
Total	285.9%	34.1%

Net historical performance[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD
2017	1.50%	0.22%	0.98%	-0.52%	-0.33%	0.00%	0.68%	0.96%	-0.02%	2.02%	-0.61%	1.00%*	6.00%*
2016	-3.57%	-0.71%	-0.46%	0.51%	0.92%	0.21%	1.66%	-0.23%	0.95%	-0.89%	1.19%	0.24%	-0.28%
2015	1.02%	0.98%	1.60%	-0.53%	1.10%	0.21%	0.38%	-0.81%	-1.00%	2.21%	0.01%	1.63%	6.95%
2014	0.82%	1.74%	-1.70%	-2.01%	1.18%	1.81%	-0.50%	1.63%	-0.12%	0.26%	1.21%	0.59%	4.93%
2013	3.14%	0.53%	2.65%	1.51%	1.00%	0.93%	2.23%	-0.27%	2.13%	1.21%	1.13%	2.39%	20.19%
2012	1.72%	1.65%	1.52%	0.98%	-3.72%	0.47%	0.11%	1.07%	1.30%	-0.13%	0.72%	0.35%	6.08%
2011	-0.18%	1.12%	0.63%	2.12%	-1.14%	-1.46%	0.56%	-3.09%	-0.63%	1.73%	-1.01%	-0.62%	-2.07%
2010	0.03%	0.25%	1.87%	0.64%	-2.42%	-1.73%	1.70%	-0.63%	1.31%	1.85%	0.15%	2.16%	5.18%
2009	0.22%	-0.52%	1.05%	1.29%	2.30%	0.64%	1.57%	1.41%	1.44%	-0.85%	0.30%	0.84%	10.08%
2008	-3.56%	0.73%	-5.33%	1.39%	2.93%	-0.78%	-1.26%	-0.29%	-6.22%	-1.91%	-0.47%	0.02%	-14.14%
2007	2.91%	0.52%	1.58%	2.73%	3.29%	1.38%	0.49%	-2.42%	1.55%	3.19%	-2.14%	0.24%	13.94%
2006	1.93%	-0.26%	0.70%	0.54%	-2.18%	-0.38%	0.00%	2.09%	1.78%	1.76%	2.49%	2.44%	11.35%
2005	0.96%	1.35%	-0.51%	-1.01%	2.25%	1.36%	1.77%	0.60%	1.40%	-1.27%	1.22%	3.35%	11.98%
2004							-2.23%	-0.55%	1.56%	1.38%	2.73%	1.73%	4.62%

WHEN REVIEWING THIS FACT SHEET, PLEASE ALSO SEE IMPORTANT DISCLOSURES ON THE FOLLOWING PAGE

Past performance is not indicative of future results

Lighthouse Credit Opportunities Fund Limited

FIRM AUM
$10.4 billion†

STRATEGY
Credit

FUND INCEPTION
January 2003

FUND AUM
$171 million††

CLASS B

MANAGEMENT FEE
1% per annum

PERFORMANCE FEE
10% per annum

WITHDRAWAL TERMS
Semiannual redemptions with at least 135 days written notice

DOMICILE
Cayman Islands

AUDITOR
PricewaterhouseCoopers

ADMINISTRATOR
SS&C Fund Services (Cayman) Ltd.[4]

BLOOMBERG CODE
LHCOPLD KY

INVESTMENT MANAGER
Lighthouse Partners
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Suite 500
Palm Beach Gardens, FL 33410
T +1 561 741 0820
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Return summary[1,2]

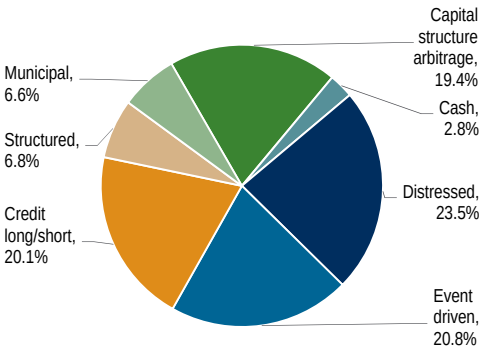
	December 2017	One Year	Three Year	Five Year
Lighthouse Credit Opportunities Fund Limited (net)	1.10%*	4.32%	-0.57%	1.98%
Barclays Govt/Credit Index	0.52%	4.00%	2.39%	2.13%
ML High Yield Master II Index	0.29%	7.48%	6.39%	5.80%

Performance characteristics[1,2,3]

	One Year	Three Year	Five Year
Annualized Compound Return	4.32%	-0.57%	1.98%
Annualized Standard Deviation	2.68%	4.52%	4.45%
Sharpe Ratio (annualized)[3]	1.27	-0.20	0.40
% positive months	67%	53%	62%
Maximum Drawdown	-1.32%	-15.86%	-17.27%
Beta to Barclays Gov/Credit	-0.07	-0.32	-0.22
Beta to ML High Yield Master II	0.64	0.38	0.38

Portfolio composition

December 2017 Strategy Allocations



Net historical performance[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD
2017	1.50%	0.96%	-0.57%	0.07%	-0.82%	0.47%	1.46%	-0.44%	0.28%	0.29%	-0.03%	1.10%*	4.32%*
2016	-3.26%	-1.33%	-0.41%	-1.01%	1.71%	0.75%	1.23%	1.16%	0.38%	1.29%	0.59%	1.49%	2.50%
2015	-1.04%	1.42%	-0.19%	1.41%	1.19%	-2.19%	-2.19%	-2.27%	-1.96%	-1.01%	-0.73%	-0.73%	-8.08%
2014	0.66%	2.02%	0.22%	0.48%	0.33%	1.53%	0.18%	-0.56%	-1.69%	-2.42%	0.99%	-0.72%	0.94%
2013	1.62%	0.41%	1.43%	0.61%	1.28%	-1.11%	0.89%	-0.26%	0.76%	1.08%	0.81%	3.21%	11.21%
2012	2.53%	1.87%	0.96%	0.33%	-1.53%	0.17%	0.34%	0.73%	1.18%	0.29%	0.17%	1.32%	8.63%
2011	1.89%	1.30%	0.90%	0.60%	0.48%	-1.01%	-0.39%	-2.30%	-3.55%	2.58%	-1.23%	-0.30%	-1.19%
2010	0.69%	-0.30%	2.87%	1.85%	-2.36%	-0.53%	1.62%	0.63%	1.45%	1.78%	0.15%	4.16%	12.52%
2009	1.45%	-0.04%	-0.62%	0.43%	3.28%	1.51%	3.14%	3.38%	4.08%	2.11%	0.26%	3.38%	24.63%
2008	-0.15%	0.98%	-0.81%	0.78%	0.65%	-0.64%	-2.34%	-1.19%	-3.59%	-8.32%	-5.67%	-4.73%	-22.74%
2007	1.38%	1.20%	0.72%	1.13%	1.01%	0.39%	0.19%	-0.82%	1.06%	1.28%	-0.51%	0.08%	7.32%
2006	1.49%	0.62%	0.85%	1.09%	-0.43%	-0.07%	0.38%	1.06%	0.57%	1.96%	1.69%	1.20%	10.88%
2005	0.07%	1.81%	0.02%	-0.31%	0.72%	1.03%	1.63%	1.33%	0.63%	-0.86%	0.54%	1.09%	7.93%
2004	2.30%	0.01%	0.22%	0.55%	-0.48%	0.94%	0.32%	0.53%	0.71%	0.80%	2.93%	1.99%	11.31%
2003	2.76%	0.39%	0.96%	3.19%	1.60%	2.24%	0.55%	0.74%	2.14%	2.00%	1.47%	1.49%	21.33%

WHEN REVIEWING THIS FACT SHEET, PLEASE ALSO SEE IMPORTANT DISCLOSURES ON THE FOLLOWING PAGE

Past performance is not indicative of future results

Lighthouse Diversified Fund Limited

FIRM AUM
$10.4 billion†

STRATEGY
Multi-Strategy

STRATEGY AUM
$6.4 billion††

FUND INCEPTION
February 2001

FUND AUM
$1.6 billion†††

CLASS A

MANAGEMENT FEE
1.5% per annum

PERFORMANCE FEE
None

WITHDRAWAL TERMS
Monthly redemptions with at least 90 days written notice

DOMICILE
Cayman Islands

AUDITOR
PricewaterhouseCoopers

ADMINISTRATOR
SS&C Fund Services (Cayman) Ltd.[4]

BLOOMBERG CODE
LHDVFLD KY

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Return summary[1,2]

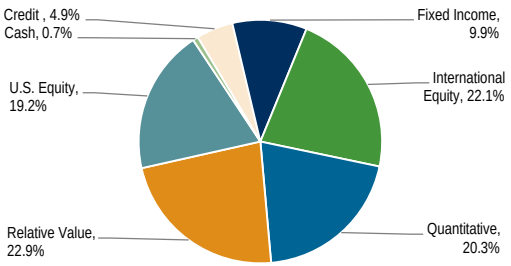
	December 2017	One Year	Three Year	Five Year
Lighthouse Diversified Fund Limited (net)	0.60%*	4.96%	3.07%	5.61%
S&P 500 TR Index	1.11%	21.84%	11.43%	15.81%
Barclays Gov/Credit Index	0.52%	4.00%	2.39%	2.13%
HFRX Global Hedge Fund Index	0.73%	5.99%	1.54%	2.12%

Performance characteristics[1,2,3]

	One Year	Three Year	Five Year
Annualized Compound Return	4.96%	3.07%	5.61%
Annualized Standard Deviation	1.48%	2.61%	2.88%
Sharpe Ratio (annualized)[3]	2.70	1.01	1.82
% positive months	83%	75%	80%
Maximum Drawdown	-0.33%	-3.66%	-3.66%
Beta to S&P 500 TR Index	0.03	0.16	0.16
Beta to Barclays Gov/Credit Index	0.08	-0.09	0.00

Portfolio composition

December 2017 Strategy Allocations[5]



Net historical performance[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD
2017	0.76%	0.55%	0.41%	-0.05%	0.22%	0.27%	0.66%	0.35%	0.09%	1.33%	-0.33%	0.60%*	4.96%*
2016	-2.06%	-0.28%	0.38%	-0.11%	0.62%	0.17%	0.82%	0.05%	0.64%	-0.35%	0.76%	0.55%	1.16%
2015	0.56%	1.17%	1.18%	0.32%	1.22%	-1.20%	0.34%	-1.19%	-1.33%	1.02%	0.18%	0.85%	3.11%
2014	1.58%	1.98%	-0.64%	0.07%	0.56%	1.24%	0.39%	0.54%	0.31%	-0.88%	1.80%	0.50%	7.66%
2013	1.37%	0.37%	1.05%	0.59%	0.20%	-0.45%	0.98%	0.03%	1.53%	1.54%	0.96%	2.75%	11.44%
2012	1.73%	1.65%	0.75%	0.11%	-1.00%	-0.09%	0.75%	0.80%	0.58%	-0.08%	0.45%	0.62%	6.42%
2011	1.08%	1.44%	0.90%	1.08%	-0.25%	-1.17%	0.22%	-2.49%	-1.65%	0.63%	-0.47%	-0.47%	-1.23%
2010	0.09%	-0.34%	1.35%	0.59%	-1.61%	-1.07%	1.15%	0.56%	0.95%	1.35%	-0.44%	2.96%	5.60%
2009	1.87%	0.85%	-0.17%	1.00%	4.08%	1.39%	2.62%	2.42%	2.19%	0.52%	0.56%	1.23%	20.14%
2008	-2.10%	1.91%	-2.60%	0.66%	1.91%	-0.18%	-2.75%	-1.78%	-6.24%	-5.38%	-2.74%	-3.05%	-20.49%
2007	1.58%	0.92%	1.35%	1.73%	2.20%	0.90%	-0.22%	-2.77%	1.18%	2.81%	-0.48%	0.25%	9.74%
2006	1.86%	0.32%	1.09%	0.79%	-1.04%	-0.14%	-0.03%	0.68%	1.14%	1.31%	1.68%	2.00%	10.05%
2005	0.54%	0.98%	-0.04%	-0.72%	0.56%	1.19%	1.07%	0.71%	1.37%	-0.42%	1.13%	1.33%	7.95%
2004	1.54%	1.06%	0.34%	-0.53%	-0.57%	0.13%	-0.03%	0.05%	0.48%	0.72%	1.84%	0.97%	6.13%
2003	0.95%	0.56%	-0.25%	1.20%	1.31%	0.59%	-0.72%	0.30%	1.27%	0.71%	0.72%	0.12%	6.95%
2002	0.99%	0.32%	0.95%	0.79%	0.46%	-0.10%	-0.10%	0.60%	0.31%	-0.05%	0.85%	1.45%	6.65%
2001		0.52%	0.52%	0.41%	-0.10%	-0.24%	0.22%	1.00%	-0.18%	1.08%	0.13%	0.59%	4.01%

WHEN REVIEWING THIS FACT SHEET, PLEASE ALSO SEE IMPORTANT DISCLOSURES ON THE FOLLOWING PAGE

Past performance is not indicative of future results

Artisan International Value Advisor (USD)

Morningstar Analyst Rating™	Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
Gold 05-11-2017	☆☆☆☆☆ 597 US Fund Foreign Large Blend	MSCI ACWI Ex USA NR USD	MSCI ACWI Ex USA NR USD	US Fund Foreign Large Blend

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	*3.65*	*0.71*	-8.57	3.08	*-1.61*
2016	0.82	-1.44	6.57	-0.22	5.67
2017	6.63	6.77	5.99	2.73	23.97

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	23.97	—	—	—	8.16
Std 12-31-2017	23.97	—	—	—	8.16
Total Return	23.97	*8.83*	*10.82*	*7.78*	8.16
+/- Std Index	-3.22	*0.99*	*4.02*	*5.94*	—
+/- Cat Index	-3.22	*0.99*	*4.02*	*5.94*	—
% Rank Cat	71	*21*	*3*	*1*	
No. in Cat	756	597	535	347	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-344-1770 or visit www.artisanfunds.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

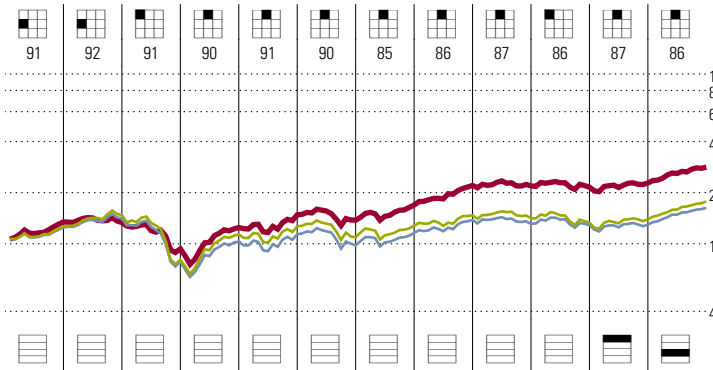
Management Fees %	0.93
12b1 Expense %	NA
Gross Expense Ratio %	**1.07**

Risk and Return Profile

	3 Yr *597 funds*	5 Yr *535 funds*	10 Yr *347 funds*
Morningstar Rating™	4☆	5☆	5☆
Morningstar Risk	*-Avg*	*Low*	*Low*
Morningstar Return	*+Avg*	*High*	*High*

	3 Yr	5 Yr	10 Yr
Standard Deviation	*10.24*	*10.00*	*15.91*
Mean	*8.83*	*10.82*	*7.78*
Sharpe Ratio	*0.84*	*1.05*	*0.53*

MPT Statistics	Standard Index	Best Fit Index
Alpha	*2.50*	—
Beta	*0.77*	—
R-Squared	*82.43*	—
12-Month Yield		—
Potential Cap Gains Exp		23.84%



Investment Style
Equity
Stocks %

Growth of $10,000
- Artisan International Value Advisor 28,248
- Category Average 16,259
- Standard Index 17,727

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
—	—	—	—	—	—	—	—	—	31.70	32.41	38.58	NAV/Price
34.46	*-0.67*	*-30.11*	*33.47*	*18.90*	*-7.14*	*22.82*	*30.49*	*-0.59*	*-1.61*	5.67	23.97	Total Return %
7.81	*-17.32*	*15.42*	*-7.98*	*7.75*	*6.57*	*5.99*	*15.20*	*3.27*	*4.05*	1.17	-3.22	+/- Standard Index
7.81	*-17.32*	*15.42*	*-7.98*	*7.75*	*6.57*	*5.99*	*15.20*	*3.27*	*4.05*	1.17	-3.22	+/- Category Index
—	—	—	—	—	—	—	—	—	—	8	71	% Rank Cat
—	—	—	—	—	—	—	—	—	—	762	756	No. of Funds in Cat

Portfolio Analysis 09-30-2017

Asset Allocation %	Net %	Long %	Short %
Cash	14.19	14.19	0.00
US Stocks	12.33	12.33	0.00
Non-US Stocks	73.27	73.27	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.21	0.21	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
	■	

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	21.3	1.27	1.20
P/C Ratio TTM	8.1	0.88	0.82
P/B Ratio TTM	1.9	1.08	0.99
Geo Avg Mkt Cap $mil	33949	0.94	0.78

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	20.3	1.99
Greater Europe	60.2	1.29
Greater Asia	19.5	0.45

Share Chg since 06-2017	Share Amount	Holdings : 49 Total Stocks , 0 Total Fixed-Income, 12% Turnover Ratio	Net Assets %
⊖	316,464	Samsung Electronics Co Ltd	4.75
⊖	3 mil	Baidu Inc ADR	4.52
⊕	39 mil	UBS Group AG	4.45
⊕	35 mil	ING Groep NV	4.33
⊕	6 mil	Arch Capital Group Ltd	4.16
⊕	29 mil	Compass Group PLC	4.09
⊕	22 mil	ABB Ltd	3.71
⊕	144 mil	Royal Bank of Scotland Group (The)	3.46
⊕	20 mil	RELX PLC	2.97
⊕	27 mil	Telefonica Brasil SA ADR	2.91
⊕	5 mil	TE Connectivity Ltd	2.81
⊕	4 mil	Groupe Bruxelles Lambert SA	2.49
⊕	5 mil	Medtronic PLC	2.49
⊕	4 mil	Cie Financiere Richemont SA	2.37
⊕	9 mil	ISS A/S	2.35

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**44.2**	**0.96**
Basic Materials	0.8	0.09
Consumer Cyclical	16.5	1.49
Financial Services	27.0	1.18
Real Estate	0.0	0.00
Sensitive	**40.9**	**1.20**
Communication Services	3.4	0.80
Energy	3.6	0.54
Industrials	13.0	1.17
Technology	20.9	1.75
Defensive	**14.9**	**0.75**
Consumer Defensive	9.4	0.96
Healthcare	5.5	0.75
Utilities	0.0	0.00

Operations

Family:	Artisan	Base Currency:	USD	Incept:	04-01-2015
Manager:	Multiple	Ticker:	APDKX	Type:	MF
Tenure:	15.3 Years	Minimum Initial Purchase:	$250,000	Total Assets:	$15,422.16 mil
Objective:	Foreign Stock	Purchase Constraints:	C		

MORNINGSTAR®

Brandes International Small Cap Equity I (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★	MSCI ACWI Ex USA NR USD	MSCI World Ex USA SMID NR USD	US Fund Foreign Small/Mid Value
59 US Fund Foreign Small/Mid Value			

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	6.01	1.43	-3.66	4.39	8.14
2016	3.37	-2.82	5.71	1.23	7.50
2017	6.29	2.34	1.29	1.45	11.78

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	11.78	9.13	10.15	—	11.06
Std 12-31-2017	11.78	—	10.15	—	11.06
Total Return	11.78	9.13	10.15	—	11.06
+/- Std Index	-15.41	1.29	3.35	—	—
+/- Cat Index	-17.52	-2.25	-0.26	—	—
% Rank Cat	96	73	43	—	
No. in Cat	64	59	44	—	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield 12-31-2017	1.08	1.07

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-331-2979 or visit www.brandesinstitutionalfunds.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

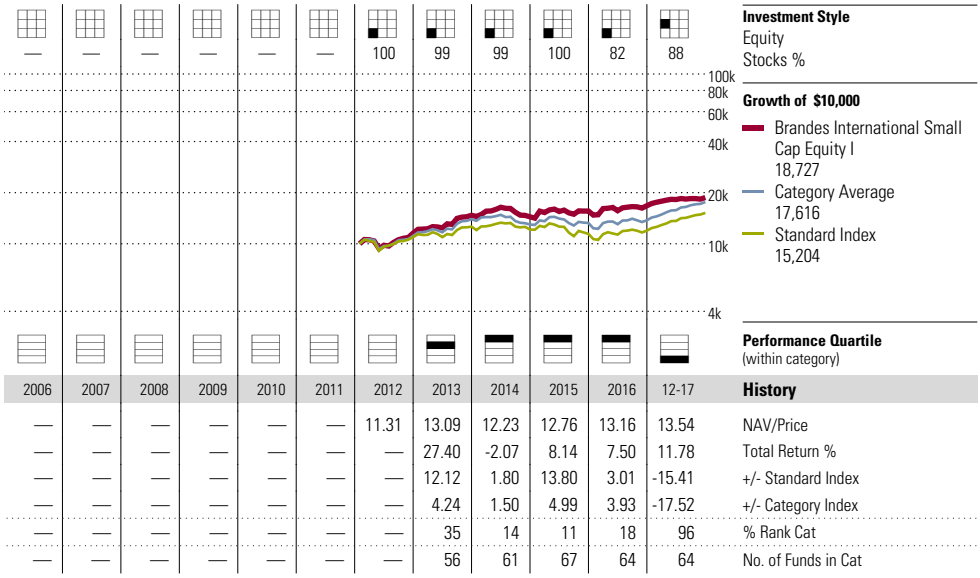
Management Fees %	0.95
12b1 Expense %	NA
Gross Expense Ratio %	**1.11**

Risk and Return Profile

	3 Yr 59 funds	5 Yr 44 funds	10 Yr *25 funds*
Morningstar Rating™	2★	3★	—
Morningstar Risk	Low	-Avg	—
Morningstar Return	-Avg	Avg	—

	3 Yr	5 Yr	10 Yr
Standard Deviation	10.64	10.56	—
Mean	9.13	10.15	—
Sharpe Ratio	0.83	0.94	—

MPT Statistics	Standard Index	Best Fit Index MSCI EASEA (EAFE ex JAPAN) NR USD
Alpha	3.05	3.79
Beta	0.74	0.74
R-Squared	70.23	74.25
12-Month Yield		4.83%
Potential Cap Gains Exp		2.57%



2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
—	—	—	—	—	—	11.31	13.09	12.23	12.76	13.16	13.54	NAV/Price
—	—	—	—	—	—	—	27.40	-2.07	8.14	7.50	11.78	Total Return %
—	—	—	—	—	—	—	12.12	1.80	13.80	3.01	-15.41	+/- Standard Index
—	—	—	—	—	—	—	4.24	1.50	4.99	3.93	-17.52	+/- Category Index
—	—	—	—	—	—	—	35	14	11	18	96	% Rank Cat
—	—	—	—	—	—	—	56	61	67	64	64	No. of Funds in Cat

	2012	2013	2014	2015	2016	12-17
	—	100	99	99	100	82	88

Investment Style
Equity
Stocks %

Growth of $10,000
- Brandes International Small Cap Equity I 18,727
- Category Average 17,616
- Standard Index 15,204

Performance Quartile (within category)

Portfolio Analysis 12-31-2017

Asset Allocation %	Net %	Long %	Short %
Cash	12.32	12.32	0.00
US Stocks	0.00	0.00	0.00
Non-US Stocks	87.68	87.68	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
■		

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	11.3	0.67	0.77
P/C Ratio TTM	5.3	0.58	0.62
P/B Ratio TTM	0.8	0.47	0.62
Geo Avg Mkt Cap $mil	1277	0.04	0.45

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	17.7	1.74
Greater Europe	37.6	0.80
Greater Asia	44.6	1.04

Share Chg since 09-2017	Share Amount	Holdings : 81 Total Stocks , 0 Total Fixed-Income, 21% Turnover Ratio	Net Assets %
⊖	10 mil	Embraer SA	3.38
⊕	17 mil	C&C Group PLC	3.35
	17 mil	Morrison (Wm) Supermarkets PLC	2.88
	1 mil	Toyo Suisan Kaisha Ltd	2.68
⊕	2 mil	Dorel Industries Inc Class B	2.35
	12 mil	Sainsbury (J) PLC	2.26
⊕	1 mil	Sankyo Co Ltd	2.25
⊖	1 mil	Kato Sangyo Co Ltd	2.18
	4 mil	Reliance Infrastructure Ltd	2.06
	2 mil	Komori Corp	2.00
	12 mil	MITIE Group PLC	1.85
⊖	1 mil	Kissei Pharmaceutical Co Ltd	1.82
	4 mil	Energy Company of Parana Class B	1.68
⊕	62 mil	Debenhams PLC	1.66
	5 mil	Hachijuni Bank Ltd	1.62

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**35.1**	**0.76**
Basic Materials	0.6	0.07
Consumer Cyclical	18.9	1.70
Financial Services	5.9	0.26
Real Estate	9.7	2.85
Sensitive	**26.7**	**0.78**
Communication Services	3.9	0.91
Energy	0.0	0.00
Industrials	15.7	1.42
Technology	7.1	0.59
Defensive	**38.2**	**1.91**
Consumer Defensive	24.8	2.54
Healthcare	6.8	0.93
Utilities	6.7	2.31

Operations

Family:	Brandes	Base Currency:	USD	Incept:	02-01-2012
Manager:	Multiple	Ticker:	BISMX	Type:	MF
Tenure:	15.1 Years	Minimum Initial Purchase:	$100,000	Total Assets:	$1,774.96 mil
Objective:	Small Company	Purchase Constraints:	—		

MORNINGSTAR®

DFA Emerging Markets Core Equity I (USD)

Morningstar Analyst Rating™ Silver 12-11-2017

Overall Morningstar Rating™ ★★★★ 647 US Fund Diversified Emerging Mkts

Standard Index MSCI ACWI Ex USA NR USD

Category Index MSCI EM NR USD

Morningstar Cat US Fund Diversified Emerging Mkts

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	1.96	0.36	-16.62	-0.20	-14.86
2016	7.26	2.22	7.97	-5.10	12.35
2017	13.68	4.68	6.54	7.71	36.55

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	36.55	9.32	4.73	3.04	8.97
Std 12-31-2017	36.55	—	4.73	3.04	8.97
Total Return	36.55	9.32	4.73	3.04	8.97
+/- Std Index	9.36	1.48	-2.07	1.20	—
+/- Cat Index	-0.73	0.21	0.38	1.36	—
% Rank Cat	42	33	37	13	
No. in Cat	806	647	467	186	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 888-576-1167 or visit www.dimensional.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

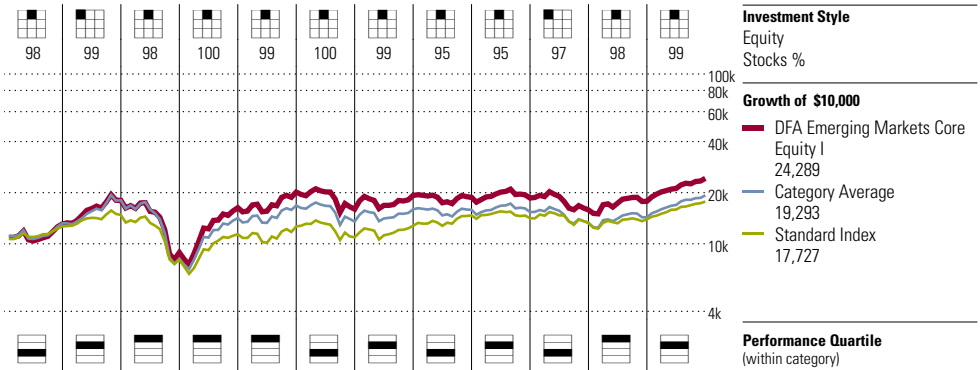
Management Fees %	0.47
12b1 Expense %	NA
Gross Expense Ratio %	**0.53**

Risk and Return Profile

	3 Yr 647 funds	5 Yr 467 funds	10 Yr 186 funds
Morningstar Rating™	3★	3★	4★
Morningstar Risk	Avg	Avg	Avg
Morningstar Return	+Avg	Avg	+Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation	15.05	14.11	23.31
Mean	9.32	4.73	3.04
Sharpe Ratio	0.64	0.38	0.23

MPT Statistics	Standard Index	Best Fit Index Morningstar EM GR USD
Alpha	1.45	-0.04
Beta	1.04	0.98
R-Squared	69.15	97.92
12-Month Yield		—
Potential Cap Gains Exp		19.54%



Investment Style
Equity
Stocks %

Growth of $10,000
- DFA Emerging Markets Core Equity I 24,289
- Category Average 19,293
- Standard Index 17,727

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
15.59	21.04	10.09	18.23	22.16	17.24	20.40	19.46	18.92	15.76	17.36	23.22	NAV/Price
30.95	37.49	-50.66	83.58	23.62	-20.65	20.49	-2.64	-0.91	-14.86	12.35	36.55	Total Return %
4.30	20.83	-5.13	42.13	12.47	-6.94	3.66	-17.93	2.95	-9.20	7.86	9.36	+/- Standard Index
-1.20	-1.93	2.67	5.07	4.74	-2.22	2.26	-0.04	1.27	0.06	1.17	-0.73	+/- Category Index
57	46	21	18	16	56	26	57	29	57	21	42	% Rank Cat
242	274	312	367	386	458	552	614	749	840	813	806	No. of Funds in Cat

Portfolio Analysis 11-30-2017

Asset Allocation %	Net %	Long %	Short %
Cash	1.07	1.10	0.03
US Stocks	0.01	0.01	0.00
Non-US Stocks	98.76	98.76	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.16	0.16	0.00
Total	100.00	100.03	0.03

Equity Style

Value	Blend	Growth
	■	

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	13.8	0.83	0.91
P/C Ratio TTM	7.5	0.81	0.73
P/B Ratio TTM	1.6	0.91	0.73
Geo Avg Mkt Cap $mil	8878	0.25	0.29

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	13.2	1.29
Greater Europe	12.4	0.27
Greater Asia	74.4	1.73

Share Chg since 10-2017	Share Amount	Holdings : 4,740 Total Stocks , 0 Total Fixed-Income, 4% Turnover Ratio	Net Assets %
⊕	475,015	Samsung Electronics Co Ltd	4.05
	10 mil	Tencent Holdings Ltd	1.94
⊕	8 mil	Taiwan Semiconductor Manufacturing	1.22
	41 mil	Taiwan Semiconductor Manufacturing	1.13
	3 mil	SK Hynix Inc	0.81
	243 mil	China Construction Bank Corp H	0.77
	56 mil	Hon Hai Precision Industry Co Ltd	0.68
	1 mil	Alibaba Group Holding Ltd ADR	0.68
	18 mil	Ping An Insurance (Group) Co. of C	0.64
⊕	15 mil	Vale SA	0.61
	186 mil	Industrial And Commercial Bank Of	0.53
⊕	11 mil	Itau Unibanco Holding SA	0.52
⊕	481,193	Naspers Ltd Class N	0.47
⊕	12 mil	MTN Group Ltd	0.41
	10 mil	China Mobile Ltd	0.38

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**45.0**	**0.98**
Basic Materials	11.1	1.28
Consumer Cyclical	12.2	1.10
Financial Services	18.0	0.79
Real Estate	3.7	1.08
Sensitive	**41.0**	**1.21**
Communication Services	4.1	0.97
Energy	5.0	0.74
Industrials	8.2	0.74
Technology	23.7	1.98
Defensive	**13.9**	**0.70**
Consumer Defensive	7.3	0.75
Healthcare	3.3	0.45
Utilities	3.3	1.15

Operations

Family:	Dimensional Fund Advisors	Base Currency:	USD	Incept:	04-05-2005
Manager:	Multiple	Ticker:	DFCEX	Type:	MF
Tenure:	7.9 Years	Minimum Initial Purchase:	$0	Total Assets:	$29,868.29 mil
Objective:	Diversified Emerging Markets	Purchase Constraints:	A		

MORNINGSTAR®

DFA International Core Equity I (USD)

Morningstar Analyst Rating™	Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
Bronze 03-15-2017	★★★★★ 597 US Fund Foreign Large Blend	MSCI ACWI Ex USA NR USD	MSCI ACWI Ex USA NR USD	US Fund Foreign Large Blend

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	4.13	2.60	-10.16	3.98	-0.21
2016	-0.90	-0.92	7.69	-0.37	5.34
2017	7.53	6.38	6.93	4.69	28.05

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	28.05	10.42	9.33	3.41	6.01
Std 12-31-2017	28.05	—	9.33	3.41	6.01
Total Return	28.05	10.42	9.33	3.41	6.01
+/- Std Index	0.86	2.58	2.53	1.57	—
+/- Cat Index	0.86	2.58	2.53	1.57	—
% Rank Cat	19	6	10	12	
No. in Cat	756	597	535	347	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 888-576-1167 or visit www.dimensional.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

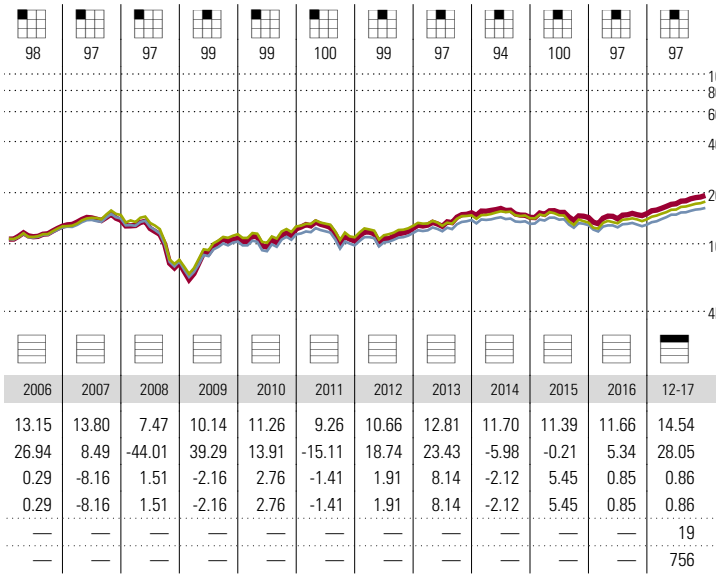
Management Fees %	0.27
12b1 Expense %	NA
Gross Expense Ratio %	**0.30**

Risk and Return Profile

	3 Yr 597 funds	5 Yr 535 funds	10 Yr 347 funds
Morningstar Rating™	5★	5★	4★
Morningstar Risk	Avg	+Avg	+Avg
Morningstar Return	High	High	+Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation	11.38	11.28	19.57
Mean	10.42	9.33	3.41
Sharpe Ratio	0.89	0.82	0.25

MPT Statistics	Standard Index	Best Fit Index Morningstar Gbl Mkts xUS GR USD
Alpha	2.91	1.09
Beta	0.92	0.95
R-Squared	95.26	95.36
12-Month Yield		—
Potential Cap Gains Exp		18.84%



Investment Style
Equity
Stocks %

Growth of $10,000
- DFA International Core Equity I: 19,264
- Category Average: 16,259
- Standard Index: 17,727

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
13.15	13.80	7.47	10.14	11.26	9.26	10.66	12.81	11.70	11.39	11.66	14.54	NAV/Price
26.94	8.49	-44.01	39.29	13.91	-15.11	18.74	23.43	-5.98	-0.21	5.34	28.05	Total Return %
0.29	-8.16	1.51	-2.16	2.76	-1.41	1.91	8.14	-2.12	5.45	0.85	0.86	+/- Standard Index
0.29	-8.16	1.51	-2.16	2.76	-1.41	1.91	8.14	-2.12	5.45	0.85	0.86	+/- Category Index
—	—	—	—	—	—	—	—	—	—	—	19	% Rank Cat
—	—	—	—	—	—	—	—	—	—	—	756	No. of Funds in Cat

Portfolio Analysis 11-30-2017

Asset Allocation %	Net %	Long %	Short %
Cash	0.56	0.56	0.00
US Stocks	3.32	3.32	0.00
Non-US Stocks	93.82	93.82	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	2.30	2.30	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
	■	

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	15.7	0.94	0.89
P/C Ratio TTM	8.3	0.90	0.84
P/B Ratio TTM	1.6	0.89	0.82
Geo Avg Mkt Cap $mil	9659	0.27	0.22

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	7.8	0.76
Greater Europe	56.1	1.20
Greater Asia	36.1	0.84

Share Chg since 10-2017	Share Amount	Holdings : 5,136 Total Stocks , 0 Total Fixed-Income, 6% Turnover Ratio	Net Assets %
	2 mil	Nestle SA	0.80
	3 mil	Toyota Motor Corp	0.67
⊕	3 mil	HSBC Holdings PLC ADR	0.60
⊕	2 mil	Daimler AG	0.59
	1 mil	Basf SE	0.53
⊖	2 mil	Royal Dutch Shell PLC ADR Class A	0.37
⊕	32 mil	Vodafone Group PLC	0.37
⊕	3 mil	Honda Motor Co Ltd	0.34
	1 mil	Royal Dutch Shell PLC ADR Class B	0.34
	5 mil	Deutsche Telekom AG	0.34
	2 mil	Total SA	0.34
	4 mil	BHP Billiton Ltd	0.33
⊕	399,360	Volkswagen AG	0.33
	2 mil	BP PLC ADR	0.33
	935,984	Novartis AG ADR	0.31

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**49.8**	**1.08**
Basic Materials	13.5	1.56
Consumer Cyclical	16.5	1.49
Financial Services	17.4	0.76
Real Estate	2.4	0.72
Sensitive	**34.5**	**1.01**
Communication Services	3.7	0.88
Energy	5.4	0.80
Industrials	17.6	1.59
Technology	7.8	0.65
Defensive	**15.7**	**0.78**
Consumer Defensive	7.4	0.76
Healthcare	5.1	0.70
Utilities	3.2	1.08

Operations

Family:	Dimensional Fund Advisors	Base Currency:	USD	Incept:	09-15-2005
Manager:	Multiple	Ticker:	DFIEX	Type:	MF
Tenure:	7.9 Years	Minimum Initial Purchase:	$0	Total Assets:	$28,284.52 mil
Objective:	Growth	Purchase Constraints:	A		

MORNINGSTAR®

DFA US Large Cap Value I (USD)

Morningstar Analyst Rating™	Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
Silver	★★★★	S&P 500 TR USD	Russell 1000 Value TR USD	US Fund Large Value
01-02-2018	1,090 US Fund Large Value			

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	-0.21	1.47	-9.36	5.15	-3.49
2016	0.13	3.97	5.14	8.63	18.89
2017	3.53	2.21	4.61	7.47	18.97

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	18.97	10.93	16.09	8.73	10.55
Std 12-31-2017	18.97	—	16.09	8.73	10.55
Total Return	18.97	10.93	16.09	8.73	10.55
+/- Std Index	-2.87	-0.48	0.30	0.23	—
+/- Cat Index	5.30	2.28	2.05	1.62	—
% Rank Cat	20	8	3	8	
No. in Cat	1260	1090	965	695	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 888-576-1167 or visit www.dimensional.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

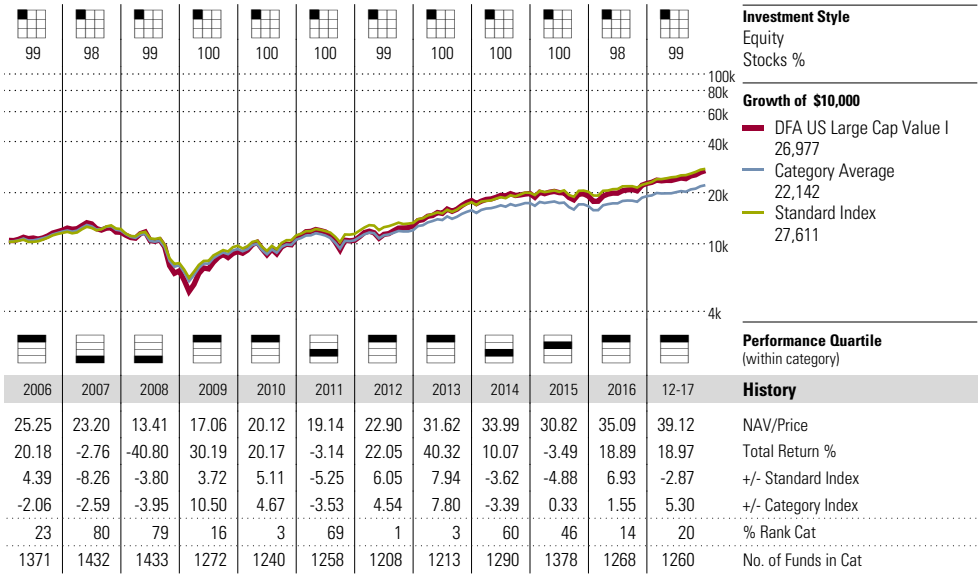
Management Fees %	0.35
12b1 Expense %	NA
Gross Expense Ratio %	**0.37**

Risk and Return Profile

	3 Yr 1090 funds	5 Yr 965 funds	10 Yr 695 funds
Morningstar Rating™	4★	5★	3★
Morningstar Risk	+Avg	+Avg	High
Morningstar Return	High	High	High

	3 Yr	5 Yr	10 Yr
Standard Deviation	12.08	11.18	19.15
Mean	10.93	16.09	8.73
Sharpe Ratio	0.89	1.37	0.52

MPT Statistics	Standard Index	Best Fit Index Russell 3000 Value TR USD
Alpha	-1.57	1.08
Beta	1.12	1.13
R-Squared	87.63	96.75
12-Month Yield		—
Potential Cap Gains Exp		34.21%



Investment Style
Equity
Stocks %

Growth of $10,000
- DFA US Large Cap Value I 26,977
- Category Average 22,142
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
25.25	23.20	13.41	17.06	20.12	19.14	22.90	31.62	33.99	30.82	35.09	39.12	NAV/Price
20.18	-2.76	-40.80	30.19	20.17	-3.14	22.05	40.32	10.07	-3.49	18.89	18.97	Total Return %
4.39	-8.26	-3.80	3.72	5.11	-5.25	6.05	7.94	-3.62	-4.88	6.93	-2.87	+/- Standard Index
-2.06	-2.59	-3.95	10.50	4.67	-3.53	4.54	7.80	-3.39	0.33	1.55	5.30	+/- Category Index
23	80	79	16	3	69	1	3	60	46	14	20	% Rank Cat
1371	1432	1433	1272	1240	1258	1208	1213	1290	1378	1268	1260	No. of Funds in Cat

Portfolio Analysis 11-30-2017

Asset Allocation %	Net %	Long %	Short %
Cash	1.06	1.06	0.00
US Stocks	98.10	98.10	0.00
Non-US Stocks	0.83	0.83	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
■		

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	18.4	0.81	0.96
P/C Ratio TTM	9.9	0.69	0.90
P/B Ratio TTM	1.9	0.60	0.88
Geo Avg Mkt Cap $mil	59666	0.62	0.63

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	99.2	1.00
Greater Europe	0.7	1.92
Greater Asia	0.2	0.32

Share Chg since 10-2017	Share Amount	Holdings : 316 Total Stocks , 0 Total Fixed-Income, 15% Turnover Ratio	Net Assets %
⊕	10 mil	JPMorgan Chase & Co	4.13
⊕	11 mil	Exxon Mobil Corp	3.73
⊕	20 mil	Intel Corp	3.55
⊕	24 mil	AT&T Inc	3.50
⊕	15 mil	Wells Fargo & Co	3.46
⊕	19 mil	Comcast Corp Class A	2.79
⊖	18 mil	Cisco Systems Inc	2.77
⊕	14 mil	Pfizer Inc	2.04
⊕	5 mil	Wal-Mart Stores Inc	1.90
⊕	4 mil	Chevron Corp	1.86
⊕	16 mil	Bank of America Corporation	1.83
⊖	6 mil	Citigroup Inc	1.81
⊕	4 mil	CVS Health Corp	1.24
⊕	5 mil	Qualcomm Inc	1.21
⊕	4 mil	Medtronic PLC	1.21

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**37.3**	**1.13**
Basic Materials	3.3	1.19
Consumer Cyclical	9.1	0.82
Financial Services	24.7	1.47
Real Estate	0.1	0.05
Sensitive	**42.6**	**1.02**
Communication Services	8.1	2.16
Energy	11.7	1.93
Industrials	8.4	0.78
Technology	14.3	0.67
Defensive	**20.1**	**0.79**
Consumer Defensive	6.0	0.72
Healthcare	13.9	0.99
Utilities	0.2	0.08

Operations

Family:	Dimensional Fund Advisors	Base Currency:	USD	Incept:	02-19-1993
Manager:	Multiple	Ticker:	DFLVX	Type:	MF
Tenure:	5.9 Years	Minimum Initial Purchase:	$0	Total Assets:	$26,201.75 mil
Objective:	Growth and Income	Purchase Constraints:	A		

MORNINGSTAR®

iShares iBoxx $ High Yield Corp Bd ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★ 609 US Fund High Yield Bond	BBgBarc US Agg Bond TR USD	ICE BofAML US High Yield TR USD	US Fund High Yield Bond

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	2.08	-0.73	-5.30	-1.58	-5.55
2016	2.70	4.38	4.96	1.26	13.92
2017	2.22	2.07	1.65	0.03	6.09

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	6.07	—	4.25	5.70	5.45
Std NAV 12-31-17	6.09	—	4.28	5.96	5.61
Mkt Total Ret	6.07	4.54	4.25	5.70	5.45
NAV Total Ret	6.09	4.51	4.28	5.96	5.61
+/- Std Index	2.55	2.27	2.18	1.95	—
+/- Cat Index	-1.39	-1.88	-1.52	-1.93	—
% Rank Cat	64	70	68	69	
No. in Cat	699	609	501	319	

	Subsidized	Unsubsidized
30-day SEC Yield 01-12-2018	5.11	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-474-2737 or visit www.ishares.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.49
Expense Ratio %	0.49
12b1 Expense %	NA

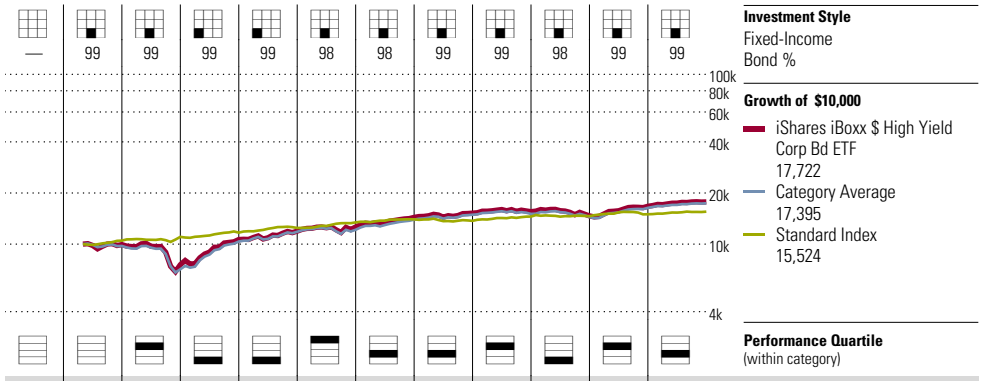
Risk and Return Profile

	3 Yr 609 funds	5 Yr 501 funds	10 Yr 319 funds
Morningstar Rating™	2★	2★	2★
Morningstar Risk	Avg	+Avg	+Avg
Morningstar Return	-Avg	Avg	-Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	5.41	5.21	10.61
Standard Deviation MKT	5.23	5.26	—
Mean NAV	4.51	4.28	5.96
Mean MKT	4.54	4.25	5.70
Sharpe Ratio	0.76	0.78	0.57

MPT Statistics	Standard Index	Best Fit Index ICE BofAML US High Yield TR USD
NAV		
Alpha	3.58	-1.44
Beta	0.30	0.94
R-Squared	2.39	97.07

12-Month Yield	5.14%
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	Markit iBoxx Liquid High Yield TR USD



Investment Style
Fixed-Income
Bond %

Growth of $10,000
- iShares iBoxx $ High Yield Corp Bd ETF 17,722
- Category Average 17,395
- Standard Index 15,524

Performance Quartile (within category)

History	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17
Mkt Total Ret %	—	—	-17.58	28.57	11.89	6.77	11.66	5.75	1.90	-5.03	13.41	6.07
NAV Total Ret %	—	—	-23.88	40.69	12.07	5.89	13.83	5.90	2.00	-5.55	13.92	6.09
+/- Standard Index	—	—	-29.12	34.76	5.53	-1.95	9.61	7.92	-3.96	-6.10	11.27	2.55
+/- Category Index	—	—	2.51	-16.82	-3.12	1.51	-1.75	-1.52	-0.50	-0.90	-3.57	-1.39
% Rank Cat	—	—	39	77	88	5	70	66	34	78	43	64
No. of Funds in Cat	—	—	559	543	574	573	598	662	731	769	707	699
Avg Prem/Discount %	—	*1.67*	2.48	1.78	0.56	0.91	0.53	0.16	0.15	0.29	0.47	—

Portfolio Analysis 01-12-2018

Asset Allocation % 01-11-2018	Net %	Long %	Short %
Cash	0.45	0.52	0.08
US Stocks	0.00	0.00	0.00
Non-US Stocks	0.00	0.00	0.00
Bonds	99.28	99.28	0.00
Other/Not Clsfd	0.27	0.27	0.00
Total	100.00	100.08	0.08

Equity Style

	Value	Blend	Growth
Large			
Mid			
Small			

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	—	—	—
P/C Ratio TTM	—	—	—
P/B Ratio TTM	—	—	—
Geo Avg Mkt Cap $mil	—	—	—

Fixed-Income Style

	Ltd	Mod	Ext
High			
Mid			
Low		■	

Avg Eff Maturity	4.04
Avg Eff Duration	3.50
Avg Wtd Coupon	6.16
Avg Wtd Price	103.79

Credit Quality Breakdown —	Bond %
AAA	0.77
AA	0.00
A	0.00
BBB	1.30
BB	47.80
B	38.05
Below B	12.08
NR	0.00

Regional Exposure	Stocks %	Rel Std Index
Americas	—	—
Greater Europe	—	—
Greater Asia	—	—

Top Holdings 01-11-2018

Share Chg since 01-2018	Share Amount	Holdings : 0 Total Stocks , 1,017 Total Fixed-Income, 13% Turnover Ratio	Net Assets %
⊖	101 mil	Numericable Grp Sa 144A 7.375%	0.60
⊖	82 mil	Sprint 7.875%	0.52
⊖	80 mil	Numericable Grp Sa 144A 6%	0.47
⊖	68 mil	Western Digital 10.5%	0.46
⊖	63 mil	Prime Sec Svcs Borrower Llc / 144A	0.41
⊖	66 mil	First Data 144A 7%	0.40
⊖	59 mil	Hca 6.5%	0.37
⊖	64 mil	Cco Hldgs Llc / Cco Hldgs Ca 144A	0.36
⊖	64 mil	Vrx Escrow 144A 5.875%	0.34
⊖	58 mil	Reynolds Grp Issuer 5.75%	0.34
⊖	62 mil	Vrx Escrow 144A 6.125%	0.34
⊖	53 mil	Altice Financing S.A. 144A 7.5%	0.33
⊖	54 mil	Tenet Healthcare 8.125%	0.33
⊖	61 mil	Chs / Cmnty Health Sys 6.25%	0.33
⊖	56 mil	Altice Sa 144A 7.75%	0.32

Sector Weightings	Stocks %	Rel Std Index
Cyclical	—	—
Basic Materials	—	—
Consumer Cyclical	—	—
Financial Services	—	—
Real Estate	—	—
Sensitive	—	—
Communication Services	—	—
Energy	—	—
Industrials	—	—
Technology	—	—
Defensive	—	—
Consumer Defensive	—	—
Healthcare	—	—
Utilities	—	—

Operations

Family:	iShares	Ticker:	HYG	Prem/Discount:	0.33
Manager:	Multiple	Incept:	04-04-2007	Mkt Price:	87.26
Tenure:	7.5 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$17,429.4 mil	Exchange:	NYSE ARCA	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	199.10 mil	NAV:	86.97	Backing Bank:	BlackRock Fund Advisors

MORNINGSTAR®

iShares MSCI EAFE Small-Cap ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★★ 72 US Fund Foreign Small/Mid Blend	MSCI ACWI Ex USA NR USD	MSCI World Ex USA SMID NR USD	US Fund Foreign Small/Mid Blend

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	5.37	4.30	-6.81	6.58	9.16
2016	-0.56	-2.57	8.83	-2.87	2.42
2017	7.96	8.10	7.31	5.81	32.51

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	32.73	—	12.41	5.13	5.07
Std NAV 12-31-17	32.51	—	12.70	5.64	5.19
Mkt Total Ret	32.73	14.12	12.41	5.13	5.07
NAV Total Ret	32.51	14.00	12.70	5.64	5.19
+/- Std Index	5.32	6.17	5.90	3.80	—
+/- Cat Index	3.21	2.63	2.30	1.42	—
% Rank Cat	46	17	28	18	
No. in Cat	106	72	61	39	

	Subsidized	Unsubsidized
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-474-2737 or visit www.ishares.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.40
Expense Ratio %	0.40
12b1 Expense %	NA

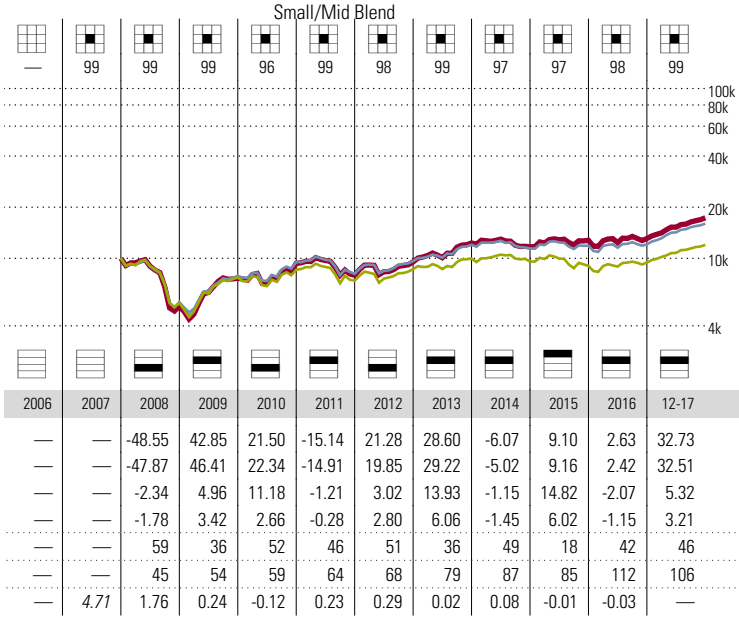
Risk and Return Profile

	3 Yr 72 funds	5 Yr 61 funds	10 Yr 39 funds
Morningstar Rating™	4★	4★	4★
Morningstar Risk	Avg	+Avg	+Avg
Morningstar Return	+Avg	+Avg	+Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	11.70	11.52	19.68
Standard Deviation MKT	11.03	11.44	20.10
Mean NAV	14.00	12.70	5.64
Mean MKT	14.12	12.41	5.13
Sharpe Ratio	1.15	1.08	0.36

MPT Statistics NAV	Standard Index	Best Fit Index MSCI EAFE NR USD
Alpha	6.39	6.22
Beta	0.90	0.92
R-Squared	84.73	89.30

12-Month Yield	—
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	MSCI EAFE Small Cap NR USD



Investment Style
Equity
Stocks %

Growth of $10,000
- iShares MSCI EAFE Small-Cap ETF 17,314
- Category Average 16,005
- Standard Index 11,999

Performance Quartile (within category)

History	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17
Mkt Total Ret %	—	—	-48.55	42.85	21.50	-15.14	21.28	28.60	-6.07	9.10	2.63	32.73
NAV Total Ret %	—	—	-47.87	46.41	22.34	-14.91	19.85	29.22	-5.02	9.16	2.42	32.51
+/- Standard Index	—	—	-2.34	4.96	11.18	-1.21	3.02	13.93	-1.15	14.82	-2.07	5.32
+/- Category Index	—	—	-1.78	3.42	2.66	-0.28	2.80	6.06	-1.45	6.02	-1.15	3.21
% Rank Cat	—	—	59	36	52	46	51	36	49	18	42	46
No. of Funds in Cat	—	—	45	54	59	64	68	79	87	85	112	106
Avg Prem/Discount %	—	*4.71*	1.76	0.24	-0.12	0.23	0.29	0.02	0.08	-0.01	-0.03	—

Portfolio Analysis 01-12-2018

Asset Allocation % 01-11-2018	Net %	Long %	Short %
Cash	0.43	0.43	0.00
US Stocks	0.62	0.62	0.00
Non-US Stocks	98.50	98.50	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.46	0.46	0.00
Total	100.00	100.00	0.00

Equity Style

	Value	Blend	Growth
Large			
Mid		■	
Small			

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	16.5	0.98	0.99
P/C Ratio TTM	9.5	1.03	0.85
P/B Ratio TTM	1.7	0.98	3.29
Geo Avg Mkt Cap $mil	2327	0.06	0.85

Fixed-Income Style

	Ltd	Mod	Ext
High			
Med			
Low			

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	0.7	0.07
Greater Europe	57.3	1.23
Greater Asia	42.0	0.97

Top Holdings 01-11-2018

Share Chg since 01-2018	Share Amount	Holdings : 1,577 Total Stocks , 3 Total Fixed-Income, 6% Turnover Ratio	Net Assets %
	256,252	Temenos Group AG	0.32
	3 mil	Informa PLC	0.31
	8 mil	Rentokil Initial PLC	0.31
	946,997	Smurfit Kappa Group PLC	0.30
	2 mil	Halma PLC	0.29
	263,248	LEG Immobilien AG	0.28
	610,605	Kingspan Group PLC	0.26
	516,530	Aalberts Industries NV	0.26
	2 mil	Svenska Cellulosa AB B	0.25
	4 mil	Smith (DS) PLC	0.25
	543,298	Bellway PLC	0.24
	421,562	Rightmove PLC	0.24
	211,172	Orpea SA	0.24
	544,800	Showa Denko KK	0.24
	276,797	ams AG	0.24

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**48.2**	**1.05**
Basic Materials	10.3	1.19
Consumer Cyclical	16.2	1.46
Financial Services	12.0	0.52
Real Estate	9.8	2.87
Sensitive	**35.9**	**1.06**
Communication Services	1.2	0.28
Energy	2.1	0.31
Industrials	20.4	1.84
Technology	12.2	1.02
Defensive	**15.9**	**0.79**
Consumer Defensive	7.3	0.75
Healthcare	6.8	0.93
Utilities	1.8	0.62

Operations

Family:	iShares	Ticker:	SCZ	Prem/Discount:	-0.15
Manager:	Multiple	Incept:	12-10-2007	Mkt Price:	64.50
Tenure:	10.0 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$10,728.9 mil	Exchange:	NASDAQ	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	160.40 mil	NAV:	64.60	Backing Bank:	BlackRock Fund Advisors

MORNINGSTAR®

iShares Russell 1000 Growth ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★★ 1,216 US Fund Large Growth	S&P 500 TR USD	Russell 1000 Growth TR USD	US Fund Large Growth

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	3.79	0.08	-5.33	7.26	5.48
2016	0.70	0.57	4.54	0.98	6.92
2017	8.85	4.61	5.86	7.81	29.96

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	29.95	—	17.11	9.84	4.26
Std NAV 12-31-17	29.96	—	17.11	9.80	4.26
Mkt Total Ret	29.95	13.63	17.11	9.84	4.26
NAV Total Ret	29.96	13.59	17.11	9.80	4.26
+/- Std Index	8.12	2.18	1.32	1.31	—
+/- Cat Index	-0.26	-0.20	-0.22	-0.19	—
% Rank Cat	35	17	20	20	
No. in Cat	1,363	1,216	1,109	787	

	Subsidized	Unsubsidized
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-474-2737 or visit www.ishares.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.20
Expense Ratio %	0.20
12b1 Expense %	NA

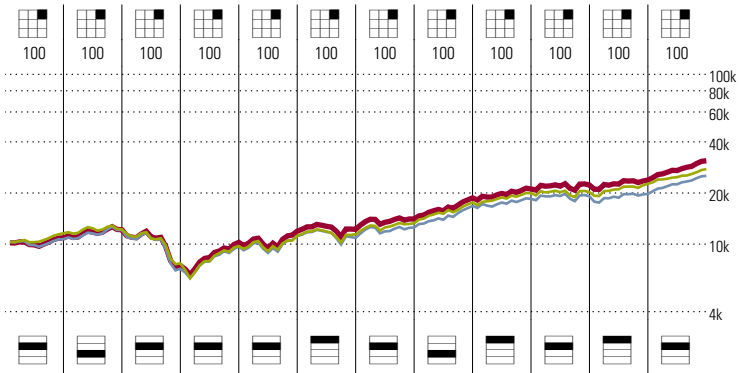
Risk and Return Profile

	3 Yr	5 Yr	10 Yr
	1216 funds	1109 funds	787 funds
Morningstar Rating™	4★	4★	4★
Morningstar Risk	-Avg	-Avg	-Avg
Morningstar Return	+Avg	+Avg	+Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	10.68	9.96	15.37
Standard Deviation MKT	10.73	10.03	15.42
Mean NAV	13.59	17.11	9.80
Mean MKT	13.63	17.11	9.84
Sharpe Ratio	1.21	1.62	0.67

MPT Statistics	Standard Index	Best Fit Index
NAV		Russell 1000 Growth TR USD
Alpha	1.77	-0.17
Beta	1.02	1.00
R-Squared	92.82	100.00

12-Month Yield	—
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	Russell 1000 Growth TR USD



Investment Style
Equity
Stocks %

Growth of $10,000
- iShares Russell 1000 Growth ETF 30,960
- Category Average 25,231
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
8.94	11.49	-38.22	36.70	16.52	2.33	15.22	33.14	12.78	5.50	7.01	29.95	Mkt Total Ret %
8.86	11.63	-38.48	36.94	16.47	2.47	15.03	33.19	12.84	5.48	6.92	29.96	NAV Total Ret %
-6.93	6.13	-1.48	10.48	1.41	0.36	-0.97	0.80	-0.85	4.09	-5.04	8.12	+/- Standard Index
-0.21	-0.19	-0.04	-0.27	-0.24	-0.17	-0.23	-0.29	-0.21	-0.19	-0.16	-0.26	+/- Category Index
33	59	34	37	39	11	50	55	22	36	22	35	% Rank Cat
1642	1748	1809	1796	1718	1683	1681	1712	1710	1681	1463	1363	No. of Funds in Cat
0.01	-0.01	0.11	-0.08	-0.04	-0.03	0.00	-0.01	-0.02	-0.01	-0.02	—	Avg Prem/Discount %

Portfolio Analysis 01-12-2018

Asset Allocation % 01-11-2018	Net %	Long %	Short %
Cash	0.32	0.32	0.00
US Stocks	98.51	98.51	0.00
Non-US Stocks	1.17	1.17	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.00	0.00

Equity Style

	Value	Blend	Growth
Large			■
Mid			
Small			

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	26.6	1.16	0.97
P/C Ratio TTM	17.4	1.21	0.99
P/B Ratio TTM	6.4	2.00	33.51
Geo Avg Mkt Cap $mil	89542	0.93	0.67

Fixed-Income Style

	Ltd	Mod	Ext
High			
Mid			
Low			

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	98.8	1.00
Greater Europe	0.1	0.17
Greater Asia	1.1	2.18

Top Holdings 01-11-2018

Share Chg since 01-2018	Share Amount	Holdings : 551 Total Stocks , 0 Total Fixed-Income, 14% Turnover Ratio	Net Assets %
⊖	16 mil	Apple Inc	6.74
⊖	23 mil	Microsoft Corp	4.94
⊖	1 mil	Amazon.com Inc	3.79
⊖	7 mil	Facebook Inc A	3.28
⊖	943,353	Alphabet Inc C	2.50
⊖	928,676	Alphabet Inc A	2.48
⊖	4 mil	The Home Depot Inc	1.72
⊖	6 mil	Visa Inc Class A	1.63
⊖	3 mil	UnitedHealth Group Inc	1.62
⊖	13 mil	Comcast Corp Class A	1.37
⊖	2 mil	Boeing Co	1.37
⊖	5 mil	AbbVie Inc	1.18
⊖	3 mil	Mastercard Inc A	1.13
⊖	4 mil	PepsiCo Inc	1.09
⊖	2 mil	3M Co	1.05

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**29.1**	**0.89**
Basic Materials	3.2	1.15
Consumer Cyclical	17.0	1.53
Financial Services	7.1	0.42
Real Estate	1.8	0.81
Sensitive	**51.5**	**1.23**
Communication Services	3.2	0.85
Energy	0.9	0.15
Industrials	14.1	1.32
Technology	33.4	1.57
Defensive	**19.3**	**0.76**
Consumer Defensive	6.7	0.80
Healthcare	12.6	0.90
Utilities	0.0	0.00

Operations

Family:	iShares	Ticker:	IWF	Prem/Discount:	0.07
Manager:	Multiple	Incept:	05-22-2000	Mkt Price:	134.68
Tenure:	10.0 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$41,988.7 mil	Exchange:	NYSE ARCA	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	297.25 mil	NAV:	134.58	Backing Bank:	BlackRock Fund Advisors

MORNINGSTAR®

iShares Russell 1000 Value ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★ 1,090 US Fund Large Value	S&P 500 TR USD	Russell 1000 Value TR USD	US Fund Large Value

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	-0.76	0.07	-8.40	5.60	-3.95
2016	1.60	4.51	3.43	6.61	17.09
2017	3.22	1.31	3.07	5.28	13.47

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	13.45	—	13.82	6.98	6.98
Std NAV 12-31-17	13.47	—	13.81	6.94	6.98
Mkt Total Ret	13.45	8.51	13.82	6.98	6.98
NAV Total Ret	13.47	8.47	13.81	6.94	6.98
+/- Std Index	-8.36	-2.94	-1.98	-1.56	—
+/- Cat Index	-0.20	-0.18	-0.22	-0.17	—
% Rank Cat	79	56	44	51	
No. in Cat	1,260	1,090	965	695	

	Subsidized	Unsubsidized
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-474-2737 or visit www.ishares.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.20
Expense Ratio %	0.20
12b1 Expense %	NA

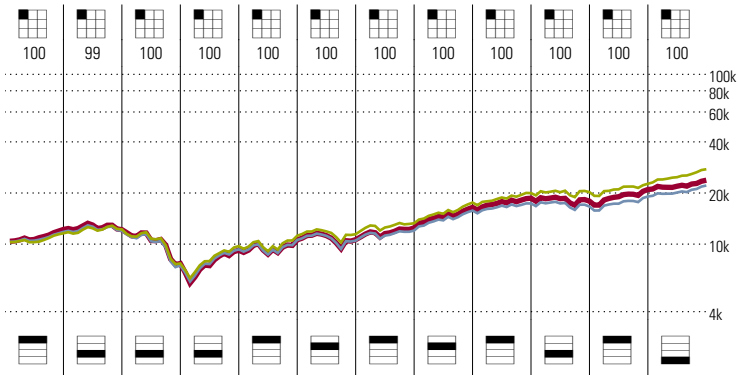
Risk and Return Profile

	3 Yr 1090 funds	5 Yr 965 funds	10 Yr 695 funds
Morningstar Rating™	3★	3★	3★
Morningstar Risk	Avg	Avg	Avg
Morningstar Return	Avg	Avg	Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	10.34	9.90	15.88
Standard Deviation MKT	10.36	9.92	15.84
Mean NAV	8.47	13.81	6.94
Mean MKT	8.51	13.82	6.98
Sharpe Ratio	0.80	1.33	0.48

MPT Statistics	Standard Index	Best Fit Index Russell 1000 Value TR USD
NAV		
Alpha	-2.47	-0.17
Beta	0.98	1.00
R-Squared	91.35	100.00

12-Month Yield	—
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	Russell 1000 Value TR USD



Investment Style
Equity
Stocks %

Growth of $10,000
- iShares Russell 1000 Value ETF 23,789
- Category Average 22,142
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
22.48	-0.72	-36.47	19.18	15.49	0.12	17.46	32.09	13.17	-3.97	17.26	13.45	Mkt Total Ret %
22.00	-0.29	-36.83	19.64	15.30	0.21	17.28	32.18	13.21	-3.95	17.09	13.47	NAV Total Ret %
6.21	-5.78	0.17	-6.83	0.24	-1.90	1.27	-0.21	-0.48	-5.33	5.14	-8.36	+/- Standard Index
-0.25	-0.12	0.02	-0.05	-0.21	-0.18	-0.23	-0.35	-0.25	-0.12	-0.25	-0.20	+/- Category Index
8	65	54	68	24	40	20	40	12	54	25	79	% Rank Cat
1371	1432	1433	1272	1240	1258	1208	1213	1290	1378	1268	1260	No. of Funds in Cat
0.03	0.00	0.04	0.04	-0.02	-0.02	-0.05	0.00	0.00	0.00	-0.02	—	Avg Prem/Discount %

Portfolio Analysis 01-12-2018

Asset Allocation % 01-11-2018	Net %	Long %	Short %
Cash	0.35	0.35	0.00
US Stocks	98.78	98.78	0.00
Non-US Stocks	0.87	0.87	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth	
■			Large
			Mid
			Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	19.6	0.86	1.02
P/C Ratio TTM	11.3	0.79	1.03
P/B Ratio TTM	2.0	0.64	4.41
Geo Avg Mkt Cap $mil	61512	0.64	0.65

Fixed-Income Style

Ltd	Mod	Ext	
			High
			Mid
			Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	99.2	1.00
Greater Europe	0.6	1.73
Greater Asia	0.2	0.44

Top Holdings 01-11-2018

Share Chg since 01-2018	Share Amount	Holdings : 713 Total Stocks , 0 Total Fixed-Income, 13% Turnover Ratio	Net Assets %
	6 mil	Berkshire Hathaway Inc B	3.07
	11 mil	JPMorgan Chase & Co	2.96
	13 mil	Exxon Mobil Corp	2.85
	7 mil	Johnson & Johnson	2.56
	31 mil	Bank of America Corporation	2.30
	14 mil	Wells Fargo & Co	2.16
	6 mil	Chevron Corp	1.94
	20 mil	AT&T Inc	1.73
	8 mil	Procter & Gamble Co	1.69
	19 mil	Pfizer Inc	1.67
	15 mil	Intel Corp	1.58
	8 mil	Citigroup Inc	1.54
	16 mil	Cisco Systems Inc	1.54
	8 mil	Merck & Co Inc	1.15
	4 mil	Philip Morris International Inc	1.14

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**40.6**	**1.24**
Basic Materials	3.1	1.10
Consumer Cyclical	6.5	0.59
Financial Services	26.6	1.58
Real Estate	4.4	2.04
Sensitive	**31.3**	**0.75**
Communication Services	3.2	0.85
Energy	11.5	1.89
Industrials	8.3	0.78
Technology	8.3	0.39
Defensive	**28.1**	**1.11**
Consumer Defensive	8.4	1.01
Healthcare	14.3	1.02
Utilities	5.4	1.84

Operations

Family:	iShares	Ticker:	IWD	Prem/Discount:	0.12
Manager:	Multiple	Incept:	05-22-2000	Mkt Price:	124.34
Tenure:	10.0 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$41,349.7 mil	Exchange:	NYSE ARCA	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	322.10 mil	NAV:	124.19	Backing Bank:	BlackRock Fund Advisors

MORNINGSTAR®

iShares Russell 2000 Growth ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★ 609 US Fund Small Growth	S&P 500 TR USD	Russell 2000 Growth TR USD	US Fund Small Growth

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	6.69	1.99	-13.02	4.40	-1.19
2016	-4.62	3.26	9.24	3.61	11.47
2017	5.37	4.41	6.24	4.59	22.24

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	22.25	—	15.37	9.32	5.57
Std NAV 12-31-17	22.24	—	15.35	9.29	5.57
Mkt Total Ret	22.25	10.44	15.37	9.32	5.57
NAV Total Ret	22.24	10.42	15.35	9.29	5.57
+/- Std Index	0.41	-0.99	-0.44	0.79	—
+/- Cat Index	0.08	0.15	0.14	0.10	—
% Rank Cat	44	43	28	29	
No. in Cat	684	609	544	406	

	Subsidized	Unsubsidized
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-474-2737 or visit www.ishares.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.24
Expense Ratio %	0.24
12b1 Expense %	NA

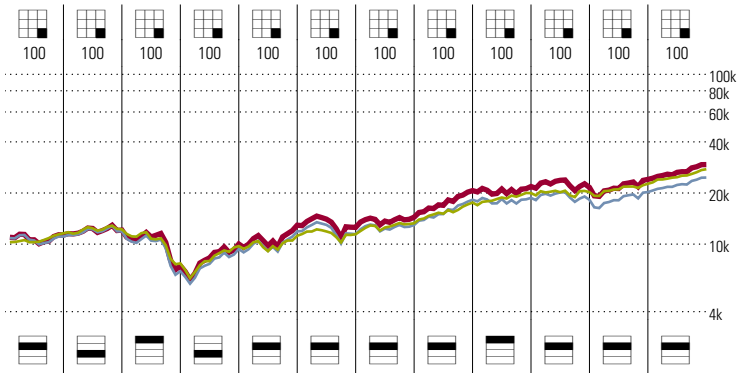
Risk and Return Profile

	3 Yr 609 funds	5 Yr 544 funds	10 Yr 406 funds
Morningstar Rating™	3★	4★	3★
Morningstar Risk	+Avg	+Avg	+Avg
Morningstar Return	Avg	+Avg	+Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	14.80	14.57	20.29
Standard Deviation MKT	14.68	14.52	20.15
Mean NAV	10.42	15.35	9.29
Mean MKT	10.44	15.37	9.32
Sharpe Ratio	0.72	1.04	0.53

MPT Statistics	Standard Index	Best Fit Index Russell 2000 Growth TR USD
NAV		
Alpha	-2.54	0.14
Beta	1.21	1.00
R-Squared	67.03	100.00

12-Month Yield	—
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	Russell 2000 Growth TR USD



Investment Style
Equity
Stocks %

Growth of $10,000
- iShares Russell 2000 Growth ETF 29,402
- Category Average 24,662
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
13.18	6.86	-38.50	34.60	29.40	-3.00	14.83	43.33	5.86	-1.34	11.68	22.25	Mkt Total Ret %
13.13	6.93	-38.44	34.39	29.07	-2.86	14.74	43.44	5.72	-1.19	11.47	22.24	NAV Total Ret %
-2.66	1.43	-1.44	7.93	14.01	-4.97	-1.26	11.05	-7.97	-2.57	-0.49	0.41	+/- Standard Index
-0.21	-0.12	0.10	-0.08	-0.01	0.05	0.16	0.14	0.12	0.19	0.15	0.08	+/- Category Index
29	54	23	51	36	46	35	37	22	34	43	44	% Rank Cat
763	829	834	778	758	764	743	714	722	730	669	684	No. of Funds in Cat
-0.19	-0.10	-0.12	-0.04	-0.03	-0.05	-0.08	-0.08	-0.04	-0.06	-0.03	—	Avg Prem/Discount %

Portfolio Analysis 01-12-2018

Asset Allocation % 01-11-2018	Net %	Long %	Short %
Cash	0.15	0.15	0.00
US Stocks	99.43	99.43	0.00
Non-US Stocks	0.38	0.38	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.04	0.04	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth	
			Large
			Mid
		■	Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	25.5	1.12	0.89
P/C Ratio TTM	15.0	1.05	0.81
P/B Ratio TTM	4.2	1.31	16.47
Geo Avg Mkt Cap $mil	2179	0.02	0.57

Fixed-Income Style

Ltd	Mod	Ext	
			High
			Mid
			Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	99.7	1.01
Greater Europe	0.2	0.63
Greater Asia	0.1	0.10

Top Holdings 01-11-2018

Share Chg since 01-2018	Share Amount	Holdings : 1,171 Total Stocks , 0 Total Fixed-Income, 28% Turnover Ratio	Net Assets %
⊖	1 mil	Nektar Therapeutics Inc	0.92
⊖	315,404	Sage Therapeutics Inc	0.59
⊖	980,753	Exact Sciences Corp	0.57
⊖	716,644	GrubHub Inc	0.52
⊖	1 mil	Knight-Swift Transportation Holdin	0.50
⊖	1 mil	Catalent Inc	0.50
⊖	415,704	EPAM Systems Inc	0.49
⊖	609,859	Aspen Technology Inc	0.48
⊖	449,672	MKS Instruments Inc	0.46
⊖	821,391	Encompass Health Corp	0.44
⊖	333,449	Monolithic Power Systems Inc	0.43
⊖	248,731	Fair Isaac Corp	0.42
⊖	369,721	Primerica Inc	0.41
⊖	535,823	Maximus Inc	0.41
⊖	1 mil	Entegris Inc	0.41

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**30.5**	**0.93**
Basic Materials	7.0	2.48
Consumer Cyclical	13.9	1.25
Financial Services	6.6	0.39
Real Estate	3.1	1.42
Sensitive	**42.4**	**1.02**
Communication Services	1.6	0.41
Energy	1.2	0.19
Industrials	15.6	1.46
Technology	24.1	1.13
Defensive	**27.0**	**1.07**
Consumer Defensive	3.8	0.46
Healthcare	22.6	1.60
Utilities	0.7	0.23

Operations

Family:	iShares	Ticker:	IWO	Prem/Discount:	0.03
Manager:	Multiple	Incept:	07-24-2000	Mkt Price:	186.70
Tenure:	10.0 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$9,442.9 mil	Exchange:	NYSE ARCA	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	48.70 mil	NAV:	186.64	Backing Bank:	BlackRock Fund Advisors

MORNINGSTAR®

iShares Russell Mid-Cap Growth ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★★ 562 US Fund Mid-Cap Growth	S&P 500 TR USD	Russell Mid Cap Growth TR USD	US Fund Mid-Cap Growth

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	5.33	-1.18	-8.04	4.07	-0.39
2016	0.54	1.52	4.54	0.41	7.15
2017	6.84	4.14	5.23	6.75	24.98

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	24.94	—	15.08	8.89	8.36
Std NAV 12-31-17	24.98	—	15.07	8.89	8.36
Mkt Total Ret	24.94	10.07	15.08	8.89	8.36
NAV Total Ret	24.98	10.08	15.07	8.89	8.36
+/- Std Index	3.15	-1.33	-0.72	0.39	—
+/- Cat Index	-0.28	-0.22	-0.23	-0.21	—
% Rank Cat	41	39	21	25	
No. in Cat	617	562	490	362	

	Subsidized	Unsubsidized
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-474-2737 or visit www.ishares.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.25
Expense Ratio %	0.25
12b1 Expense %	NA

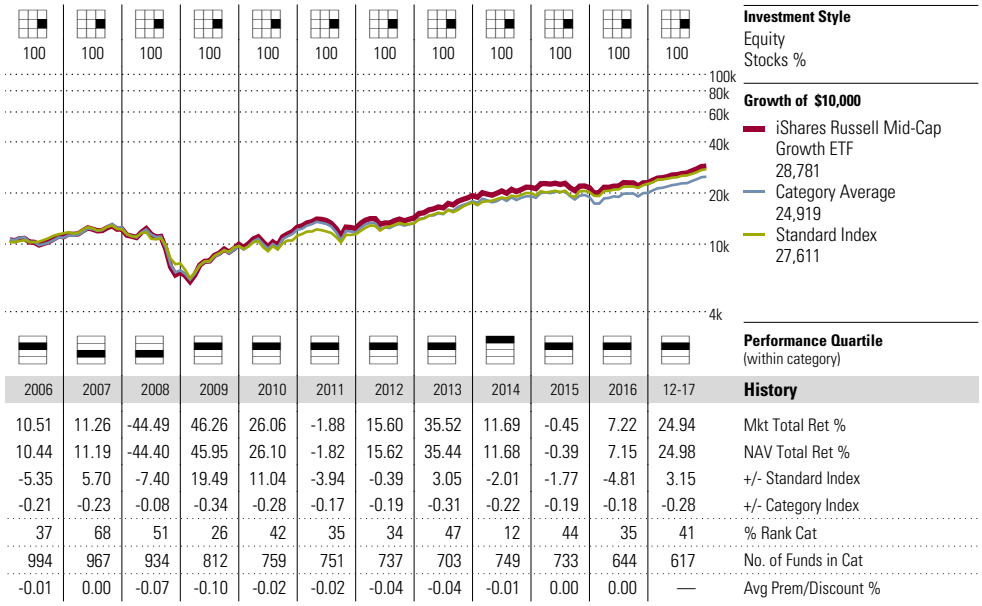
Risk and Return Profile

	3 Yr	5 Yr	10 Yr
	562 funds	490 funds	362 funds
Morningstar Rating™	3★	4★	4★
Morningstar Risk	Avg	-Avg	Avg
Morningstar Return	Avg	+Avg	+Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	11.04	10.81	17.99
Standard Deviation MKT	11.05	10.88	18.02
Mean NAV	10.08	15.07	8.89
Mean MKT	10.07	15.08	8.89
Sharpe Ratio	0.89	1.33	0.55

MPT Statistics	Standard Index	Best Fit Index Morningstar US Mid Growth TR USD
NAV		
Alpha	-1.42	0.60
Beta	1.03	0.95
R-Squared	88.03	96.17

12-Month Yield	—
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	Russell Mid Cap Growth TR USD



Investment Style
Equity
Stocks %

Growth of $10,000
- iShares Russell Mid-Cap Growth ETF 28,781
- Category Average 24,919
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
10.51	11.26	-44.49	46.26	26.06	-1.88	15.60	35.52	11.69	-0.45	7.22	24.94	Mkt Total Ret %
10.44	11.19	-44.40	45.95	26.10	-1.82	15.62	35.44	11.68	-0.39	7.15	24.98	NAV Total Ret %
-5.35	5.70	-7.40	19.49	11.04	-3.94	-0.39	3.05	-2.01	-1.77	-4.81	3.15	+/- Standard Index
-0.21	-0.23	-0.08	-0.34	-0.28	-0.17	-0.19	-0.31	-0.22	-0.19	-0.18	-0.28	+/- Category Index
37	68	51	26	42	35	34	47	12	44	35	41	% Rank Cat
994	967	934	812	759	751	737	703	749	733	644	617	No. of Funds in Cat
-0.01	0.00	-0.07	-0.10	-0.02	-0.02	-0.04	-0.04	-0.01	0.00	0.00	—	Avg Prem/Discount %

Portfolio Analysis 01-12-2018

Asset Allocation % 01-11-2018	Net %	Long %	Short %
Cash	0.06	0.06	0.00
US Stocks	99.11	99.11	0.00
Non-US Stocks	0.83	0.83	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.00	0.00

Equity Style

	Value	Blend	Growth
Large			
Mid			■
Small			

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	28.2	1.23	0.98
P/C Ratio TTM	17.0	1.19	0.97
P/B Ratio TTM	5.5	1.73	24.02
Geo Avg Mkt Cap $mil	13407	0.14	1.10

Fixed-Income Style

	Ltd	Mod	Ext
High			
Mid			
Low			

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	99.1	1.00
Greater Europe	0.2	0.69
Greater Asia	0.6	1.18

Top Holdings 01-11-2018

Share Chg since 01-2018	Share Amount	Holdings : 421 Total Stocks , 0 Total Fixed-Income, 27% Turnover Ratio	Net Assets %
⊕	1 mil	Zoetis Inc	1.14
⊕	396,395	Illumina Inc	1.08
⊕	995,581	Analog Devices Inc	1.03
⊕	2 mil	Progressive Corp	1.00
⊕	1 mil	Ross Stores Inc	0.96
⊕	438,868	Lam Research Corp	0.94
⊕	576,793	Fiserv Inc	0.90
⊕	770,133	DXC Technology Co	0.89
⊕	812,915	Amphenol Corp Class A	0.84
⊕	349,308	Rockwell Automation Inc	0.82
⊕	258,769	Roper Technologies Inc	0.80
⊕	452,208	Moody's Corporation	0.80
⊕	568,581	Edwards Lifesciences Corp	0.78
⊕	728,586	Aptiv PLC	0.76
⊕	593,433	Dollar Tree Inc	0.75

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**34.7**	**1.06**
Basic Materials	4.4	1.56
Consumer Cyclical	19.4	1.74
Financial Services	8.3	0.50
Real Estate	2.7	1.23
Sensitive	**47.7**	**1.14**
Communication Services	0.7	0.18
Energy	2.6	0.42
Industrials	20.4	1.91
Technology	24.1	1.14
Defensive	**17.5**	**0.69**
Consumer Defensive	5.2	0.62
Healthcare	12.3	0.88
Utilities	0.1	0.02

Operations

Family:	iShares	Ticker:	IWP	Prem/Discount:	-0.01
Manager:	Multiple	Incept:	07-17-2001	Mkt Price:	120.64
Tenure:	10.0 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$8,842.6 mil	Exchange:	NYSE ARCA	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	70.00 mil	NAV:	120.65	Backing Bank:	BlackRock Fund Advisors

MORNINGSTAR®

iShares Russell Mid-Cap Value ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★ 366 US Fund Mid-Cap Value	S&P 500 TR USD	Russell Mid Cap Value TR USD	US Fund Mid-Cap Value

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	2.38	-2.01	-8.08	3.09	-4.93
2016	3.86	4.68	4.39	5.46	19.69
2017	3.71	1.30	2.09	5.45	13.10

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	13.15	—	14.44	8.93	9.94
Std NAV 12-31-17	13.10	—	14.42	8.91	9.94
Mkt Total Ret	13.15	8.80	14.44	8.93	9.94
NAV Total Ret	13.10	8.77	14.42	8.91	9.94
+/- Std Index	-8.73	-2.64	-1.37	0.41	—
+/- Cat Index	-0.25	-0.23	-0.26	-0.19	—
% Rank Cat	50	49	34	37	
No. in Cat	405	366	311	221	

	Subsidized	Unsubsidized
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-474-2737 or visit www.ishares.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.25
Expense Ratio %	0.25
12b1 Expense %	NA

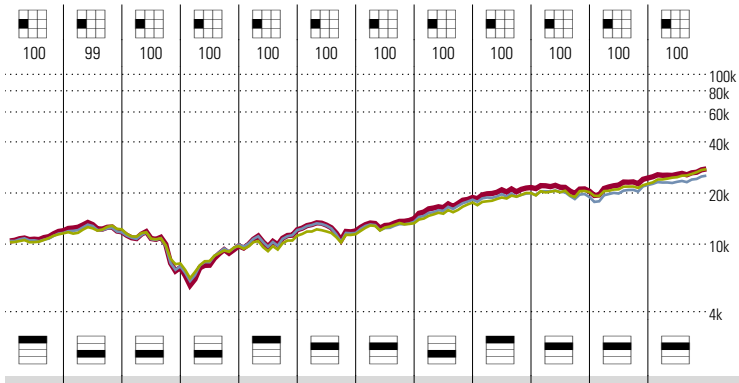
Risk and Return Profile

	3 Yr 366 funds	5 Yr 311 funds	10 Yr 221 funds
Morningstar Rating™	3★	4★	3★
Morningstar Risk	-Avg	-Avg	Avg
Morningstar Return	Avg	Avg	Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	10.47	10.40	17.89
Standard Deviation MKT	10.47	10.44	17.99
Mean NAV	8.77	14.42	8.91
Mean MKT	8.80	14.44	8.93
Sharpe Ratio	0.81	1.33	0.55

MPT Statistics	Standard Index	Best Fit Index Morningstar US Mid Cap TR USD
NAV		
Alpha	-1.74	-1.12
Beta	0.94	0.96
R-Squared	81.85	95.03

12-Month Yield	—
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	Russell Mid Cap Value TR USD



Investment Style
Equity
Stocks %

Growth of $10,000
- iShares Russell Mid-Cap Value ETF 27,722
- Category Average 25,291
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
19.97	-1.57	-37.99	33.25	24.49	-1.56	18.30	33.23	14.39	-4.98	19.79	13.15	Mkt Total Ret %
19.95	-1.57	-38.35	34.01	24.46	-1.55	18.27	33.11	14.49	-4.93	19.69	13.10	NAV Total Ret %
4.15	-7.06	-1.35	7.55	9.39	-3.67	2.27	0.72	0.81	-6.32	7.73	-8.73	+/- Standard Index
-0.27	-0.14	0.09	-0.20	-0.29	-0.17	-0.23	-0.35	-0.26	-0.15	-0.31	-0.25	+/- Category Index
14	70	63	51	24	31	28	66	10	50	39	50	% Rank Cat
375	405	442	416	420	422	425	415	460	471	399	405	No. of Funds in Cat
0.01	-0.05	-0.06	-0.03	-0.06	-0.04	-0.03	-0.04	-0.01	0.01	0.00	—	Avg Prem/Discount %

Portfolio Analysis 01-12-2018

Asset Allocation % 01-11-2018	Net %	Long %	Short %
Cash	0.18	0.23	0.05
US Stocks	99.14	99.14	0.00
Non-US Stocks	0.68	0.68	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.05	0.05

Equity Style

Value	Blend	Growth
	■	

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	18.8	0.82	0.98
P/C Ratio TTM	9.8	0.69	1.01
P/B Ratio TTM	2.0	0.62	3.88
Geo Avg Mkt Cap $mil	12019	0.12	1.11

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	99.4	1.00
Greater Europe	0.3	0.85
Greater Asia	0.3	0.56

Top Holdings 01-11-2018

Share Chg since 01-2018	Share Amount	Holdings : 584 Total Stocks , 0 Total Fixed-Income, 21% Turnover Ratio	Net Assets %
⊕	1 mil	Marathon Petroleum Corp	0.83
⊕	1 mil	Prologis Inc	0.79
⊕	1 mil	SunTrust Banks Inc	0.79
⊕	2 mil	Synchrony Financial	0.76
⊕	995,508	Discover Financial Services	0.71
⊕	690,430	Sempra Energy	0.65
⊕	2 mil	Weyerhaeuser Co	0.64
⊕	942,650	PACCAR Inc	0.63
⊕	1 mil	Public Service Enterprise Group Inc	0.62
⊕	388,814	M&T Bank Corp	0.61
⊕	854,485	Consolidated Edison Inc	0.61
⊕	1 mil	Mylan NV	0.61
⊕	554,842	Zimmer Biomet Holdings Inc	0.60
⊕	377,511	Stanley Black & Decker Inc	0.58
⊕	2 mil	Williams Companies Inc	0.57

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**50.7**	**1.54**
Basic Materials	5.9	2.11
Consumer Cyclical	12.0	1.08
Financial Services	19.4	1.16
Real Estate	13.4	6.13
Sensitive	**28.2**	**0.67**
Communication Services	0.8	0.20
Energy	8.9	1.47
Industrials	11.7	1.10
Technology	6.8	0.32
Defensive	**21.1**	**0.83**
Consumer Defensive	5.0	0.60
Healthcare	6.6	0.47
Utilities	9.4	3.22

Operations

Family:	iShares	Ticker:	IWS	Prem/Discount:	0.07
Manager:	Multiple	Incept:	07-17-2001	Mkt Price:	89.15
Tenure:	10.0 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$11,317.0 mil	Exchange:	NYSE ARCA	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	123.80 mil	NAV:	89.09	Backing Bank:	BlackRock Fund Advisors

MORNINGSTAR®

T. Rowe Price Instl Large Cap Growth (USD)

Morningstar Analyst Rating™ Bronze 01-27-2017

Overall Morningstar Rating™ ★★★★★ 1,216 US Fund Large Growth

Standard Index S&P 500 TR USD

Category Index Russell 1000 Growth TR USD

Morningstar Cat US Fund Large Growth

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	5.49	0.79	-4.86	8.81	10.08
2016	-6.44	0.00	8.03	1.76	2.85
2017	10.70	8.06	7.38	7.29	37.82

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	37.82	15.99	19.63	11.60	10.34
Std 12-31-2017	37.82	—	19.63	11.60	10.34
Total Return	37.82	15.99	19.63	11.60	10.34
+/- Std Index	15.99	4.58	3.84	3.10	—
+/- Cat Index	7.61	2.20	2.31	1.60	—
% Rank Cat	3	2	3	3	
No. in Cat	1363	1216	1109	787	

	Subsidized	Unsubsidized
7-day Yield 01-12-2018	0.00	—
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-638-8797 or visit www.troweprice.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

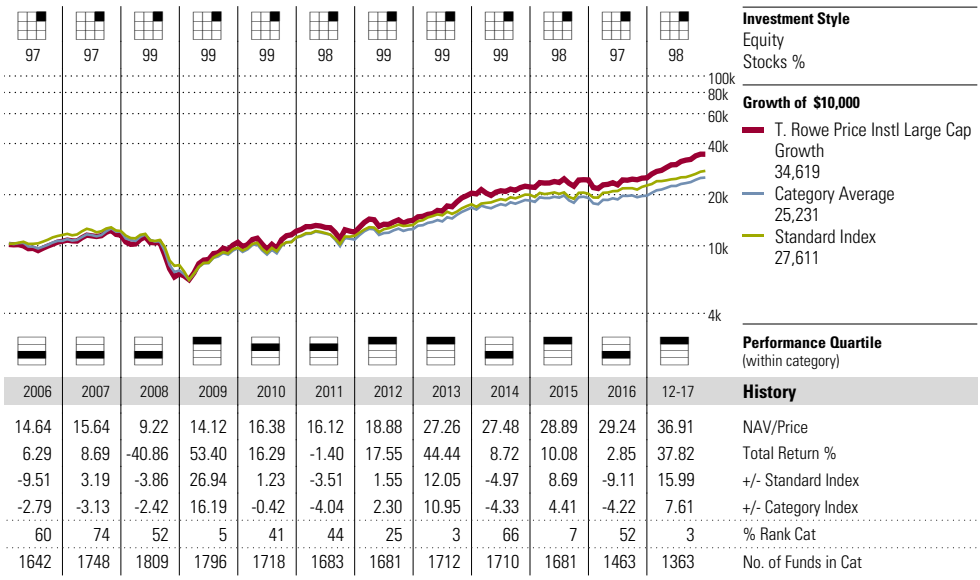
Management Fees %	0.55
12b1 Expense %	NA
Gross Expense Ratio %	**0.56**

Risk and Return Profile

	3 Yr 1216 funds	5 Yr 1109 funds	10 Yr 787 funds
Morningstar Rating™	5★	5★	5★
Morningstar Risk	+Avg	High	+Avg
Morningstar Return	High	High	High

	3 Yr	5 Yr	10 Yr
Standard Deviation	12.55	11.97	17.80
Mean	15.99	19.63	11.60
Sharpe Ratio	1.22	1.54	0.69

MPT Statistics	Standard Index	Best Fit Index Morningstar US Large Growth TR USD
Alpha	3.53	2.73
Beta	1.08	1.01
R-Squared	74.38	89.57
12-Month Yield		—
Potential Cap Gains Exp		46.70%



Investment Style
Equity
Stocks %

Growth of $10,000
- T. Rowe Price Instl Large Cap Growth 34,619
- Category Average 25,231
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
14.64	15.64	9.22	14.12	16.38	16.12	18.88	27.26	27.48	28.89	29.24	36.91	NAV/Price
6.29	8.69	-40.86	53.40	16.29	-1.40	17.55	44.44	8.72	10.08	2.85	37.82	Total Return %
-9.51	3.19	-3.86	26.94	1.23	-3.51	1.55	12.05	-4.97	8.69	-9.11	15.99	+/- Standard Index
-2.79	-3.13	-2.42	16.19	-0.42	-4.04	2.30	10.95	-4.33	4.41	-4.22	7.61	+/- Category Index
60	74	52	5	41	44	25	3	66	7	52	3	% Rank Cat
1642	1748	1809	1796	1718	1683	1681	1712	1710	1681	1463	1363	No. of Funds in Cat

Portfolio Analysis 09-30-2017

Asset Allocation %	Net %	Long %	Short %
Cash	0.00	0.00	0.00
US Stocks	92.17	92.17	0.00
Non-US Stocks	6.17	6.17	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	1.66	1.66	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
		■ Large
		Mid
		Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	30.4	1.33	1.11
P/C Ratio TTM	17.1	1.19	0.97
P/B Ratio TTM	5.5	1.73	1.04
Geo Avg Mkt Cap $mil	108209	1.12	0.81

Fixed-Income Style

Ltd	Mod	Ext
		High
		Mid
		Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	94.6	0.95
Greater Europe	0.5	1.27
Greater Asia	4.9	9.68

Share Chg since 06-2017	Share Amount	Holdings : 62 Total Stocks , 0 Total Fixed-Income, 37% Turnover Ratio	Net Assets %
⊖	986,129	Amazon.com Inc	6.52
⊕	10 mil	Microsoft Corp	5.08
⊖	392,430	The Priceline Group Inc	4.94
⊖	4 mil	Facebook Inc A	4.93
⊕	682,322	Alphabet Inc A	4.57
⊖	6 mil	Visa Inc Class A	4.48
⊖	2 mil	Boeing Co	4.06
⊖	3 mil	Apple Inc	3.68
⊖	2 mil	UnitedHealth Group Inc	2.84
⊖	2 mil	Alibaba Group Holding Ltd ADR	2.77
⊖	368,708	Intuitive Surgical Inc	2.65
⊕	393,427	Alphabet Inc C	2.59
⊖	6 mil	PayPal Holdings Inc	2.49
⊕	2 mil	Cigna Corp	1.96
⊕	2 mil	Vertex Pharmaceuticals Inc	1.88

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**32.9**	**1.00**
Basic Materials	0.0	0.00
Consumer Cyclical	20.5	1.84
Financial Services	12.4	0.74
Real Estate	0.0	0.00
Sensitive	**42.6**	**1.02**
Communication Services	2.3	0.60
Energy	0.0	0.00
Industrials	8.7	0.81
Technology	31.6	1.49
Defensive	**24.5**	**0.97**
Consumer Defensive	2.9	0.35
Healthcare	21.6	1.54
Utilities	0.0	0.00

Operations

Family:	T. Rowe Price	Base Currency:	USD	Incept:	10-31-2001
Manager:	Taymour Tamaddon	Ticker:	TRLGX	Type:	MF
Tenure:	1.0 Year	Minimum Initial Purchase:	$1 mil	Total Assets:	$15,812.20 mil
Objective:	Growth	Purchase Constraints:	A		

MORNINGSTAR®

Vanguard FTSE Emerging Markets ETF (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★★ 647 US Fund Diversified Emerging Mkts	MSCI ACWI Ex USA NR USD	MSCI EM NR USD	US Fund Diversified Emerging Mkts

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	2.08	1.73	-18.21	-0.33	-15.35
2016	5.36	2.33	7.80	-3.84	11.75
2017	10.87	3.47	7.76	6.28	31.38

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Std Mkt 12-31-17	31.48	—	3.37	1.35	7.43
Std NAV 12-31-17	31.38	—	3.50	1.29	7.38
Mkt Total Ret	31.48	7.49	3.37	1.35	7.43
NAV Total Ret	31.38	7.52	3.50	1.29	7.38
+/- Std Index	4.19	-0.32	-3.30	-0.55	—
+/- Cat Index	-5.90	-1.59	-0.85	-0.39	—
% Rank Cat	66	62	65	57	
No. in Cat	806	647	467	186	

	Subsidized	Unsubsidized
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 800-662-7447 or visit www.vanguard.com.

Fees and Expenses

Fund Expenses

Management Fees %	0.07
Expense Ratio %	0.14
12b1 Expense %	NA

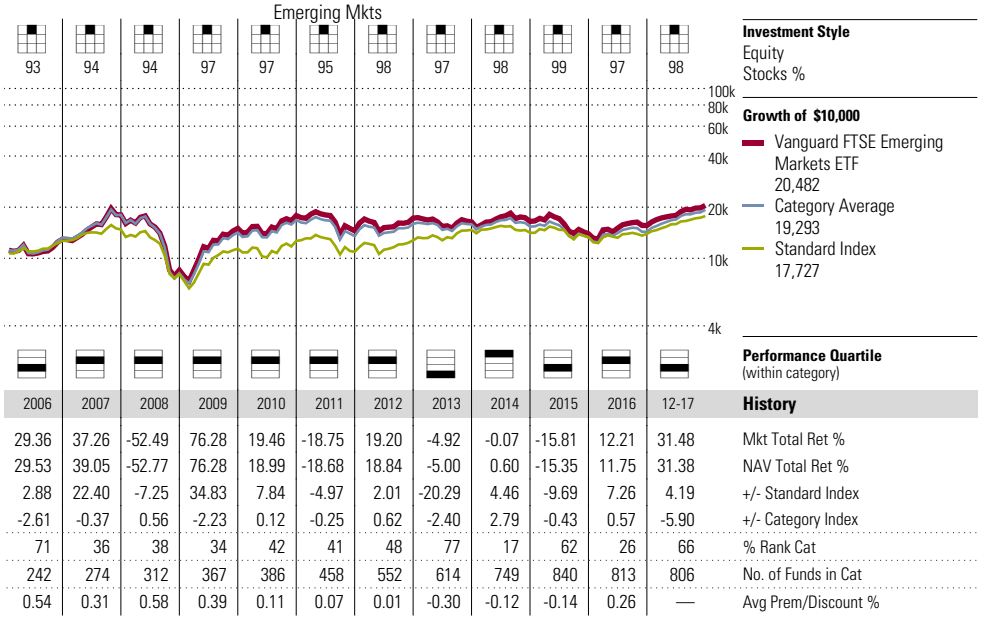
Risk and Return Profile

	3 Yr 647 funds	5 Yr 467 funds	10 Yr 186 funds
Morningstar Rating™	3★	3★	3★
Morningstar Risk	Avg	Avg	Avg
Morningstar Return	Avg	Avg	Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation NAV	15.07	14.39	23.06
Standard Deviation MKT	15.04	14.54	23.16
Mean NAV	7.52	3.50	1.29
Mean MKT	7.49	3.37	1.35
Sharpe Ratio	0.53	0.29	0.16

MPT Statistics	Standard Index	Best Fit Index Morningstar EM GR USD
NAV		
Alpha	-0.38	-1.74
Beta	1.06	0.99
R-Squared	71.71	98.25

12-Month Yield	—
Potential Cap Gains Exp	—
Leveraged	No
Leverage Type	—
Leverage %	100.00
Primary Prospectus Benchmark	FTSE EMs AC China A Incl (US RIC) NR USD



Investment Style
Equity
Stocks %

Growth of $10,000
- Vanguard FTSE Emerging Markets ETF 20,482
- Category Average 19,293
- Standard Index 17,727

Performance Quartile (within category)

History	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17
Mkt Total Ret %	29.36	37.26	-52.49	76.28	19.46	-18.75	19.20	-4.92	-0.07	-15.81	12.21	31.48
NAV Total Ret %	29.53	39.05	-52.77	76.28	18.99	-18.68	18.84	-5.00	0.60	-15.35	11.75	31.38
+/- Standard Index	2.88	22.40	-7.25	34.83	7.84	-4.97	2.01	-20.29	4.46	-9.69	7.26	4.19
+/- Category Index	-2.61	-0.37	0.56	-2.23	0.12	-0.25	0.62	-2.40	2.79	-0.43	0.57	-5.90
% Rank Cat	71	36	38	34	42	41	48	77	17	62	26	66
No. of Funds in Cat	242	274	312	367	386	458	552	614	749	840	813	806
Avg Prem/Discount %	0.54	0.31	0.58	0.39	0.11	0.07	0.01	-0.30	-0.12	-0.14	0.26	—

Portfolio Analysis 12-31-2017

Asset Allocation % 11-30-2017	Net %	Long %	Short %
Cash	2.22	2.22	0.00
US Stocks	2.45	2.45	0.00
Non-US Stocks	94.20	94.20	0.00
Bonds	0.12	0.12	0.00
Other/Not Clsfd	1.01	1.01	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
	■	

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	15.8	0.94	1.04
P/C Ratio TTM	9.4	1.02	0.92
P/B Ratio TTM	1.9	1.07	4.03
Geo Avg Mkt Cap $mil	18862	0.52	0.62

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	13.2	1.30
Greater Europe	15.9	0.34
Greater Asia	70.8	1.65

Top Holdings 11-30-2017

Share Chg since 11-2017	Share Amount	Holdings : 4,111 Total Stocks , 5 Total Fixed-Income, 6% Turnover Ratio	Net Assets %
⊕	92 mil	Tencent Holdings Ltd	5.22
⊕	7 mil	Naspers Ltd Class N	2.18
⊕	237 mil	Taiwan Semiconductor Manufacturing	1.99
⊖	35 mil	Taiwan Semiconductor Manufacturing	1.54
	1,541 mil	China Construction Bank Corp H	1.50
	1,372 mil	Industrial And Commercial Bank Of	1.19
	90 mil	China Mobile Ltd	1.02
	91 mil	Ping An Insurance (Group) Co. of C	1.00
⊕	256 mil	Hon Hai Precision Industry Co Ltd	0.95
⊕	5 mil	Alibaba Group Holding Ltd ADR	0.90
	55 mil	Reliance Industries Ltd	0.87
	27 mil	Housing Development Finance Corp L	0.79
	181 mil	Sberbank of Russia PJSC	0.77
	1,334 mil	Bank Of China Ltd H	0.72
	33 mil	Infosys Ltd	0.55

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**46.8**	**1.02**
Basic Materials	8.6	0.99
Consumer Cyclical	10.2	0.92
Financial Services	23.3	1.02
Real Estate	4.7	1.38
Sensitive	**39.7**	**1.17**
Communication Services	5.3	1.23
Energy	6.7	1.00
Industrials	6.5	0.58
Technology	21.3	1.78
Defensive	**13.5**	**0.68**
Consumer Defensive	7.2	0.73
Healthcare	3.1	0.43
Utilities	3.2	1.10

Operations

Family:	Vanguard	Ticker:	VWO	Prem/Discount:	0.02
Manager:	Multiple	Incept:	03-04-2005	Mkt Price:	45.91
Tenure:	9.4 Years	Expiration Date:	—	Base Currency:	USD
Total Assets:	$69,915.2 mil	Exchange:	NYSE ARCA	Legal Structure:	Open Ended Investment Company
Shares Outstanding:	1,451.43 mil	NAV:	45.90	Backing Bank:	Vanguard Group Inc

MORNINGSTAR®

Vanguard Institutional Index I (USD)

Morningstar Analyst Rating™	Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
Gold	★★★★	S&P 500 TR USD	Russell 1000 TR USD	US Fund Large Blend
07-31-2017	1,217 US Fund Large Blend			

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	0.94	0.28	-6.45	7.05	1.37
2016	1.34	2.45	3.85	3.82	11.93
2017	6.05	3.08	4.48	6.63	21.79

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	21.79	11.38	15.76	8.50	9.93
Std 12-31-2017	21.79	—	15.76	8.50	9.93
Total Return	21.79	11.38	15.76	8.50	9.93
+/- Std Index	-0.04	-0.03	-0.03	0.00	—
+/- Cat Index	0.10	0.16	0.05	-0.10	—
% Rank Cat	29	14	13	21	
No. in Cat	1396	1217	1079	800	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 888-809-8102 or visit www.vanguard.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

Management Fees %	0.04
12b1 Expense %	NA
Gross Expense Ratio %	**0.04**

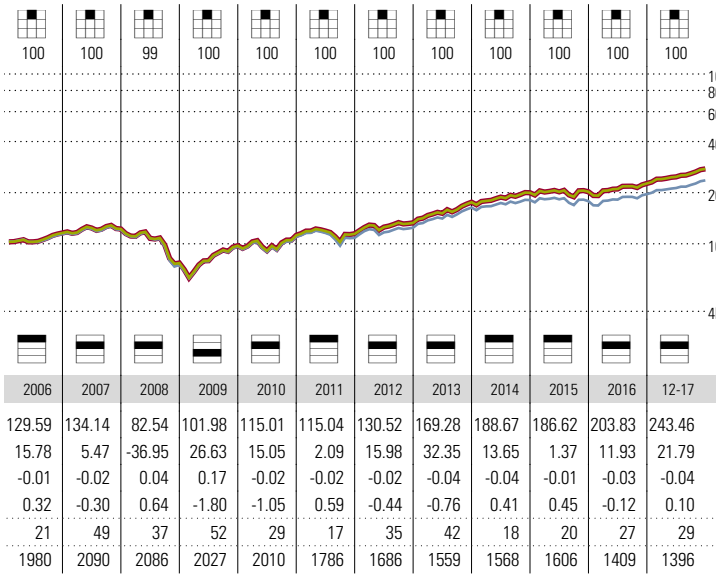
Risk and Return Profile

	3 Yr 1217 funds	5 Yr 1079 funds	10 Yr 800 funds
Morningstar Rating™	4★	5★	4★
Morningstar Risk	Avg	-Avg	Avg
Morningstar Return	+Avg	+Avg	+Avg

	3 Yr	5 Yr	10 Yr
Standard Deviation	10.07	9.49	15.07
Mean	11.38	15.76	8.50
Sharpe Ratio	1.08	1.57	0.60

MPT Statistics	Standard Index	Best Fit Index S&P 500 TR USD
Alpha	-0.02	-0.02
Beta	1.00	1.00
R-Squared	100.00	100.00

12-Month Yield	—
Potential Cap Gains Exp	46.88%



Investment Style
Equity
Stocks %

Growth of $10,000
- Vanguard Institutional Index I 27,606
- Category Average 23,626
- Standard Index 27,611

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
129.59	134.14	82.54	101.98	115.01	115.04	130.52	169.28	188.67	186.62	203.83	243.46	NAV/Price
15.78	5.47	-36.95	26.63	15.05	2.09	15.98	32.35	13.65	1.37	11.93	21.79	Total Return %
-0.01	-0.02	0.04	0.17	-0.02	-0.02	-0.02	-0.04	-0.04	-0.01	-0.03	-0.04	+/- Standard Index
0.32	-0.30	0.64	-1.80	-1.05	0.59	-0.44	-0.76	0.41	0.45	-0.12	0.10	+/- Category Index
21	49	37	52	29	17	35	42	18	20	27	29	% Rank Cat
1980	2090	2086	2027	2010	1786	1686	1559	1568	1606	1409	1396	No. of Funds in Cat

Portfolio Analysis 12-31-2017

Asset Allocation % 11-30-2017	Net %	Long %	Short %
Cash	0.17	0.17	0.00
US Stocks	98.79	98.79	0.00
Non-US Stocks	1.04	1.04	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
	■	

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	22.9	1.00	1.01
P/C Ratio TTM	14.3	1.00	0.99
P/B Ratio TTM	3.2	1.00	1.06
Geo Avg Mkt Cap $mil	96387	1.00	0.71

Fixed-Income Style

Ltd	Mod	Ext

High / Mid / Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	99.45

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	99.1	1.00
Greater Europe	0.4	1.00
Greater Asia	0.5	1.00

Top Holdings 11-30-2017

Share Chg since 11-2017	Share Amount	Holdings : 506 Total Stocks , 0 Total Fixed-Income, 5% Turnover Ratio	Net Assets %
⊖	53 mil	Apple Inc	3.91
⊖	79 mil	Microsoft Corp	2.85
⊖	4 mil	Amazon.com Inc	2.07
⊖	24 mil	Facebook Inc A	1.85
⊖	28 mil	Johnson & Johnson	1.65
⊖	36 mil	JPMorgan Chase & Co	1.62
⊖	43 mil	Exxon Mobil Corp	1.55
⊖	19 mil	Berkshire Hathaway Inc B	1.54
⊖	3 mil	Alphabet Inc A	1.36
⊖	3 mil	Alphabet Inc C	1.36
⊖	101 mil	Bank of America Corporation	1.22
⊖	46 mil	Wells Fargo & Co	1.11
⊖	26 mil	Procter & Gamble Co	1.01
⊖	19 mil	Chevron Corp	0.99
⊖	63 mil	AT&T Inc	0.98

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**33.1**	**1.01**
Basic Materials	2.8	1.00
Consumer Cyclical	11.1	1.00
Financial Services	16.8	1.00
Real Estate	2.4	1.09
Sensitive	**41.6**	**1.00**
Communication Services	3.6	0.95
Energy	6.1	1.00
Industrials	10.7	1.00
Technology	21.3	1.00
Defensive	**25.3**	**1.00**
Consumer Defensive	8.4	1.00
Healthcare	14.0	1.00
Utilities	2.9	1.00

Operations

Family:	Vanguard	Base Currency:	USD	Incept:	07-31-1990
Manager:	Multiple	Ticker:	VINIX	Type:	MF
Tenure:	17.1 Years	Minimum Initial Purchase:	$5 mil	Total Assets:	$232,158.10 mil
Objective:	Growth and Income	Purchase Constraints:	—		

MORNINGSTAR®

Vulcan Value Partners Small Cap (USD)

Overall Morningstar Rating™	Standard Index	Category Index	Morningstar Cat
★★	S&P 500 TR USD	Russell 2000 TR USD	US Fund Small Blend
652 US Fund Small Blend			

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	3.20	0.65	-10.90	2.20	-5.42
2016	3.92	-2.43	9.35	7.17	18.82
2017	3.63	3.71	-0.25	3.97	11.46

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	11.46	7.79	12.33	—	14.21
Std 12-31-2017	11.46	—	12.33	—	14.21
Total Return	11.46	7.79	12.33	—	14.21
+/- Std Index	-10.37	-3.62	-3.46	—	—
+/- Cat Index	-3.19	-2.16	-1.79	—	—
% Rank Cat	61	73	71	—	
No. in Cat	802	652	558	—	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield	—	—

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 877-421-5078 or visit www.vulcanvaluepartners.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

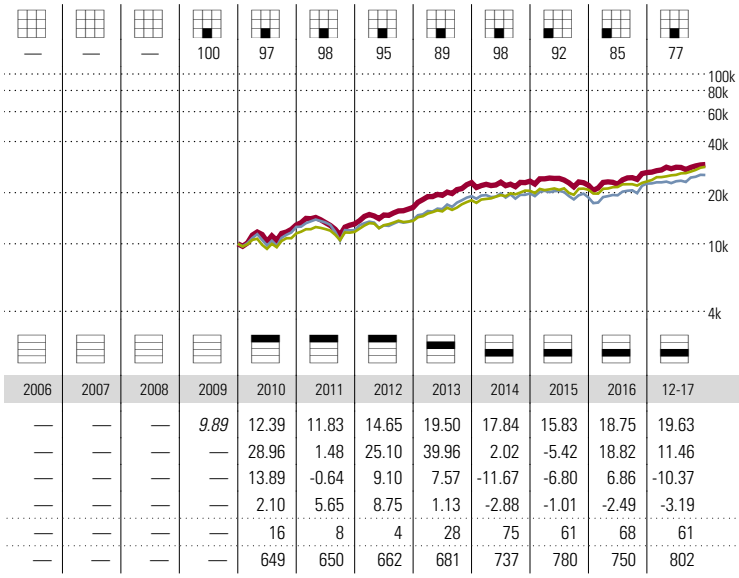
Management Fees %	1.15
12b1 Expense %	NA
Gross Expense Ratio %	**1.27**

Risk and Return Profile

	3 Yr 652 funds	5 Yr 558 funds	10 Yr *400 funds*
Morningstar Rating™	2★	2★	—
Morningstar Risk	-Avg	-Avg	—
Morningstar Return	-Avg	-Avg	—

	3 Yr	5 Yr	10 Yr
Standard Deviation	12.49	12.24	—
Mean	7.79	12.33	—
Sharpe Ratio	0.63	0.99	—

MPT Statistics	Standard Index	Best Fit Index Morningstar US Small Core TR USD
Alpha	-3.06	-0.72
Beta	1.00	0.88
R-Squared	64.70	80.82
12-Month Yield		—
Potential Cap Gains Exp		15.95%



Investment Style
Equity
Stocks %

Growth of $10,000
- Vulcan Value Partners Small Cap 29,277
- Category Average 25,408
- Standard Index 28,369

Performance Quartile (within category)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
	—	—	—	—	100	97	98	95	89	98	92	85	77	
	—	—	—	*9.89*	12.39	11.83	14.65	19.50	17.84	15.83	18.75	19.63	NAV/Price
	—	—	—	—	28.96	1.48	25.10	39.96	2.02	-5.42	18.82	11.46	Total Return %
	—	—	—	—	13.89	-0.64	9.10	7.57	-11.67	-6.80	6.86	-10.37	+/- Standard Index
	—	—	—	—	2.10	5.65	8.75	1.13	-2.88	-1.01	-2.49	-3.19	+/- Category Index
	—	—	—	—	16	8	4	28	75	61	68	61	% Rank Cat
	—	—	—	—	649	650	662	681	737	780	750	802	No. of Funds in Cat

Portfolio Analysis 09-30-2017

Asset Allocation %	Net %	Long %	Short %
Cash	22.71	22.71	0.00
US Stocks	63.89	63.89	0.00
Non-US Stocks	13.40	13.40	0.00
Bonds	0.00	0.00	0.00
Other/Not Clsfd	0.00	0.00	0.00
Total	100.00	100.00	0.00

Equity Style

Value	Blend	Growth
			Large
			Mid
	■		Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	20.3	0.89	0.88
P/C Ratio TTM	12.2	0.86	0.94
P/B Ratio TTM	2.3	0.72	0.91
Geo Avg Mkt Cap $mil	2622	0.03	0.79

Fixed-Income Style

Ltd	Mod	Ext
			High
			Med
			Low

Avg Eff Maturity	—
Avg Eff Duration	—
Avg Wtd Coupon	—
Avg Wtd Price	—

Credit Quality Breakdown —	Bond %
AAA	—
AA	—
A	—
BBB	—
BB	—
B	—
Below B	—
NR	—

Regional Exposure	Stocks %	Rel Std Index
Americas	82.7	0.83
Greater Europe	17.3	48.57
Greater Asia	0.0	0.00

Share Chg since 06-2017	Share Amount	Holdings : 31 Total Stocks , 12 Total Fixed-Income, 52% Turnover Ratio	Net Assets %
⊖	527,129	Jones Lang LaSalle Inc	5.53
	2 mil	ACI Worldwide Inc	4.57
⊕	3 mil	Sabre Corp	4.52
⊕	2 mil	Sleep Number Corp	4.03
⊖	1 mil	Ituran Location and Control Ltd	3.95
⊖	748,047	Axis Capital Holdings Ltd	3.64
⊕	705,165	WESCO International Inc	3.49
⊖	960,485	Aspen Insurance Holdings Ltd	3.30
✲	426,386	MSC Industrial Direct Co Inc Class	2.74
	114,958	Credit Acceptance Corp	2.74
⊖	550,857	Navigators Group Inc	2.73
✲	5 mil	Howden Joinery Group PLC	2.67
⊖	136,405	Everest Re Group Ltd	2.65
	353,824	Woodward Inc	2.33
⊖	276,629	Lindsay Corp	2.16

Sector Weightings	Stocks %	Rel Std Index
Cyclical	**58.0**	**1.76**
Basic Materials	2.6	0.92
Consumer Cyclical	22.4	2.02
Financial Services	21.8	1.30
Real Estate	11.1	5.09
Sensitive	**42.0**	**1.01**
Communication Services	0.0	0.00
Energy	0.0	0.00
Industrials	25.2	2.36
Technology	16.9	0.79
Defensive	**0.0**	**0.00**
Consumer Defensive	0.0	0.00
Healthcare	0.0	0.00
Utilities	0.0	0.00

Operations

Family:	Vulcan Value Partners	Base Currency:	USD	Purchase Constraints:	C
Manager:	C.T. Fitzpatrick	Ticker:	VVPSX	Incept:	12-30-2009
Tenure:	8.1 Years	Minimum Initial Purchase:	$5,000	Type:	MF
Objective:	Small Company	Minimum IRA Purchase:	$500	Total Assets:	$1,212.97 mil

MORNINGSTAR®

Western Asset Core Plus Bond I (USD)

Morningstar Analyst Rating™ Gold 03-10-2017

Overall Morningstar Rating™ ★★★★★ 847 US Fund Intermediate-Term Bond

Standard Index BBgBarc US Agg Bond TR USD

Category Index BBgBarc US Agg Bond TR USD

Morningstar Cat US Fund Intermediate-Term Bond

Performance 12-31-2017

Quarterly Returns	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total %
2015	2.18	-1.80	0.72	0.24	1.31
2016	2.59	2.91	1.58	-2.29	4.79
2017	1.91	2.68	1.74	0.47	6.96

Trailing Returns	1 Yr	3 Yr	5 Yr	10 Yr	Incept
Load-adj Mthly	6.96	4.33	3.88	5.96	6.19
Std 12-31-2017	6.96	—	3.88	5.96	6.19
Total Return	6.96	4.33	3.88	5.96	6.19
+/- Std Index	3.41	2.09	1.78	1.96	—
+/- Cat Index	3.41	2.09	1.78	1.96	—
% Rank Cat	1	1	2	2	
No. in Cat	986	847	778	554	

	Subsidized	Unsubsidized
7-day Yield	—	—
30-day SEC Yield 12-29-2017	2.82 [1]	2.70

1. Contractual waiver; Expires 12-31-2018

Performance Disclosure

The Overall Morningstar Rating is based on risk-adjusted returns, derived from a weighted average of the three-, five-, and 10-year (if applicable) Morningstar metrics.

The performance data quoted represents past performance and does not guarantee future results. The investment return and principal value of an investment will fluctuate; thus an investor's shares, when sold or redeemed, may be worth more or less than their original cost.

Current performance may be lower or higher than return data quoted herein. For performance data current to the most recent month-end, please call 877-721-1926 or visit www.leggmason.com.

Fees and Expenses

Sales Charges

Front-End Load %	**NA**
Deferred Load %	**NA**

Fund Expenses

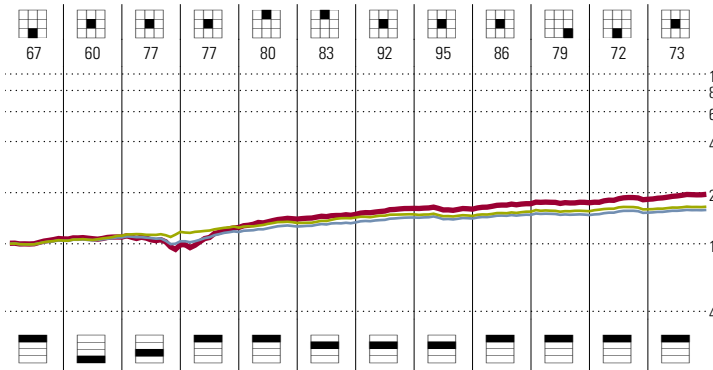
Management Fees %	0.40
12b1 Expense %	NA
Gross Expense Ratio %	**0.52**

Risk and Return Profile

	3 Yr 847 funds	5 Yr 778 funds	10 Yr 554 funds
Morningstar Rating™	5★	5★	5★
Morningstar Risk	High	+Avg	High
Morningstar Return	High	High	High

	3 Yr	5 Yr	10 Yr
Standard Deviation	3.16	3.21	5.65
Mean	4.33	3.88	5.96
Sharpe Ratio	1.22	1.12	0.99

MPT Statistics	Standard Index	Best Fit Index BBgBarc US Credit TR USD
Alpha	2.04	1.30
Beta	1.00	0.80
R-Squared	79.08	90.12
12-Month Yield		3.04%
Potential Cap Gains Exp		1.44%



Investment Style
Fixed-Income
Bond %

Growth of $10,000
- Western Asset Core Plus Bond I 19,553
- Category Average 15,821
- Standard Index 16,529

Performance Quartile (within category)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	12-17	History
10.54	10.19	8.66	10.14	10.78	11.11	11.67	11.19	11.64	11.43	11.43	11.84	NAV/Price
6.81	2.57	-9.78	26.20	11.97	6.72	8.44	-1.07	7.68	1.31	4.79	6.96	Total Return %
2.48	-4.39	-15.02	20.27	5.43	-1.12	4.22	0.96	1.72	0.76	2.14	3.41	+/- Standard Index
2.48	-4.39	-15.02	20.27	5.43	-1.12	4.22	0.96	1.72	0.76	2.14	3.41	+/- Category Index
4	90	75	7	3	36	28	31	3	7	13	1	% Rank Cat
1092	1097	1135	1123	1164	1195	1165	1079	1038	1042	985	986	No. of Funds in Cat

Portfolio Analysis 09-30-2017

Asset Allocation %	Net %	Long %	Short %
Cash	-0.65	36.73	37.38
US Stocks	0.04	0.14	0.11
Non-US Stocks	0.00	0.00	0.00
Bonds	99.61	100.27	0.66
Other/Not Clsfd	1.01	1.06	0.06
Total	100.00	138.20	38.20

Equity Style

Value	Blend	Growth

Large / Mid / Small

Portfolio Statistics	Port Avg	Rel Index	Rel Cat
P/E Ratio TTM	—	—	—
P/C Ratio TTM	—	—	—
P/B Ratio TTM	—	—	—
Geo Avg Mkt Cap $mil	—	—	—

Fixed-Income Style

Ltd	Mod	Ext

High / Mod / Low

Avg Eff Maturity	12.76
Avg Eff Duration	6.93
Avg Wtd Coupon	3.90
Avg Wtd Price	—

Credit Quality Breakdown 09-30-2017	Bond %
AAA	56.61
AA	3.81
A	14.35
BBB	11.42
BB	7.20
B	2.97
Below B	3.68
NR	-0.04

Regional Exposure	Stocks %	Rel Std Index
Americas	—	—
Greater Europe	—	—
Greater Asia	—	—

Share Chg since 06-2017	Share Amount	Holdings : 3 Total Stocks , 1,715 Total Fixed-Income, 97% Turnover Ratio	Net Assets %
⊕	1,095 mil	US Treasury Bond 3%	5.50
⊕	757 mil	US Treasury Bond 3%	3.77
	632 mil	US Treasury Bond 3.75%	3.62
✲	635 mil	Fed Natl Mort Assc 3.5%	3.16
✲	534 mil	US Treasury Note 1.875%	2.58
✲	356 mil	Freddie Mac Gold Single Family TBA	1.72
⊕	325 mil	US Treasury Note 1.375%	1.56
✲	304 mil	Govt Natl Mtg Asso 3%	1.49
✲	290 mil	Fannie Mae Single Family TBA 3% 20	1.43
⊕	237 mil	US Treasury Note 2.25%	1.16
✲	212 mil	FHLMC 3.5%	1.06
✲	204 mil	Ginnie Mae Jumbos TBA 4% 2047-10-01	1.04
✲	185 mil	Freddie Mac Gold Single Family TBA	0.94
✲	189 mil	Fed Natl Mort Assc 3%	0.92
⊕	182 mil	US Treasury Bond 3%	0.91

Sector Weightings	Stocks %	Rel Std Index
Cyclical	—	—
Basic Materials	—	—
Consumer Cyclical	—	—
Financial Services	—	—
Real Estate	—	—
Sensitive	—	—
Communication Services	—	—
Energy	—	—
Industrials	—	—
Technology	—	—
Defensive	—	—
Consumer Defensive	—	—
Healthcare	—	—
Utilities	—	—

Operations

Family:	Legg Mason	Ticker:	WACPX	Incept:	07-08-1998
Manager:	Multiple	Minimum Initial Purchase:	$1 mil	Type:	MF
Tenure:	19.5 Years	Min Auto Investment Plan:	$1 mil	Total Assets:	$22,297.12 mil
Objective:	Corporate Bond - General	Minimum IRA Purchase:	$1 mil		
Base Currency:	USD	Purchase Constraints:	A		

MORNINGSTAR®

Important Disclosures

SunTrust Foundations and Endowments Specialty Practice

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Curriculum Vitae

SUSAN L. PEKARSKE, M.D.
1281 East Calle de la Cabra
Tucson, Arizona 85718
(520) 544-3846

EDUCATION

1995-1996:	Fellowship in Hematopathology, Department of Pathology, Scripps Clinic and Research Foundation, La Jolla, California
1991-1995:	Residency in Anatomic and Clinical Pathology, Department of Pathology, University of California at San Diego, San Diego, California
1990-1991:	Internship in Internal Medicine, Department of Medicine, University of California at San Diego, San Diego, California
1986-1990:	M.D., University of Wisconsin Medical School, Madison, Wisconsin
1982-1986:	B.S. in Biology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina

BOARD CERTIFICATION

Diplomate of The American Board of Pathology in combined Anatomic and Clinical Pathology, Fall 1995

Diplomate of The American Board of Hematology, August 1998

EMPLOYMENT

November 1998- March 2011:	Staff Pathologist, Foothills Pathology, P.C., Northwest Medical Center, Tucson, Arizona
July 1997- June 1998:	Assistant Clinical Professor (nonsalaried), Department of Pathology, UCSD School of Medicine, San Diego, California
July 1996- June 1997:	Clinical Instructor, Department of Pathology, UCSD School of Medicine, San Diego, California
July 1996- June 1998:	Attending Physician, UCSD Medical Group, San Diego, California

Susan L. Pekarske, *Curriculum Vitae*

HONORS

Alpha Omega Alpha Medical Honorary Society,
University of Wisconsin Medical School, 1990.

George Maki Memorial Scholarship for Outstanding Achievement,
University of Wisconsin Medical School, 1990.

Edith and Lewis Phillips Award for Outstanding Achievement,
University of Wisconsin Medical School, 1989.

Leonard Award for Outstanding Performance on OB/GYN Clerkship,
University of Wisconsin Medical School, 1989.

Youmans Award for Medical Physiology, University of Wisconsin Medical School, 1988.

Phi Beta Kappa, University of North Carolina at Chapel Hill, 1985.

SOCIETY MEMBERSHIPS

American Society of Clinical Pathologists
International Academy of Pathology

PUBLICATIONS

Pekarske, S.L. and Shin, S.S. Bone marrow changes induced by recombinant granulocyte colony-stimulating factor resembling metastatic carcinoma: distinction with cytochemical and immunohistochemical studies. *American Journal of Hematology* 1996; 51(4): 332-34.

Pekarske, S.L. Placental pathology casebook. *Journal of Perinatology* 1995; 15(1): 81-83.

Pekarske, S.L. and Herold, D.A. Primary aldosteronism in a patient with an aldosterone producing adenoma. *Clinical Chemistry* 1993; 39: 1729-33.

REFERENCES

Will be provided upon request

The McKnight Brain Research Foundation®

Preserving Memory, Enhancing Life

Established by Evelyn F. McKnight to Alleviate Memory Loss in the Aging.

Trustees

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Silver Spring, MD

Robert M. Wah, M.D.
Falls Church, VA

SunTrust Bank
Orlando, FL

February 13, 2017

Tom Brannan.
Interim Vice President for
Development and Alumni
The University of Alabama at Birmingham
AB 1230 1720 2nd Ave S
Birmingham, AL 35294-0112

Dear Mr. Brannan,

The trustees of the McKnight Brain Research Foundation (MBRF) reviewed the 2016 annual report of the Evelyn F. McKnight Brain Institute (EMBI) at the University of Alabama at Birmingham (UAB) at their February, 2017, meeting. The trustees join the leadership of UAB in the disappointment of Dr. David Sweatt's resignation and departure from the UAB in mid-2016, as the Director of the EMBI and the occupant of the Evelyn F. McKnight Chair in Learning and Memory in Aging.

However, the trustees are pleased the leadership of UAB responded quickly by appointing Dr. David Standaert, the John N. Whitaker Professor and Endowed Chair of the Department of Neurology, as co-chair of the search committee and the Interim Director of the EMBI while searching for Dr. Sweatt's replacement. The Trustees are appreciative of the communication from the leadership of the UAB throughout this period of transition in leadership of the EMBI at the UAB.

The successful recruitment of Dr. Ronald M. Lazar as the new Director of the EMBI and the occupant of the McKnight Endowed Chair is due largely to Dr. Standaert's efforts. Dr. Standaert's administrative oversight, as chair of Dr. Lazar's academic appointment in the Department of Neurology and Dr. Standaert's service as chair of the EMBI advisory council provide assurance the EMBI at UAB under new leadership will be successful. With Dr. Lazar's recruitment, the trustees desire reassurance that the commitment of 75,000 sq. ft. of research space in the Shelby Building dedicated to the EMBI in the 2009 Gift Agreement remains intact.

In personal discussions, the trustees have voiced their concerns regarding the appointment of individuals to endowed chairs with unlimited terms of occupancy. The trustees request their concerns continue to be honored throughout the performance review process.

Under the combined interim leadership of Dr. Standaert and Dr. Erik Roberson, the Co-Director of the EMBI at the UAB, the trustees are also pleased to note the impressive progress in many areas of the research in cognitive aging and associated age related memory loss has been maintained during this period of transition to new leadership.

The trustees remain disappointed that the two endowed chairs that were committed to the EMBI when the current gift agreement was signed in 2009, remain vacant. However, the trustees are aware the efforts to fill these positions have been and remain a high priority and two very good prospects are currently under consideration, following a recently declined offer after vigorous efforts failed.

The trustees extend their collective appreciation to you and the leadership of the UAB for your efforts to preserve and maintain our valuable research partnership.

Sincerely

Melanie A. Cianciotto
Corporate Trustee

CC. MBRF Trustees
Selwyn M. Vickers, MD
David G. Standaert, MD, Ph.D.
Daphne B. Powell
Henry H. Raattama, Esquire

Please address all correspondence to

Melanie Cianciotto • SunTrust Bank • Post Office Box 620005 • Orlando, Florida 32862-0005 • (407) 237-4485

the CAMPAIGN for UAB

GIVE SOMETHING | CHANGE EVERYTHING

March 2, 2017

The McKnight Brain Research Foundation
c/o Ms. Melanie Cianciotto
Vice President for Foundations and Endowments
SunTrust Bank
200 South Orange Avenue
SOAB 10th Floor
Orlando, Florida 32801

Dear Ms. Cianciotto,

Thank you for your letter dated February 13 in follow-up to UAB's annual report for 2016. We remain grateful for our ongoing partnership with the Evelyn F. McKnight Brain Research Foundation in support of the Evelyn F. McKnight Brain Institute (EMBI) at UAB. Our collaboration holds much promise for the future for all humankind, and our researchers' remarkable work would not be possible without the Foundation's steadfast support.

We are excited about Dr. Lazar's recruitment as the new Director of the EMBI, and we agree that Dr. Standaert has played a critical role in both Dr. Lazar's hiring and the leadership of the EMBI during this transition period. I would like to assure the trustees that the EMBI's location and dedicated 75,000-square-feet of research space in the Shelby Biomedical Research Building remains intact as outlined in our 2009 Gift Agreement. In addition, the academic leadership of the University and the School of Medicine understand your concerns regarding unlimited terms of occupancy for endowed chair and professorship holders, and they are committed to ensuring appropriate academic oversight of chair and professorship holders.

We continue to aggressively recruit for the two vacant endowed chair positions in our Department of Psychiatry that are dedicated to EMBI Investigators.

- Next week, on March 7-8, Dr. Raj Badgaiyan will be visiting our campus.
- He is an extremely well-funded imager who does research in multiple areas, but one of his funded interests is imaging cortical function as it relates to cognition in aging using PET in human subjects.
- He is very attracted to UAB because of our world-class imaging resources (especially the cyclotron and PET/MR capabilities), and the vast majority of his funding and experience is in patient-based studies.
- On March 12-14, Dr. Terry Goldberg will visit UAB for the third time.
- He is a neuropsychologist whose research focus is on cognition and aging.
- Knowing that his family also has visited and scouted schools, we are very optimistic that this hire will occur.

Both of these individuals conduct patient-based research, and we are excited about the possibility of these scientists coming to UAB. Moreover, we have identified a third candidate—a grant-funded researcher and geriatric psychiatrist currently at Pittsburgh—and are working to schedule

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a visit in case one of the preferred recruits does not accept our offer. Please be assured that these recruits remain a high priority.

We are incredibly proud to be home to the Evelyn F. McKnight Brain Institute at UAB, and on behalf of all the McKnight Investigators and UAB administrative team, I extend my wholehearted gratitude for your support, your vision, and your ongoing partnership.

Sincerely,

Tom Brannan
Vice President for Development and Alumni

cc: Dr. James H. Meador-Woodruff
Ms. Daphne B. Powell
Dr. David G. Standaert
Dr. Selwyn M. Vickers
Dr. Ray L. Watts

Carol A. Barnes, Ph.D.
Director, Evelyn F. McKnight Brain Institute
University of Arizona
Tucson, Arizona

February 22, 2017

The McKnight Brain Research Foundation®

Preserving Memory, Enhancing Life

Established by Evelyn F. McKnight to Alleviate Memory Loss in the Aging.

Dear Dr. Barnes,

The trustees of the McKnight Brain Research Foundation (MBRF) reviewed the 2016 Annual report from the Evelyn F. McKnight Brain Institute (EMBI) at the University of Arizona (UA) at their February, 2017, meeting. The 2016 Annual Report represents ten years since the beginning of the MBRF/ UA partnership with the signing of the first Gift Agreement in 2006, establishing the EMBI and the Evelyn F. McKnight Chair for Learning and Memory in Aging.

The trustees have great admiration and respect for your leadership as the founding Director of the EMBI and the first, and only, occupant of the McKnight endowed chair. It is also noted the UA also recognized your academic qualifications by naming you a Regents' Professor in 2006. Your election as the first and ongoing chair of the leadership council composed of the directors and associate directors of the four McKnight Brain Institutes (MBIs) is also a testament to the respect and admiration in which you are held by your colleagues.

The hosting by the EMBI at UA of the first inter-institutional meeting which fosters research collaborations between the four MBIs has become an annual event for a decade. Your support of the establishment of a poster reception hosted by the MBRF in conjunction with the annual meeting of the Society for Neuroscience (of which you are a past president) has become an annual tradition.

The trustees are aware and offer comment on events and circumstances at the UA which have retarded the success and achievements of the EMBI. At the first visit of the trustees to the UA in 2006, we were told by Dr. Keith Joiner, the Dean of the UA College of Medicine (COM) that college was reorganizing the neurosciences and the establishment of the EMBI would facilitate those discussions; and, could potentially result in allocation of additional space to the EMBI. **This did not occur**. Soon after the EMBI was established, Dr. Bruce McNaughton, a key individual in the operation of your laboratory, left the UA. The position remained vacant for a long time despite an additional substantial GIFT from MBRF for salary support.

Leadership vacancies throughout the UA have had a deleterious effect on the development of the EMBI. Each of the offices of the President of the UA, the President of the UA Foundation and the Senior Vice President for Research has been vacant periodically. These vacancies have had budgetary effects on the EMBI regarding recruitment of qualified faculty and fund raising efforts to meet the matching requirements defined in the 2014 Gift Agreement. Uncertainty exists regarding the value the UA places on the EMBI and accompanying budgetary constraints have compromised the EMBI. The trustees of the MBRF have not met any of the Deans of the COM since Dr. Joiner's departure. To develop a clinical translational research programs in cognitive aging and memory loss, research collaborations are necessary with clinical departments, such as the departments of neurology and psychiatry, within the COM as well as the Center on Aging. The trustees question how these liaisons can be established.

Finally, regarding the 2016 Annual report specifically, it is obvious your leadership is responsible for its success to date. None of the other limited number of faculty has been successful in securing competitive funding year after year from National funding organizations or in getting their work published in reputed peer reviewed journals compared to your frequent and repeated success. Therefore, it is understandable why the trustees are concerned regarding the future of the EMBI at UA should you be recruited away.

It is hoped the leadership of the UA will take these unsolicited comments and concerns of the trustees under consideration and take favorable action affecting future of the EMBI.

Sincerely,

J. Lee Dockery, MD

CC. Dr. Andrew C. Comrie
Dr. Kimberly Andrews Espy
Jenny Flynn

MBRF Trustees
Henry H. Raattama, Esquire

Please address all correspondence to

Melanie Cianciotto • SunTrust Bank • Post Office Box 620005 • Orlando, Florida 32862-0005 • (407) 237-4485

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J. Lee Dockery, M.D.
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Silver Spring, MD

Robert M. Wah, M.D.
Falls Church, VA

SunTrust Bank
Orlando, FL

February 13, 2017

David S. Guzick, M.D., Ph.D.
Senior Vice President, Health Affairs
President, UF Health

Michael L. Good, MD
Dean, UF College of Medicine
Folke H. Peterson Dean's Distinguished Professor

Michael G. Perri, Ph.D.
Dean, College of Public Health and Health Professions
Robert G. Frank, Endowed Professor

Dear Drs. Guzick, Good and Perri,

At their February, 2017, meeting of the McKnight Brain Research Foundation (MBRF), the trustees reviewed the 2016 Annual Report submitted by the University of Florida (UF) on the Age-Related Memory Loss (ARML) program and the Cognitive Aging and Memory Clinical Translational Research Program (CAM-CTRP). In addition, the trustees reviewed the 2016 Annual Reports on the McKnight Research Grant Program, the two McKnight Endowed Chairs, the William G. Luttge Lectureship and the University of Florida Foundation (UFF) Endowment and Investment Report.

During the 2016 year, the research programs supported by the MBRF have undergone tremendous change involving the reorganization and relocation of the CAM-CTRP and a change in leadership of the MBI. Despite these disruptive changes, the trustees are impressed with the significant achievements in both the ARML program and the CAM-CTRP. The trustees express appreciation to each of you for your collective efforts in working toward a satisfactory temporary resolution of disruptive circumstances and influences. The commitment of continued efforts and support to provide adequate space, resources, and management oversight will ensure a successful future for the research programs supported by the MBRF at the UF.

Although not addressed in the annual reports, the trustees have received information that the proposal to establish a Cognitive Aging and Memory Clinical Translational Research Center (CAM Center) has been approved. It is important the relationship between the CAM Center and the CAM-CTRP be clearly defined. With so much change in the McKnight sponsored research programs, the trustees express some urgency in developing an approved Memorandum of Understanding (MOU) of the new arrangements involving the CAM-CTRP, which is under consideration by the UF, in advance of amending the Gift Agreement.

The trustees wish to reinforce their interest in enhancing the clinical translational potential of the CAM-CTRP. The clinical translational research remains underdeveloped and could be enhanced by the participation of clinical research scientists either by recruitment, collaborations within the institution or between the McKnight Brain Institutes and beyond. Bridging the research initiatives between the basic scientists and the clinicians is critical in the successful translation of the research from the laboratory to the bedside.

The trustees express their collective appreciation for your support and efforts to continue to advance the research initiatives supported by the MBRF to advance the understanding and alleviation of age related memory loss.

Sincerely,

Melanie A. Cianciotto
Corporate Trustee, MBRF

CC. Thomas A. Pearson, MD, Ph.D.
Todd E. Golde, M.D., Ph.D.
Steven T. DeKosky, MD
Glenn Smith, Ph.D.
Ronald A. Cohen, Ph.D.
Thomas C. Foster, Ph.D.
MBRF Trustees
Henry H. Raattama, Esq.

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The McKnight Brain Research Foundation®

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February 10, 2017

Ralph L Sacco, MD, MS, Executive Director
The Evelyn F. McKnight Brain Institute
Professor and Chair, Department of Neurology
University of Miami Miller School of Medicine
P.O Box 016960 (C-215)
Miami, Florida 33101

Tatjana Rundek, M.D, Ph.D., Scientific Director
Evelyn F. McKnight Brain Institute
University of Miami Miller School of Medicine
P.O Box 016960 (C-215)
Miami, Florida 33101

Dear Dr. Sacco and Dr. Rundek,

The trustees of the McKnight Brain Research Foundation (MBRF) reviewed the 2016 annual report from the Evelyn F. McKnight Brain Institute (EMBI) at the University of Miami (UM) at their February, 2017, board meeting. The trustees were pleased to note the development and progress in implementation of a transition plan to new leadership of the EMBI following the departure of Dr. Clinton Wright. The trustees are confident in your combined leadership during the search process for a new scientific director which is already underway. The trustees also commend the establishment of a formal partnership with the UM Center on Aging under the capable leadership of Dr. Sara Czaja.

The trustees were also pleased to note the enhancements in the education program with the establishment of the McKnight small pilot collaborative Research Award Program. The establishment of a structured neurocognitive training program with the acceptance of the first McKnight Cognitive Fellow beginning July 1, 2107, is an important catalyst in promoting the emphasis and interest in translational research in cognitive aging and associated memory loss.

In the 2015 annual report from the EMBI, the trustees were informed that the fifth five-year renewal of the Northern Manhattan Study (NOMAS) had been renewed, and was now focusing on age-related cognitive changes and "outcomes". Although the trustees are pleased to note progress, it is disappointing the clinical translational research programs remain underdeveloped in reaching their full potential. It is understood the grant awards by the MBRF to establish an MBI inter-institutional Brain Aging Registry and a Neuroimaging Cognitive Aging Assessment Research Core have just begun. It is the hope these grant awards, in addition to the existing support by the MBRF, will facilitate the development of more robust clinical translational research programs in cognitive aging and age related memory loss at the EMBI at UM.

In the 2016 reply by the trustees following a review of the 2015 annual report, additional information was requested regarding the formation and activities of the Scientific Advisory Board. The membership was noted in the 2016 annual report, but no details were provided concerning how the members are selected and the committee's function.

The trustees convey appreciation to you and the team of research scientists at the EMBI at the UM for the collective and the inter-institutional collaborative efforts to advance the knowledge leading to the understanding and alleviation of age related memory loss

Sincerely,

Melanie A. Cianciotto
Corporate Trustee, MBRF

CC. Laurence B. Gardiner, MD
MBRF Trustee
Henry H. Raattama, Jr., Esquire

Please address all correspondence to

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March 22, 2017

Dear Dr. Dockery and McKnight Board of Trustees,

We received your comments regarding our 2016 Annual Progress Report and very much appreciate the thorough review and thoughtful input outlined in your letter dated February 10, 2017. During the past year we have continued to put forth considerable effort building our research focus by creating a comprehensive database, formalizing our collaborations with the Center on Aging (COA), and strengthening our collaborations and projects with other MFBI. As such, we thank you for recognizing our accomplishments and the transition plan we have implemented.

We would like to specifically address two points raised in your critique, one *related to our clinical translational program* and the other *related to the function and membership of our Scientific Advisory Board*, as areas that need to be strengthened.

First, our clinical translational research program has progressed slower than we expected for several reasons. On a positive note, there has been notable progress in our clinical research portfolio last year as listed in our 2016 Annual Report including the organization and implementation of our frailty study under the leadership of Dr. Levin, which involves integrating the frailty evaluation with comprehensive cognitive testing, the neurologic examination, MRI and inflammatory biomarkers. We are currently working with our colleagues at the other MFBI sites on projects to incorporate this protocol for collaborative projects. Another UM project developed over this past year is a fully integrated Cognitive Brain Registry. This database includes over 400 subjects with demographic, cognitive, psychiatric, neurologic, and psychosocial information entered into REDCap, which will provide critical information for grant development. In addition, we have initiated a study of *MRI Markers of Aging---Related Brain Loss*, and completion of a brochure for *Exercise Guidelines for Brain Health*. We would also like to highlight that we are initiating the NIA---funded ACT Collaborative Study that will evaluate 150 subjects in Miami. We included information about a new clinical translational *DUAL TARGET* research project that has been recently award by the NIH to Dr. Czaja and her team. This research project is evaluating the efficacy of a dyadic psychosocial technology---based intervention that integrates an evidenced---based caregiver intervention program and an evidence---based cognitive/functional training for the care recipient (patient with mild AD). The program is tailored for

needs of the caregiver and emphasizes issues important to caregivers early in their caregiver role, and also targets issues across the caregiving trajectory to help prepare the caregivers for changes in their role. This program is highly innovative given the focus on a dyadic approach, the use of state---of---the---art technology for intervention delivery, a community---based and stage---model approach to intervention development and implementation and the inclusion of the caregiver as a therapy extender and the cultural tailoring of the program. Dr. Czaja and her team also recently received funding from the NIH to evaluate an intervention that is focused on wellness and social connectivity for older adults who are sedentary and socially isolated. This project is also translational in nature, community---based and involves collaboration with an industry partner, Palo Alto Research Corporation (PARC).

We have had some slower progress on our McKnight Brain Imaging project and oldest old registry due to some technical issues. For instance, most of our research MR imaging protocols resided on the GE system. However, other MFBIs and national MRI research centers switched towards more advanced research protocols using the Siemens---Skyra systems. Therefore, we have also switched our research MRI protocols from a GE to Skyra scanner, which required time for the implementation and validation of our research MRI protocols. Another obstacle we have encountered is related to regulatory and administrative delays. For example, our specific protocols for IRB and IRB applications required extensive reviews and, more often than not, multiple revisions and resubmissions. In addition, amendments are always required when there are personnel fluctuations, a situation, which has occurred within our team several times over the past year. Finally, in order to insure high quality research, and best utilize the funds awarded to us, it's important to gather preliminary data by designing and implementing pilot studies and in some cases, seeking out a community control group. All of these are necessary and labor---intensive steps that require time.

With regard to the second point in the critique, we are pleased to clarify the membership and function of our McKnight Scientific Advisory Board. As per our McKnight Charter, the members' "consisting of the directors of the institute's clinical, research and educations programs with research expertise in the area of normal aging and memory as well as the aging brain" primary function is to "advise the Scientific Director" on research directions and the issues relating to the operations of the Institute. Also, "The Scientific Director of the Institute serves as chair of the Scientific Advisory Board". Therefore, our McKnight Scientific Advisory Board consists of Directors (Drs. Sacco – Executive Director, Sun --- Education Director, and Rundek---interim Scientific Director and interim Chair of the Scientific Advisory Board), and research experts in aging (Drs. Czaja and Levin as clinical/translational scientists, and Dr. Perez---Pinzon as a basic/translational scientist). The Board convenes quarterly to provide oversight and advice on our research portfolio that will advance and carry our Institute's mission forward and to determine the best use of the Institute's resources. The board also monitors the scientific activities, their progress and success. We held our last McKnight Scientific Advisory Board meeting on March 15, 2017, and discussed the Committee's function, charge, and objectives for the current year.

We have also discussed the possibility of creating an additional advisory committee consisting of University of Miami faculty outside of our immediate McKnight membership (external Advisory Committee from the University of Miami). This committee may help in expanding our mission across the Campus by suggesting Campus---wide collaborators and innovative aging programs to be included and integrated with our McKnight Brain Institute. However, during this transition period we are inclined to delay this new initiative. The next Scientific Director together with the current Scientific Advisory Board will ultimately decide the Scientific Advisory Board's membership, function and direction. At this time, our priority and focus is to maintain continuity and excellence in our Institute and research, and build upon our established research and educational programs. Recruiting the new Scientific Director will help accelerate our clinical translational research program and advance the scope of our research focus.

We thank you again for your continued support, vision and valuable guidance to our research and educational program. Please let us know if you would like further information.

Sincerely,

Ralph L. Sacco, MD, MS
Executive Director
Evelyn F. McKnight Brain Institute
University of Miami Miller School of Medicine

Tatjana Rundek, MD, PhD
Interim Scientific Director
Evelyn F. McKnight Brain Institute
University of Miami Miller School of Medicine

Cianciotto.Melanie

From: Espy, Kimberly Andrews - (kespy) <kespy@email.arizona.edu>
Sent: Monday, March 27, 2017 6:24 PM
To: J Lee Dockery
Cc: Barnes, Carol A - (barnesca); comrie@arizona.edu; Jenny.Flynn@uafoundation.org; snyderlu; N39LGC@AOL.COM; Cianciotto.Melanie; mike.dockery@orthocarolina.com; generyerson@gmail.com; 1techdoc@gmail.com; 'Madhav Thambisetty'; 'Richard Isaacson'; Pierson.Priscila; hank.raattama@akerman.com; Cunningham, Elaine - (elainecunningham)
Subject: RE: MBRF Review of 2016 Tucson EMBI Report

Thank you, Lee. We are very excited where this initiative is headed. With Carol and Robbie working hand in hand – watch out ☺!!

Unfortunately, I am not able to attend the Summit, and hope to have another opportunity to visit with you soon.

My best,

Kimberly

Kimberly Andrews Espy, Ph.D.
Senior Vice President for Research
The University of Arizona
PO Box 210066, Administration 601
Tucson, AZ 85721-0066
kespy@email.arizona.edu
520.621.3513 | **FAX**: 520.621.7507

From: J Lee Dockery [mailto:jld007@cox.net]
Sent: Monday, March 27, 2017 1:30 PM
To: Espy, Kimberly Andrews - (kespy) <kespy@email.arizona.edu>
Cc: Barnes, Carol A - (barnesca) <carol@nsma.arizona.edu>; comrie@arizona.edu; Jenny.Flynn@uafoundation.org; snyderlu <luann@nsma.arizona.edu>; N39LGC@AOL.COM; Melanie.Cianciotto@SunTrust.com; mike.dockery@orthocarolina.com; generyerson@gmail.com; 1techdoc@gmail.com; 'Madhav Thambisetty' <madhavtr71@gmail.com>; 'Richard Isaacson' <rii9004@med.cornell.edu>; 'Pierson.Priscila' <Priscila.Pierson@SunTrust.com>; hank.raattama@akerman.com; Cunningham, Elaine - (elainecunningham) <elainecunningham@email.arizona.edu>
Subject: RE: MBRF Review of 2016 Tucson EMBI Report
Importance: High

Dear Kimberly,

Thank you for your thoughtful and comprehensive email outlining some of he initiatives underway at the University of Arizona (UA) to focus on the development of the interdisciplinary initiatives to address the problems of aging and age related diseases.
Dr. Barnes, in her communications related to the development of the MacArthur 100&Change proposal, had informed us of the appointment of Dr. Brinton and how impressed she is with her work. Dr. Brinton's

leadership of the health sciences focus of the Center for Innovation in Brain Sciences and her service as a member of the advisory board of the Evelyn F McKnight Brain Institute (EMBI) at the UA are anticipated to be very beneficial. The hiring of two new faculty members and "almost hires" of two additional age-focused cognitive neuroscientists with additional searches underway is very good news. The hiring of a new president, with such a strong link to medicine, will enable UA to more rapidly establish the translational research connections within both the basic and clinical sciences important in developing a visible and effective translational research programs.

It is good news to hear that Elaine Cunningham has joined the UA Foundation and her time will be dedicated to philanthropic efforts to support the interdisciplinary life sciences centered in EMBI and the BIO5. I look forward to meeting her at the Cognitive Aging Summit III.

In the meantime, the trustees are pleased the leadership at the UA has begun new and augmenting other efforts in place to advance the research initiatives within the EMBI collaborative efforts throughout the UA in support of Dr. Barnes research leading to the understanding and alleviation of age related memory loss. Your personal efforts are also recognized and appreciated.

With warm regards and best wishes,

Lee

P. S. Will you be attending the Cognitive Aging Summit III?

From: Espy, Kimberly Andrews - (kespy) [mailto:kespy@email.arizona.edu]
Sent: Saturday, March 25, 2017 8:00 PM
To: J Lee Dockery <jld007@cox.net>
Cc: Barnes, Carol A - (barnesca) <carol@nsma.arizona.edu>; comrie@arizona.edu; Jenny.Flynn@uafoundation.org; snyderlu <luann@nsma.arizona.edu>; N39LGC@AOL.COM; Melanie.Cianciotto@SunTrust.com; mike.dockery@orthocarolina.com; generyerson@gmail.com; 1techdoc@gmail.com; 'Madhav Thambisetty' <madhavtr71@gmail.com>; 'Richard Isaacson' <rii9004@med.cornell.edu>; 'Pierson.Priscila' <Priscila.Pierson@SunTrust.com>; hank.raattama@akerman.com; Cunningham, Elaine - (elainecunningham) <elainecunningham@email.arizona.edu>
Subject: RE: MBRF Review of 2016 Tucson EMBI Report

Dear Lee,
As we continue with our internal communications to formalize a proper game plan addressing the Evelyn McKnight Brain Research Foundation Trustee's concerns, I wanted to provide several updates from the University of Arizona that will be of interest to you and the trustees.

As you may be aware, Dr. Robert C. Robbins, CEO of Texas Medical Center has been named the sole candidate as President of UA; the final contract negotiations are expected to be completed by April 6. He is a highly regarded cardiac surgeon, and spent 20 years working for the Stanford University School of Medicine as professor and department chair in cardiothoracic surgery. In 2005, he founded the Stanford Cardiovascular Institute. At Texas Medical Center, Robbins has introduced new research initiatives in areas such as genomics and regenerative medicine. According to Chair Greg Patterson, "In addition to the obvious benefits to UA's two medical schools, Dr. Robbins' championship of cross-institutional research initiatives demonstrates that he is well-positioned to guide UA from its strong existing foundation to continued success in the areas of interdisciplinary scholarship and student success." I look forward to having a chance to introduce you to Dr. Robbins and to his learning more about the vision and mission of the EMBI.

From: Carol A. Barnes [mailto:carol@nsma.arizona.edu]
Sent: Wednesday, March 08, 2017 9:59 AM
To: 'J. Lee Dockery' (jld007@cox.net) <jld007@cox.net>
Cc: comrie@arizona.edu; Espy, Kimberly Andrews - (kespy) <kespy@email.arizona.edu>; Flynn, Jenny (Jenny.Flynn@uafoundation.org) <Jenny.Flynn@uafoundation.org>; snyderlu <luann@nsma.arizona.edu>
Subject: MBRF Review of 2016 Tucson EMBI Report

Dear Dr. Dockery,

Thank you for your letter dated February 22, 2017 that I received yesterday afternoon (as did Drs. Comrie and Espy and Ms. Flynn). I appreciate the thoughtful comments generated by the Trustees on my behalf. I have been in contact with Andrew, Kimberly and Jenny who all agree that you have given us 'food for thought', and want to assure you that we will be discussing these issues further and will respond more fully in the near future.

Thanks again for the feedback, and for your continued support of the work on aging brain and memory at the Tucson EMBI.

Sincerely,
Carol

C. A. Barnes, Ph.D.
Regents' Professor, Psychology, Neurology and Neuroscience
Evelyn F. McKnight Chair for Learning and Memory in Aging
Director, Evelyn F. McKnight Brain Institute
Director, Division of Neural Systems, Memory and Aging
Life Sciences North Building, Room 355
P.O. Pox 245115
University of Arizona
Tucson, AZ 85724-5115

Dr. Robert C. Robbins Biography

Dr. Robert C. Robbins assumed his position as the 22nd president of the University of Arizona on June 1, 2017. Previously, he served as president and CEO of the Texas Medical Center (TMC) in Houston from 2012 to 2017. In this role, he significantly enhanced TMC's commitment to collaboration, introducing five cross-institutional research initiatives centered on innovation, genomics, regenerative medicine, health policy and clinical research.

Prior to his time in Houston, Dr. Robbins served as professor and chairman of the Department of Cardiothoracic Surgery at Stanford University School of Medicine, founding director of the Stanford Cardiovascular Institute, president of the International Society of Heart and Lung Transplantation, president of the Western Thoracic Surgical Association, president of the American Heart Association Western States Affiliate, president of the Bay Area Society of Thoracic Surgeons, and chair of the American Heart Association Cardiovascular Surgery and Anesthesia Council, among other roles. In 2016 he served as president of the American Heart Association Southwest Affiliate.

An internationally recognized cardiac surgeon, Robbins has focused his clinical efforts on acquired cardiac diseases with a special expertise in the surgical treatment of congestive heart failure and cardiothoracic transplantation. His research work includes the investigation of stem cells for cardiac regeneration, cardiac transplant allograft vasculopathy, bioengineered blood vessels, and automated vascular anastomotic devices. Robbins is the author of more than 300 peer-reviewed articles and a former guest editor of the Circulation Surgical Supplement.

In addition to his role at the UA, Dr. Robbins serves on the boards of the Arizona Commerce Authority, Southern Arizona Leadership Council, Tucson Metro Chamber of Commerce, United Way of Tucson and Southern Arizona, and the Greater Phoenix Economic Council. He is also a member of the Chairman's Circle of Sun Corridor, Inc., and a member of Greater Phoenix Leadership. While at TMC, Robbins served on the Houston branch of the Dallas Federal Reserve board, the board of directors of the Welch Foundation, and the American Heart Association Southwest Affiliate in 2016. He served on an independent blue ribbon committee to evaluate the Veterans Affairs health system, and the World Affairs Council of Greater Houston honored him as the 2016 International Citizen of the Year.

His educational background includes a B.S. in chemistry from Millsaps College, medical degree from the University of Mississippi, general surgical training at the University of Mississippi, cardiothoracic training at Stanford University, postdoctoral research at Columbia University and the National Institutes of Health, and congenital heart surgical fellowships at Emory University and Royal Children's Hospital.