



# 3<sup>RD</sup> WORKSHOP ON RESEARCH DEFINITIONS FOR RESERVE & RESILIENCE IN COGNITIVE AGING AND DEMENTIA BETHESDA, MD – OCTOBER 31-NOVEMBER 1, 2021 REPORT



# COLLABORATORY ON RESEARCH DEFINITIONS FOR RESERVE & RESILIENCE

## 3<sup>RD</sup> WORKSHOP ON RESEARCH DEFINITIONS FOR RESERVE & RESILIENCE IN COGNITIVE AGING AND DEMENTIA

OCTOBER 31-NOVEMBER 1 • BETHESDA, MD – USA

### INTRODUCTION

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Research indicates that specific life exposures and genetic factors contribute to some people being more resilient than others, with lower rates of cognitive decline with aging and reduced risk of developing Alzheimer's disease and related dementia (ADRD). The factors associated with resilience have an important role in the development of interventions and health policies. There are likely several complex and highly interactive mechanisms that lead to these individual differences in vulnerability to decline, probably reliant on both structural and functional brain mechanisms. Investigators in this area have employed many terms encapsulating individual differences including resilience, cognitive reserve, brain reserve, brain maintenance, and compensation. In addition, there are terms commonly used in cognitive neuroscience studies of aging, such as efficiency, capacity, and compensation. However, the definitions of these concepts differ across researchers, and the translation from human to animal research is not well developed.

It is important to bring together researchers from basic neuroscience to human studies to develop operational definitions for these concepts. Along with these definitions, there is a need for translating these concepts so that they can guide research on all levels of epidemiologic, clinical, intervention, imaging and basic animal research. A particular challenge will be to identify corresponding concepts in neurobiology, animal models and models at the level of cells and molecules and approaches bridging those levels of analysis.

The three year, NIA-supported Collaboratory on Research Definitions has provided and will continue to offer a platform for the exchange of ideas. The goal of the Collaboratory is to develop operational definitions, research guidelines, and data sharing platforms with consensus and assistance from the research community.

To reach its goal the Collaboratory held three cross-discipline workshops that brought together investigators to discuss and come to consensus on these concepts, created focused work groups that had examined each of these issues, funded pilot grants designed to further the understanding and research applicability of these concepts, and developed data sharing and information exchange platforms to help guide research in this area.



# WORKSHOP SUMMARY AND NEXT STEPS

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The program began with Dr. Yaakov Stern recapping the history of the Collaboratory, and the process through which the new Framework was developed. The Framework incorporates formal definitions and operational research definitions for three terms: **cognitive reserve**, **brain maintenance**, and **brain reserve**. The definitions were carefully crafted so that they are applicable to both human and nonhuman research. The hope is that people either use these terms in their research or, when using their own terms reference them to the operational definitions in the Framework. This will facilitate communication in the field.

Three sessions followed, on **non-human studies**, **human cohort studies**, and **brain imaging studies**. Each session began by a senior researcher in that area, explaining how their research comports with the Framework. This was followed by reports of three pilot awardees who described their pilot projects and explained how they are implementing the operational definitions for the concepts in the Framework.

The final session of the day was devoted to **data sharing**. This topic has drawn special interest of the NIA, where data sharing will become obligatory for large grants. We included the session because the executive committee has decided that our remaining activities will be focused on data sharing.

The first session on day two was designed to allow researchers who have utilized other terms or models for reserve and resilience to discuss how their work comports with the concepts laid out in the Framework. Each of the speakers had already published papers specifying alternate terminology. For some of the speakers, the concepts that they presented previously are well integrated with those in the framework. For others, they explained how the research underlying their concepts can be distinct from research directed at reserve and resilience.

The second session of the day focused on **new or unique applications of the Framework**. These included talks on genetics, economics, intervention, and brain stimulation. Each of these domains can contribute to our understanding of reserve, and provide unique approaches to studying reserve.

The conference wrapped up with a discussion between the Executive Committee and the attendees. One new idea that arose was the possibility of developing a new conference that would meet every two years focusing specifically on the concepts that the Workshops had worked on for the past three years.

Our plan is to **publish the Framework**, along with the brief descriptions of the pilot projects. We will also support the publication of the results of all of the pilot projects in an open-source format. This will allow us to bring all of this material together into an **e-book**. This and many other sources of information will remain available on our **website**. The website contains slides and talks from all three Workshops along with guides to data sharing, and researchers in the field. Our hope is that the website serves as a continuous resource for investigators in this area.

## EXECUTIVE COMMITTEE

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**Yaakov Stern, PhD**, (Workshop Chair) is Chief of the Cognitive Neuroscience Division, Department of Neurology, and Professor of Neuropsychology, Gertrude H. Sergievsky Center and Taub Institute for Research on Alzheimer's Disease (AD) and the Aging Brain at Columbia University Medical Center.

Dr. Stern's research focuses on cognition in normal aging and diseases of aging, particularly AD. A strong theme of his research has been exploring individual differences in task performance in general and more specifically the reason why some individuals show more cognitive deficits than others in the face of brain insult. This has led to the cognitive reserve hypothesis, which provides rationale for intervening to improve cognitive aging.

Dr. Stern has provided some of the earliest epidemiologic evidence and developing the theory of cognitive reserve, differentiating it from other important concepts such as brain reserve and brain maintenance. His lab is involved in several ongoing, large scale imaging studies of cognition in normal aging, studies of heterogeneity of AD and epidemiologic studies of aging, AD incidence and progression. Dr. Stern's research approach includes classic neuropsychological and cognitive experimental techniques, with strong focus on functional imaging.



**Marilyn Albert, PhD**, is Professor of Neurology and Director of Cognitive Neuroscience Division in the Department of the Neurology at the Johns Hopkins University School of Medicine. She is also the Director of the Johns Hopkins Alzheimer's Disease Research Center.

Her research focuses on understanding the cognitive and brain changes in aging and neurodegenerative disorders such as AD. Dr. Albert's research aims to identify the relationship between biomarkers based on imaging, cerebrospinal fluid, blood and genetics to cognitive changes and the early diagnosis of AD. Her research was the first to show the characteristic feature of delayed recall in AD.

Dr. Albert's work on the examination of risk and protective factors in progression from normal cognition to mild cognitive impairment incorporates the important concept of cognitive reserve. More recently, her work has combined longitudinal studies with biomarkers and cognitive test scores to characterize the progression across the AD continuum.



**Carol Barnes, PhD**, is Regents' Professor of Psychology, Neurology and Neuroscience at the University of Arizona (UA), and the Evelyn F. McKnight Chair for Learning and Memory in Aging. She is also the Director of the Evelyn F. McKnight Brain Institute and the Division of Neural Systems, Memory and Aging at UA.

Dr. Barnes is an elected Fellow of the American Association for the Advancement of Science and a member of the National Academy of Sciences. Dr. Barnes is known for her pioneering work in animal models of brain aging and cognition, and the development of the novel "Barnes maze". Her research aims to understand the

neurobiological mechanisms that underly memory change in normal aging and individual differences in cognitive trajectories that occurs in aging. Dr. Barnes' seminal work in 1980 on synaptic transmission in the hippocampus of aging animals first demonstrated the concept of compensation in aging brain. Over the course of her research career, she has developed a number of methods for high-density electrophysiological recording of behavior-driven single cell activity and molecular activity monitoring across the brain. Her lab uses behavioral, electrophysiological and molecular approaches to identify factors that would benefit from specific treatment or prevention approaches for optimizing memory across the lifespan.



**Roberto Cabeza, PhD**, is Professor at the Department of Psychology of Neuroscience of Duke University, where he is also Core Member of the Center for Cognitive Neuroscience and Senior Fellow of the Center for Aging and Human Development. Dr. Cabeza has over 20 years of experience in neuroimaging of episodic memory and aging.

His laboratory uses functional MRI (fMRI), diffusion tensor imaging (DTI), electro-encephalography (EEG), and transcranial magnetic stimulation (TMS).

Using these various techniques, his laboratory investigates compensatory mechanisms in the aging brain, including the phenomena that older adults tend to show more bilateral and more frontal activation patterns than younger adults. Dr. Cabeza and his students also examine age-related deficits in white-matter and their impact on functional brain activity and connectivity. They also study the effects of aging on the neural mechanisms of memory processes, including recollection, source memory, false memory, emotional memory, and autobiographical memory.

Currently, Dr. Cabeza's laboratory is using sophisticated network and representational analyses to examine age effects on cognitive abilities, including decision making, and examining the use of cognitive training and TMS to enhance cognition in older adults. Dr. Cabeza's work has direct implications for understanding individual differences in cognitive abilities among older adults, including those related to pathological processes such as Alzheimer's Disease (AD).



**Alvaro Pascual-Leone, MD, PhD** is affiliated with the Institute for the Aging Brain and the Center for Memory Health at Hebrew Senior Life. Dr. Pascual-Leone's research aims at understanding the mechanisms that control brain plasticity across the life span to be able to modify them for the patient's optimal behavioral outcome, prevent age-related cognitive decline, reduce the risk for dementia, and minimize the impact of neurodevelopmental disorders (<http://www.brainfitclub.org>).

Dr. Pascual-Leone is a world leader in the field of noninvasive brain stimulation where his contributions span from technology development, through basic neurobiologic insights from animal studies and modeling approaches, to human proof-of-principle and multicenter clinical trials. His research has been fundamental in establishing the field of therapeutic brain stimulation. His work has provided evidence for the efficacy of noninvasive brain stimulation in treating various neurologic and psychiatric conditions, including epilepsy, stroke, Parkinson disease, chronic pain, autism, and drug-resistant depression.

Dr. Pascual-Leone has authored more than 600 scientific papers as well as several books, and is listed inventor in several patents. His work is highly regarded for its innovation and quality

and is highly cited. Dr. Pascual-Leone ranks number 1 among authors worldwide in the specific field of “Transcranial Magnetic Stimulation” and “Noninvasive Brain Stimulation” and has an H-index of 130.



**Peter Rapp, PhD**, is Chief of the Neurocognitive Aging Section and Senior Investigator in the Laboratory of Behavioral Neuroscience at the National Institute on Aging (NIA) Intramural Research Program. His research centers on the cognitive and neurobiological effects of aging in preclinical animal models including rats and monkeys.

Dr. Rapp is well known for establishing a widely used rat model of cognitive aging and advancing a non-human primate model of cognitive aging. In the preclinical animal models, Dr. Rapp's research recognized that neuron death is neither a consequence of aging, nor required for the age-related cognitive impairment and therefore the relative changes in cognitive aging is subtle rather than dramatic neuron loss.

Advancing his research, Dr. Rapp has active collaborations which have identified key neurobiological signatures of age-related cognitive impairments. His body of work suggests that successful healthy cognitive aging arises from a process of neuroadaptation that could lead to interventions towards effective aging.

# WORKSHOP PROGRAM

The 3<sup>rd</sup> Workshop was led over 2 days as follows:

## SUNDAY, OCTOBER 31, 2021

8:00-8:50	Breakfast/Meet with Senior Researchers ( <i>reservation required</i> )	
9:00-9:30	Introduction - Development of Framework	Yaakov Stern, PhD, <i>Columbia University</i>
9:30-10:45	SESSION 1A: APPLICATION OF THE FRAMEWORK: NON-HUMAN STUDIES	CO-CHAIRS: Michela Gallagher, PhD, <i>Johns Hopkins University</i> Carol Barnes, PhD, <i>University of Arizona</i>
9:30-9:45	Neurobiological Adaptations in Aging and Relevance for Cognitive Resilience	Jennifer Bizon, PhD, <i>University of Florida</i>
9:45-10:00	Molecular Markers to Operationally Define Cognitive Reserve	Thomas Foster, PhD, <i>University of Florida</i>
10:00-10:15	A Test of the Hypothesis that Factors Acting to Protect Synapse Function Will Lead to an Understanding of the Biological Basis on Cognitive Reserve	Daniel Gray, PhD, <i>University of Arizona</i>
10:15-10:30	Cognitive Training to Enhance Cognitive Reserve in Aging Mice	Holly Hunsberger, PhD, <i>Columbia University</i>
10:30-10:45	GROUP DISCUSSION	
10:45-11:15	Coffee Break	
11:15-12:30	SESSION 1B: APPLICATION OF THE FRAMEWORK: COHORT STUDIES	CO-CHAIRS: Lon White, MD, MPH, <i>Pacific Health Res &amp; Ed Inst.</i> William Kremen, PhD, <i>University of California, San Diego</i>
11:15-11:30	Cross-sectional & Longitudinal Relations between Educational Attainment and Brain Aging	Lars Nyberg, PhD, <i>Umea University</i>
11:30-11:45	Reserve and Maintenance in AD; Effects on Individual Cognitive Trajectories (REMIND-ICT)	Colin Groot, PhD, <i>Lund University</i>
11:45-12:00	Developing a Biological Marker of Cognitive Reserve with Deep Learning from Multimodal Structural MRI	Anna Marseglia, PhD, <i>Karolinska Institute</i>
12:00-12:15	Aging and Memory Origins of Heterogeneity in Cognitive Trajectories Study	Eero Vuoksimaa, PhD, <i>University of Helsinki</i>
12:15-12:30	GROUP DISCUSSION	
12:30-13:30	Lunch	
13:30-14:45	SESSION 1C: APPLICATION OF THE FRAMEWORK: BRAIN IMAGING	CO-CHAIRS: Emrah Düzel, MD, <i>DZNE</i> Michael Rugg, PhD, <i>UT Dallas</i>
13:30-13:45	Introduction	William Jagust, MD, <i>University of California, Berkeley</i>
13:45-14:00	Functional Activation Patterns to Explain Cognitive Performance beyond Brain Structure and Age	Christian Habeck, PhD, <i>Columbia University</i>
14:00-14:15	Improving the Moderation and Independent Effect Criteria of Cognitive Reserve	Rory Boyle, PhD, <i>Trinity College Dublin</i>
14:15-14:30	Decision Tree Testing Cognition-MRI Associations to Define and Differentiate CR and BM	Lidia Vaque-Alcazar, PhD, <i>University of Barcelona</i>
14:30-14:45	GROUP DISCUSSION	
14:45-15:15	SESSION 1 (a, b, c): DISCUSSION	Yaakov Stern, PhD, <i>Columbia University</i>
15:15-15:45	Coffee Break	
15:45-17:20	SESSION 2: HOW DO YOU SHARE DATA? HOW TO ACCESS IT?	CO-CHAIRS: Kristine Beate Walhovd, PhD, <i>University of Oslo</i> Dorene Rentz, PsyD, <i>Harvard Medical School</i>
15:45-15:50	Session Overview	Co-chairs
15:50-16:05	New NIA Sharing Requirements	Jennie Larkin, PhD, <i>NIA</i>

16:05-16:20	Models of Data Sharing	Nirav Merchant, MS, <i>University of Arizona</i>
16:20-16:35	Sharing Non-human Data	Amy Dunn, PhD, <i>Jackson Laboratory</i>
16:35-16:50	Human Data Sharing	Scott Hofer, PhD, <i>University of Victoria</i>
16:50-17:20	SESSION 2: GROUP DISCUSSION	
17:20-19:00	Networking Reception	

## MONDAY, NOVEMBER 1, 2021

8:00-8:50	Breakfast/Meet with Senior Researchers ( <i>reservation required</i> )	
9:00-9:05	Day 2 Program Overview	Yaakov Stern, PhD, <i>Columbia University</i>
9:05-10:20	SESSION 3: INTEGRATION OF THE FRAMEWORK FROM OTHER PERSPECTIVES	CO-CHAIRS: Marcus Richards, PhD, <i>UCL</i> Nikolaos Scarmeas, MD, MS, <i>Columbia University</i>
9:05-9:10	Session Overview	Co-Chairs
9:10-9:20	Cognitive Aging Models of Reserve Require Increased Cognitive Competence with Age	Denise Park, PhD, <i>University of Texas at Dallas</i>
9:20-9:30	Integration of the Framework from other Perspectives: Neuropathology	Thomas Montine, MD, <i>Stanford University</i>
9:30-9:40	Framework in the Context of Resistance and Resilience Used in AD Biomarker Research	Prashanthi Vemuri, PhD, <i>Mayo Clinic</i>
9:40-9:50	Linking the Concepts of Cognitive Reserve and Compensation	Roberto Cabeza, PhD, <i>Duke University</i>
9:50-10:20	SESSION 3: GROUP DISCUSSION	
10:20-10:50	Coffee Break	
10:50-12:45	SESSION 4: APPLICATION OF THE FRAMEWORK IN OTHER AREAS	CO-CHAIRS: Changiz Geula, PhD, <i>Northwestern University</i> David Bartrés-Faz, PhD, <i>University of Barcelona</i>
10:50-10:55	Session Overview	Co-chairs
10:55-11:15	Genetics	Timothy Hohman, PhD, <i>Vanderbilt University Medical Center</i>
11:15-11:35	Economics	Robert Willis, PhD, <i>University of Michigan</i>
11:35-11:55	Cognitive Intervention	Sylvie Belleville, PhD, <i>University of Montreal</i>
11:55-12:15	Brain Stimulation	Alvaro Pascual-Leone, PhD, <i>Harvard Medical School</i>
12:15-12:45	SESSION 4: GROUP DISCUSSION	
12:45-13:45	Lunch	
13:45-14:50	SESSION 5: OPEN DISCUSSION - Future Directions	Executive Committee
14:50-15:00	Concluding Remarks	



# AUDIENCE

The audience counted 161 virtual participants and 118 in-person attendees.

First Name	Last Name	Suffix	Organization
Shanika	Jayakody	PhD	Albert Einstein College of Medicine
Helena	Blumen	PhD	Albert Einstein College of Medicine
Jinshil	Hyun	PhD	Albert Einstein College of Medicine
Claire	Sexton	PhD	Alzheimer's Association
Srilatha	Raghuram	PhD	Alzheimer's Association
Maria	Carrillo	PhD	Alzheimer's Association
Rebecca	Edelmayer	PhD	Alzheimer's Association
Diana	Bocancea	MS	Amsterdam UMC
Linda	Lorenz	MS	Amsterdam UMC
Müge	Akinci	MS	BarcelonaBeta Brain Research Center (BBRC)
Eider	M. Arenaza-Urquijo	PhD	BarcelonaBeta Brain Research Center (BBRC)
Eleni	Palpatzis	MS	BarcelonaBeta Brain Research Center (BBRC)
Cleofé	Peña-Gómez	PhD	BarcelonaBeta Brain Research Center (BBRC)
Jiachen	Chen	MS	Boston University
Yuan	Fang	PhD	Boston University
Phillip	Hwang	PhD	Boston University
Thomas	Perls	MD	Boston University
Renee	Groechel	MS	Boston University School of Medicine
Stacy	Andersen	PhD	Boston University School of Medicine
Anne	Berry	PhD	Brandeis University
Martha	Taggart	MA	BrightFocus Foundation
Sharyn	Rossi	PhD	BrightFocus Foundation
Rebecca	Atkinson	PhD	Brighton and Sussex Medical School
Richard	Jones	Other	Brown University
Zachary	Kunicki	PhD	Brown University
Deirdre	Oshea	PhD	Brown University
Tara	Tracy	PhD	Buck Institute for Research on Aging
Joanne	Murabito	PhD	BUSM
Evan	Smith	PhD	Center for Vital Longevity
Sarah	Monier	Other	Center for Vital Longevity
Da Yeoun	Moon	Other	Center for Vital Longevity, University of Texas at Dallas
Brenda	Chino	PhD (cand.)	Center of Biomedical Technology
Heather	Demali	MS	Charles River
Pavla	Cermakova	MD, PhD	Charles University
Katrin	Wolfova	MD	Charles University
Hyunju	Seo	PhD	Chungnam national university
Ainara	Estangs	PhD	Cita-alzheimer
Ladan	Saidi	PhD	College of Education
Sharon	Simon	PhD	Columbia University
Silvia Chapman	Chapman	PhD	Columbia University
Eleanna	Varangis	PhD	Columbia University

First Name	Last Name	Suffix	Organization
Georgette	Argiris	PhD	Columbia University
Suhang	Song	PhD	Columbia University
Annie	Lee	PhD	Columbia University
Yian	Gu	PhD	Columbia University
Jet	Vonk	PhD	Columbia University
Holly	Hunsberger	PhD	Columbia University
Kulbir	Kaur	PhD	Columbia University
Christine Ann	Denny	PhD	Columbia University Irving Medical Center
Yunglin	Gazes	PhD	Columbia University Irving Medical Center
Courtney	Delacuesta	Other	Columbia University Irving Medical Center
Alexandra	Gaynor	PhD	Columbia University Medical Center
Samira	Mellah	PhD	CRIUGM
Sylvie	Belleville	PhD	CRIUGM
Jonathan Adrian	Zegarra Valdivia	PhD (cand.)	CSIC- Cajal Institute
Cherie	Strikwerda-Brown	PhD	Douglas Mental Health University Institute
Hanzhang	Xu	PhD	Duke University
Roberto	Cabeza	PhD	Duke University
Tingzhong (Michelle)	Xue	PhD (cand.)	Duke University School of Nursing
Emrah	Duzel	PhD	DZNE
Gerd	Kempermann	MD	DZNE
Miranka	Wirth	PhD	DZNE, Dresden
Antoine	Trammell	MD	Emory University
Monica	Rosselli	PhD	Florida Atlantic University
Idaly	Velez Uribe	PhD	Florida Atlantic University
Gladys	Ibanez	PhD	Florida International University
Damaris	Aschwanden	PhD	Florida State University
Xianghe	Zhu	PhD	Florida State University
Amanda	Sesker	PhD	Florida State University College of Medicine
Vonetta	Dotson	PhD	Georgia State University
Gerd	Kempermann	MD	German Center for Neurodegenerative Diseases (DZNE)
Ana	Baena	MA	Grupo Neurociencias de Antioquia
Patricia	Heyn	PhD	GSA ADRD Group/ University of Colorado
Francesca	Gelfo	PhD	Guglielmo Marconi University
Dorene	Rentz	PsyD	Harvard Medical School
Felipe	Schiffino	PhD	Harvard Medical School
Anne	Murray	MD	Hennepin HealthCare Research Foundation
Alvaro	Pascual-Leone	MD, PhD	Honda and Arthur Marcus Institute for Aging Research
Raphael	Castilhos	PhD	Hospital de Clínicas de Porto Alegre
Renata	Kochhann	PhD	Hospital Mopinhos de Vento
Dzerassa	Kadieva	MS	HSE
Sam	Gandy	MD, PhD	Icahn SOM Mount Sinai
Marina	Leiman Algranati	PhD (cand.)	IKND
Chinedu	Momoh	PhD	Imperial College London
Gonneaud	Julie	PhD	Inserm Nord Ouest
Sonia	Montemurro	PhD	IRCCS San Camillo Hospital, Venice (Italy)

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Michelle	Carlson	PhD	Johns Hopkins University
George	Rebok	PhD	Johns Hopkins University
Gail	Wallace	PhD	Johns Hopkins University
Nadia	Chu	PhD	Johns Hopkins University
Qianli	Xue	PhD	Johns Hopkins University
Michela	Gallagher	PhD	Johns Hopkins University
Marilyn	Albert	PhD	Johns Hopkins University
Anja	Soldan	PhD	Johns Hopkins University
Jeremy	Walston	MD	Johns Hopkins University School of Medicine
Anders	Rydström	PhD (cand.)	Karolinska Institute
Anna	Marseglia	PhD	Karolinska Institutet
David	Predovan	PhD	Laval University
Stefania	Pezzoli	PhD	Lawrence Berkeley National Laboratory
Nathan	Dejong	PhD (cand.)	Maastricht University
Julie	Oomens	MS	Maastricht University
Clara	Vila-Castelar	PhD	Massachusetts General Hospital
Rachel	Buckley	PhD	Massachusetts General Hospital
Maria	Vassilaki	MD, PhD	Mayo Clinic
Prashanthi	Vemuri	PhD	Mayo Clinic
Naga	Thovinakere	Other	McGill University
Maiya	Geddes	MD	McGill University
Catherine	Robb	PhD	Monash University
Joanne	Ryan	PhD	Monash University
Adrian	Noriega De La Colina	MD, PhD	Montreal Neurological Institute
Shabnam	Salimi	MD	Morgan State University
Nikolaos	Scarmeas	MD, PhD	National and Kapodistrian Univ of Athens /Columbia Univ
Shulan	Hsieh	PhD	National Cheng Kung University
Cristina	Banuelos	PhD	National Institute on Aging
Ciana	Cooper	PhD	National Institute on Aging
Francesca	Macchiarini	PhD	NATIONAL INSTITUTE ON AGING
Murat	Bilgel	PhD	National Institute on Aging
Susan	Resnick	PhD	National Institute on Aging
Peter	Rapp	PhD	National Institute on Aging
Luke	Stoeckel	PhD	National Institute on Aging/NIH
Liz	Necka	PhD	National Institute on Aging/NIH
Janine	Simmons	MD, PhD	National Institute on Aging/NIH
Jonathan	King	PhD	National Institute on Aging/NIH
Lis	Nielsen	PhD	National Institute on Aging/NIH
Amber	Penning	MS	Netherlands Institute for Neuroscience
Chhanda	Dutta	PhD	NIA
Basil	Eldadah	MD, PhD	NIA
Perla	Moreno Castilla	PhD	NIA
Ross	Mcdevitt	PhD	NIA-IRP
Eleonor	Simonsick	PhD	NIH NIA

First Name	Last Name	Suffix	Organization
Qu	Tian	PhD	NIH NIA
Michael	Duggan	PhD	NIH/NIA
Melissa	Kitner Triolo	PhD	NIH/NIA
Dave	Frankowski	PhD	NIH/NIA/DN
Devon	Oskvig	PhD	NIH/NIA/DN
Luci	Roberts	PhD	NIH/NIA/DN
Molly	Wagster	PhD	NIH/NIA/DN
Jennie	Larkin	PhD	NIH/NIA/DN
Coryse	St. Hillaire Clarke	PhD	NIH/NIA/DN
Matt	Sutterer	PhD	NIH/NIA/DN
Jeffrey Long	Long	PhD	NIH\NIA
Timothy	Morris	PhD	Northeastern University
Emily	Rogalski	PhD	Northwestern University
John	Disterhoft	PhD	Northwestern University
Changiz	Geula	PhD	Northwestern University Feinberg School of Medicine
Sandra	Weintraub	PhD	Northwestern University Feinberg School of Medicine
Raymond	Ownby	MD, PhD	Nova Southeastern University
Kerstin	Pahl	PhD	NYU School of Medicine
Ged	Ridgway	PhD	Oxford Brain Diagnostics Ltd
Mario	Torso	PhD	Oxford Brain Diagnostics Ltd
Wanrui	Wei	Other	Peking Union Medical College
Anapatricia	Aguilerahermida	PhD	Penn State University
Kristin	Krueger	PhD	private practice
Quinn	Kennedy	PhD	QK Consulting
Michelle	Jansen	PhD (cand.)	Radboud University
Kristine	Sneidere	MS	Riga Stradiņš University
Maude	Wagner	PhD	Rush Alzheimer's Disease Center
Darina	Petrovsky	PhD	Rutgers University
Irene	Neuner	MD	RWTH Aachen University
Anja	Pogarcic	MS	Saint Louis University
Patricia	Jumbo	MD, PhD	Samford University
Somin	Kim	Other	Seoul National University
Jihyeon	Jo	MS	Seoul National University
Jeanyung	Chey	PhD	Seoul national university
Daniel	Gan	PhD	Simon Fraser University
Alexandra	Trelle	PhD	Stanford University
Thomas	Montine	MD, PhD	Stanford University School Of Medicine
Chenyang	Jiang	MS	SZBL
Allison	Heaps	MS	Taub Institute, Columbia ADRC
Vinay	Parikh	PhD	Temple University
Karienn	Montgomery	PhD	Texas A&M Health Science Center
Hanna	Lu	PhD	The Chinese University of Hong Kong
Hanna	Lu	PhD	The Chinese University of Hong Kong
Catherine	Kaczorowski	PhD	The Jackson Laboratory
Amy	Dunn	PhD	The Jackson Laboratory
Niran	Hadad	PhD	The Jackson Laboratory

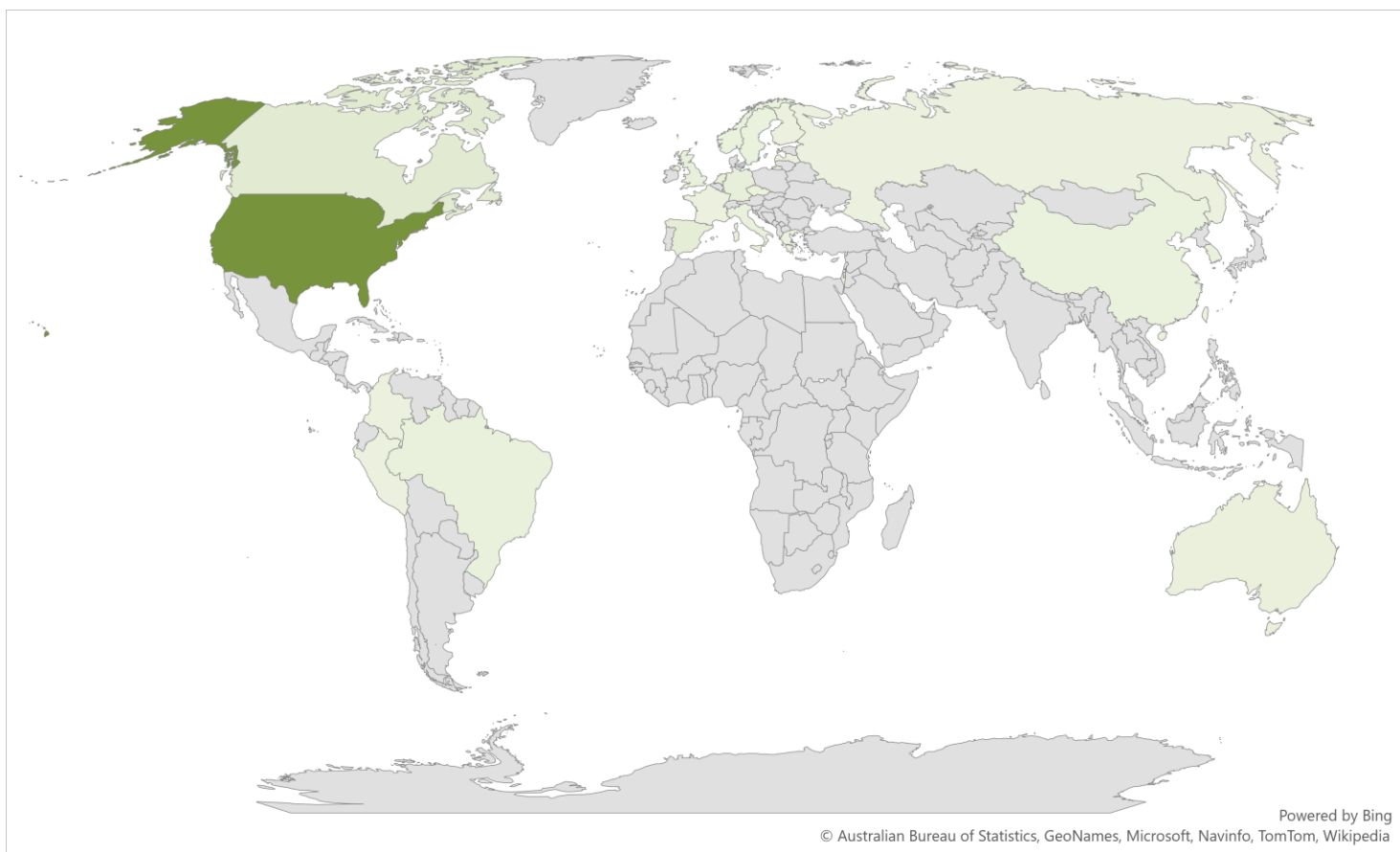


First Name	Last Name	Suffix	Organization
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Matthew	Stauder	PhD (cand.)	The Ohio State University
Scott	Hayes	PhD	The Ohio State University
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Gagan	Wig	PhD	The University of Texas at Dallas
Lianlian	Du	PhD	The University of Wisconsin-Madison
Ileana	De Anda-Duran	MD	Tulane University
Theresa	Harrison	PhD	UC Berkeley
Evan	Fletcher	PhD	UC Davis
Sarah	Tomaszewski Farias	PhD	UC Davis
Chandra	Reynolds	PhD	UC Riverside
Erik	Buchholz	MA	UC San Diego
Steven	Edland	PhD	UCSD
Christina	Dintica	PhD	UCSF
Marianne	Chapleau	PhD	UCSF
Kaitlin	Casaleto	PhD	UCSF
Breton	Asken	PhD	UCSF Memory and Aging Center
Eleanor	Liu	PhD (cand.)	University of TX at Dallas
Alvin	Thomas	PhD (cand.)	UNC Chapel Hill
Felipe	Schroeder De Oliveira	MD	Universidade Franciscana
Marco	Calabria	PhD	Universitat Oberta de Catalunya
Dorina	Cadar	PhD	University College London
Melis	Anaturk	PhD	University College London
Sara	Sims	MA	University of Alabama at Birmingham
Daniel	Gray	PhD	University of Arizona
Siobhan	Hoscheidt	PhD	University of Arizona
Nirav	Merchant	MS	University of Arizona
Lee	Ryan	PhD	University of Arizona
Meredith	Hay	PhD	University of Arizona
Carol	Barnes	PhD	University of Arizona
Maria Del Rocio	Cabello Toscano	MS	University of Barcelona
Lidia	Vaqué-Alcázar	PhD	University of Barcelona
Carol	Franz	PhD	University of California San Diego
Jeremy	Elman	PhD	University of California San Diego
Xi	Chen	PhD	University of California, Berkeley
Alexander	Ehrenberg	PhD (cand.)	University of California, Berkeley
William	Jagust	MD	University of California, Berkeley
Alyssa	Rodriguez	Other	University of California, Irvine
Maria	Corrada	PhD	University of California, Irvine
Jenna	Merenstein	MA	University of California, Riverside
Patricia	Heyn	PhD	University of Colorado Anschutz Medical Campus
Jennifer	Bizon	PhD	University of Florida
Thomas	Foster	PhD	University of Florida
Claudia	Schwarz	PhD	University of Helsinki
Marco	Pipoly	PhD (cand.)	University of Iowa
Adriana	Rivera-Dompenciel	PhD (cand.)	University of Iowa

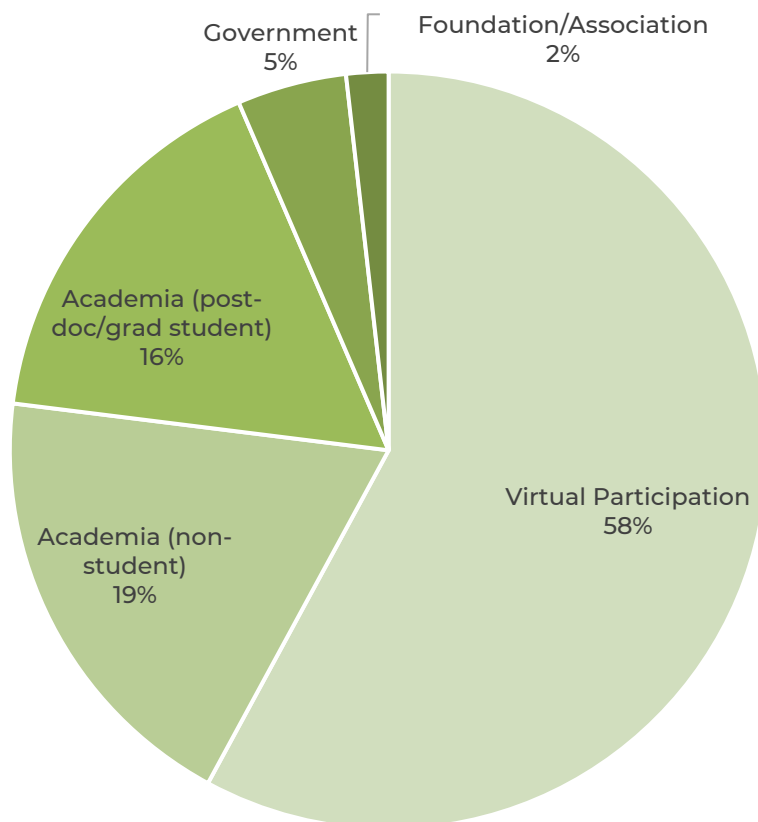
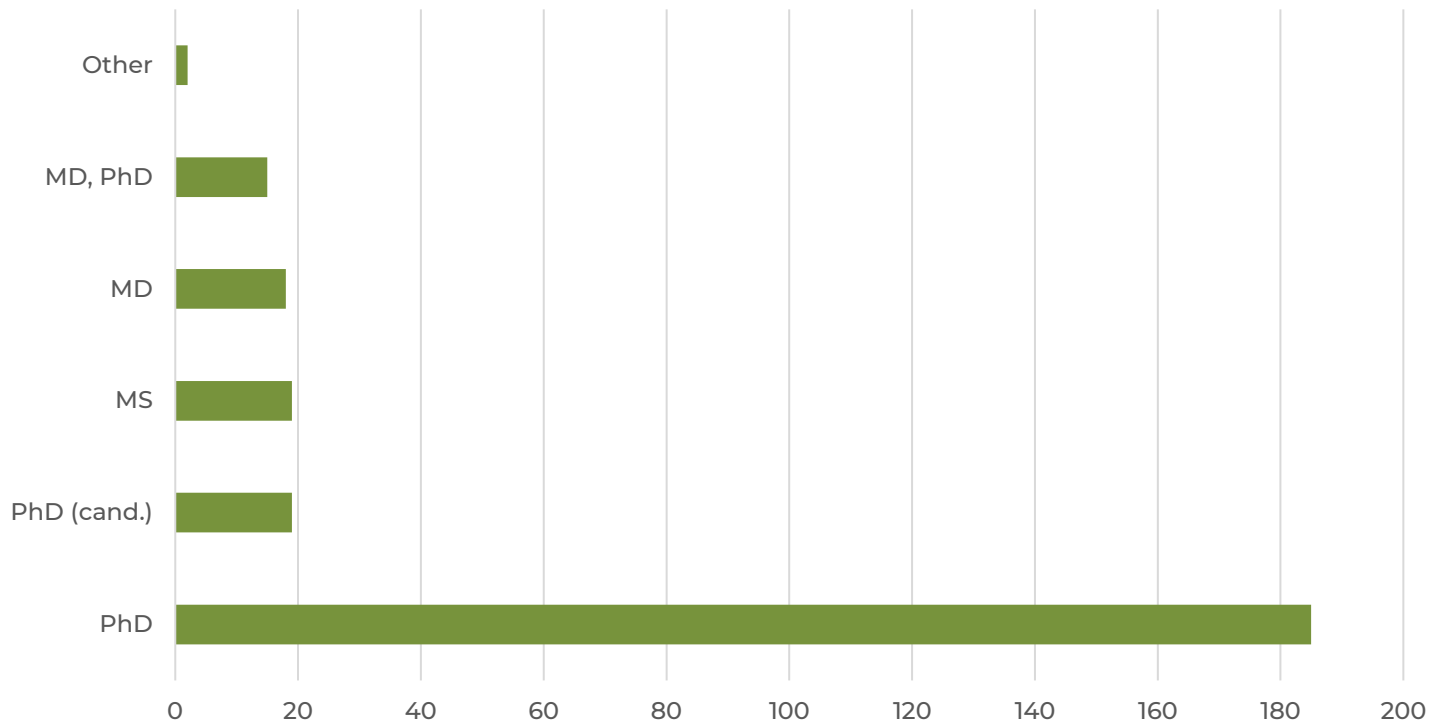
First Name	Last Name	Suffix	Organization
In-Young	Choi	PhD	University of Kansas Medical Center
Phil	Lee	PhD	University of Kansas Medical Center
Kenneth	Langa	MD, PhD	University of Michigan
Robert	Willis	PhD	University of Michigan
Samantha	Maltezos	PhD (cand.)	University of Montreal
Ersin	Ersözlü	MD	University of Munich (LMU)
Kaarin	Anstey	PhD	University of New South Wales
Liisa	Raud	PhD	University of Oslo
Didac	Vidal Pineiro	PhD	University of Oslo
Veronica	Pucci	PhD (cand.)	University of Padua
Sara	Mondini	PhD	University of Padua
Paola	Pisetta	Other	University of Sao Paulo
Joseph	Mcquail	PhD	University of South Carolina
Jingkai	Wei	PhD	University of South Carolina
Em	Arpawong	PhD	University of Southern California
Teal	Eich	PhD	University of Southern California
Stephanie	Grasso	PhD	University of Texas at Austin
Sabina	Srokova	PhD (cand.)	University of Texas at Dallas
Mingzhu	Hou	PhD	University of Texas at Dallas
Ziwei	Zhang	Other	University of Texas at Dallas
Ambereen	Kidwai	MS	University of Texas at Dallas
Madeline	Wood	Other	University of Toronto
Luis	Fornazzari	MD, PhD	University of Toronto
Mary	Hynes	MS	University of Toronto
Luis	Fornazzari	MD	University of Toronto
Tarek	Rajji	MD	University of Toronto; Ctre for Addiction & Mental Health
Scott	Hofer	PhD	University of Victoria
Suzanne	Tyas	PhD	University of Waterloo
Corinna	Burger	PhD	University of Wisconsin
Lisa	Bratzke	PhD	University of Wisconsin - Madison
Peter	Nathanielsz	MD, PhD	University of Wyoming
Judy	Pa	PhD	USC
Michael	Rugg	PhD	UT Dallas
Jamie	Walker	MD, PhD	UT Health San Antonio
Jackie	Eissman	Other	Vanderbilt Memory & Alzheimer's Center
Jared	Phillips	Other	Vanderbilt Memory and Alzheimer's Center
Mabel	Seto	PhD (cand.)	Vanderbilt University
Jerri	Rook	PhD	Vanderbilt University
Timothy	Hohman	PhD	Vanderbilt University Medical Center
Logan	Dumitrescu	PhD	Vanderbilt University Medical Center
Blake	Neyland	PhD	Vanderbilt University Medical Center
Lori	Newman	PhD	Vassar College
Mary	Lee	MD	Veterans Affairs
Vaibhav Janve	Janve	PhD	vumc
Christina	Hugenschmidt	PhD	Wake Forest School of Medicine
Deepthi	Thumuluri	Other	Wake Forest University

First Name	Last Name	Suffix	Organization
Nicole	Armstrong	PhD	Warren Alpert Medical School of Brown University
Marta	Stojanovic	MA	Washington University in Saint Louis
Denise	Head	PhD	Washington University in St. Louis
Jorge	Llibre-Guerra	MD	Washington University School of Medicine in St.Louis
Naftali	Raz	PhD	Wayne State university
Tamir	Eisenstein	PhD (cand.)	Weizmann Institute of Science

Countries represented were:



## Academic Distribution





## SCHOLARSHIPS

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The workshop had provided 42 scholarships towards registration, travel support and accommodation for graduate students, post docs and early career scientists to attend the workshop. The website had an online application form with a submission deadline of August.

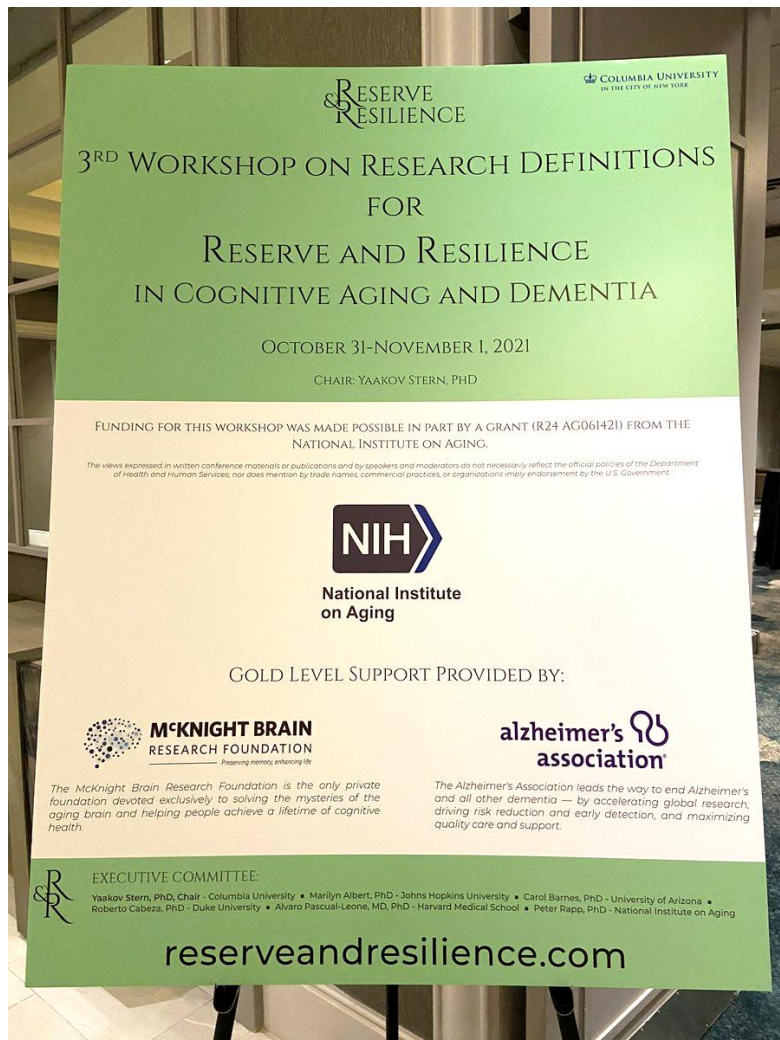


## SUPPORT

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Funding for this conference was provided in part by a Cooperative Agreement from the National Institute on Aging. Significant support was received from the **The McKnight Brain Research Foundation** and the **Alzheimer's Association**.

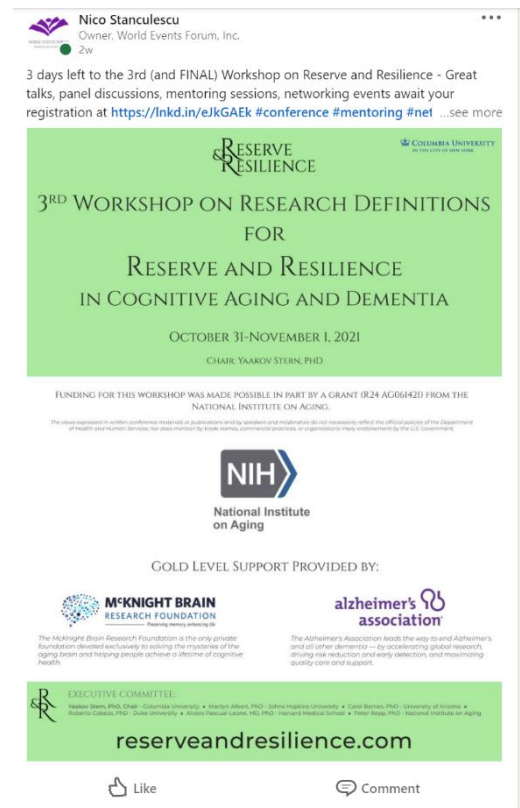
## Support Recognition Posters at the Event



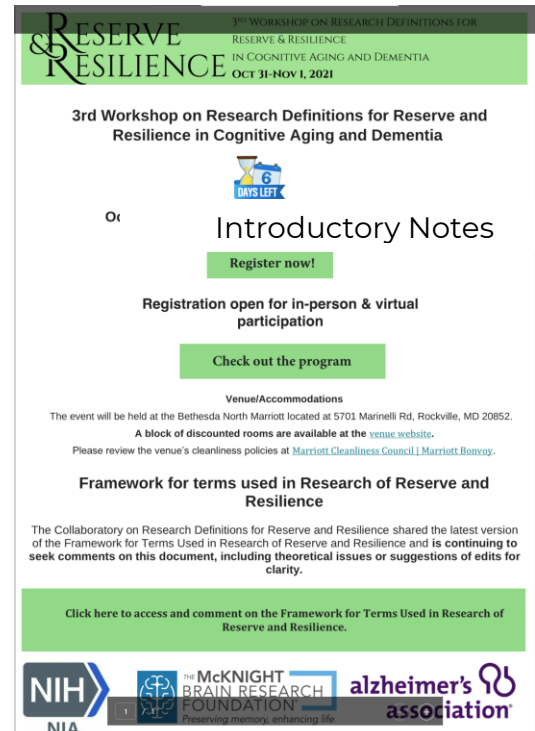
## At the event



## LinkedIn



## E-blast and Twitter



## VIDEOS

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The video recordings are currently being edited and will soon be posted at the event's website <https://reserveandresilience.com/>

## CONTACTS

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