

#### The Cambridge Handbook of Cognitive Aging

Decades of research have demonstrated that normal aging is accompanied by cognitive change. Much of this change has been conceptualized as a decline in function. However, age-related changes are not universal, and decrements in older adult performance may be moderated by experience, genetics, and environmental factors. Cognitive aging research to date has also largely emphasized biological changes in the brain, with less evaluation of the range of external contributors to behavioral manifestations of age-related decrements in performance. This handbook provides a comprehensive overview of cutting-edge cognitive aging research through the lens of a life course perspective that takes into account both behavioral and neural changes. Focusing on the fundamental principles that characterize a life course approach – genetics, early life experiences, motivation, emotion, social contexts, and lifestyle interventions – this handbook is an essential resource for researchers in cognition, aging, and gerontology.

AYANNA K. THOMAS is Professor of Psychology at Tufts University. She takes a translational approach to the study of memory and age-related changes in cognition by applying basic science findings to areas such as eyewitness memory, education, and cognitive aging.

ANGELA GUTCHESS is Associate Professor of Psychology at Brandeis University, with appointments in the Neuroscience Program and the Volen Center for Complex Systems. Her research investigates the influence of age and culture on memory and social cognition, using behavioral, neuroimaging (fMRI), electrophysiological (EEG), and patient research methods.





# The Cambridge Handbook of Cognitive Aging

A Life Course Perspective

Edited by

Ayanna K. Thomas

Tufts University, Massachusetts

Angela Gutchess Brandeis University, Massachusetts





## **CAMBRIDGE**UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

79 Anson Road, #06-04/06, Singapore 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781108428347

DOI: 10.1017/9781108552684

© Cambridge University Press 2020

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2020

Printed in the United Kingdom by TJ International Ltd. Padstow Cornwall

A catalogue record for this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data

Names: Thomas, Ayanna K., editor. | Gutchess, Angela, editor.

Title: The Cambridge handbook of cognitive aging : a life course perspective / edited by Ayanna K. Thomas, Tufts University, Massachusetts, Angela Gutchess, Brandeis University, Massachusetts.

Description: 1 Edition. | New York : Cambridge University Press, 2020. | Series: Cambridge handbooks in psychology | Includes bibliographical references and index. Identifiers: LCCN 2019042613 (print) | LCCN 2019042614 (ebook) | ISBN 9781108428347 (hardback) | ISBN 9781108552684 (ebook)

Subjects: LCSH: Cognition – Age factors. | Aging – Physiological aspects. | Dementia – Prevention.

Classification: LCC BF724.55.C63 C36 2020 (print) | LCC BF724.55.C63 (ebook) | DDC 155.67/13–dc23

LC record available at https://lccn.loc.gov/2019042613

LC ebook record available at https://lccn.loc.gov/2019042614

ISBN 978-1-108-42834-7 Hardback

ISBN 978-1-108-44936-6 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.



## Contents

	List of Figures	page ix
	List of Tables	xi
	List of Contributors	xii
		1
	Introduction	
	Part I Models of Cognitive Aging	3
1	Overview of Models of Cognitive Aging	5
	NANCY A. DENNIS, ANGELA GUTCHESS, AND AYANNA K. THOMA	S
2	Cognitive Reserve	32
	ELEANNA VARANGIS AND YAAKOV STERN	
3	How Age-Related Changes in the Brain Affect Cognition	47
	ANDERS M. FJELL AND KRISTINE B. WALHOVD	
4	Neuroadaptive Trajectories of Healthy Mindspan: From	
	Genes to Neural Networks	62
	PETER R. RAPP, CRISTINA BAÑUELOS, AND CRAIG MYRUM	
5	Cognitive Aging: The Role of Neurotransmitter Systems	82
	ANNA RIECKMANN AND LARS NYBERG	
6	How Arousal-Related Neurotransmitter Systems	
	Compensate for Age-Related Decline	101
	MARA MATHER	
Part I	Summary	121
	AYANNA K. THOMAS	
	Part II Mechanisms of Cognitive Aging	125
7	Aging Effects on Brain and Cognition: What Do We Learn	
	from a Strategy Perspective?	127
	THOMAS HINAULT AND PATRICK LEMAIRE	

V



vi Contents

8	Inhibitory Theory: Assumptions, Findings, and Relevance to Interventions LYNN HASHER AND KAREN L. CAMPBELL	147
9	From Perception to Action: Bottom-Up and Top-Down Influences on Age Differences in Attention CINDY LUSTIG AND HYESUE JANG	161
10	Age-Related Sensory Deficits and Their Consequences  JONATHAN E. PEELLE	179
11	Episodic Memory Decline in Aging AUDREY DUARTE AND MICHAEL R. DULAS	200
12	Age Differences in Decision Making JONELL STROUGH, WÄNDI BRUINE DE BRUIN, AND JENNA M. WILSON	218
13	Emotion and Memory ELIZABETH A. KENSINGER, JACLYN FORD, AND RYAN T. DALEY	236
14	Time Perception from Seconds to Lifetimes: How Perceived Time Affects Adult Development HSIAO-WEN LIAO, SABINE HOMMELHOFF, AND LAURA L. CARSTENSEN	254
Part II	Summary KRYSTAL R. LEGER AND ANGELA GUTCHESS	273
	Part III Aging in a Socioemotional Context	279
15	Memory and Aging in Social Contexts  MICHELLE L. MEADE, VLADIMIR A. PERGA, AND KATHERINE  M. HART	281
16	Emotion Regulation in Adulthood and Old Age: A Cognitive Aging Perspective on Strategy Use and Effectiveness KATHRYN L. OSSENFORT AND DEREK M. ISAACOWITZ	299
17	Changes in Social and Emotional Well-Being over the Lifespan ANNE C. KRENDL	315
18	Aging and Cognitive Functioning: The Impact of Goals and Motivation THOMAS M. HESS	332
19	Social Relationships and Cognitive Development in Adulthood KAREN L. FINGERMAN, MENG HUO, YEE TO NG, AND STEVEN H. ZARIT	350



More Information

		Contents	vi
20	Emotion Recognition and Aging of the Social Brain TED RUFFMAN AND RYAN SUTCLIFFE	367	
21	Narrative and Identity: The Importance of Our Personal Past in Later Life GERBEN J. WESTERHOF, NICOLE ALEA, AND SUSAN BLUCK	383	
22	Stereotype Threat and the Cognitive Performance of Older Adults SARAH J. BARBER AND KRISTY LUI	400	
Part III	Summary ISABELLE MOORE AND ANGELA GUTCHESS	417	
	Part IV Cognitive, Social, and Biological Factors across the Lifespan	421	
23	Prenatal Influences on Cognitive Aging SUSANNE R. DE ROOIJ	423	
24	Associations between Activity Participation across the Life Course and Cognitive Aging  ALAN J. GOW	440	
25	Cognitive Aging and Culture: Older Brain Predictions about Different Environments YU-SHIANG SU AND JOSHUA OON SOO GOH	457	
26	Current Perspectives on Aging and Bilingualism across the Life Span ANGELA GRANT, KRISTINA COULTER, AND NATALIE PHILLIPS	480	
27	Grit and Successful Aging EMMA RHODES AND TANIA GIOVANNETTI	499	
28	Control and Cognition: Contextual and Individual Differences in Cognitive Aging SHEVAUN D. NEUPERT AND JENNIFER A. BELLINGTIER	514	
29	Cognition and Well-Being across Adulthood and Old Age JOHANNA DREWELIES AND DENIS GERSTORF	532	
30	The Genetics of Cognitive Abilities  GORAN PAPENBERG AND LARS BÄCKMAN	552	
31	Blood Biomarkers of Cognitive Health and Neurodegenerative Disease MARK MAPSTONE, THOMAS J. GROSS, SUDHAKAR RAJA SUBRAMANIAM, MASSIMO S. FIANDACA, AND HOWARD J. FEDEROFF	568	



V111	Contents

Contents		
Part IV	Summary NATHANIEL RABB AND AYANNA K. THOMAS	587
	Part V Later Life and Interventions	591
32	Cerebrovascular Disease, Aging, and Depression: Clinical Features, Pathophysiology, and Treatment FAITH GUNNING AND ABHISHEK JAYWANT	593
33	The Role of Nutrition in Cognitive Decline BERNA RAHI, CYRUS A. RAJI, SOMAYEH MEYSAMI, AND DAVID MERRILL	612
34	The Role of Sleep in Cognitive Aging TAYLOR TERLIZZESE AND MICHAEL K. SCULLIN	628
35	The Relationship between Accelerometer-Derived Metrics of Physical Activity and Cognition among Older Adults NICOLE J. HEGBERG, SHEENA DEV, AND SCOTT M. HAYES	645
36	Far Transfer and Cognitive Training: Examination of Two Hypotheses on Mechanisms PAMELA M. GREENWOOD	666
37	Maximizing the Impact of Cognitive Engagement Interventions for Older Adults RACHEL WU AND GEORGE W. REBOK	685
38	Mobility and Cognitive Decline in Older Adults with Cognitive Impairment CAROLINE WARD, EMILY TOUCHET, ELIZABETH MARFEO, AND NATHAN WARD	701
39	Current and Emerging Technologies for Supporting Successful Aging WENDY A. ROGERS, KENNETH A. BLOCKER, AND LUCILE DUPUY	717
Part V	Summary Renée decaro and ayanna K. Thomas	737
	Index	743

Plate section can be found between pages 400 and 401



## **Figures**

1.1	Functional deactivations: Change with age and dementia	
	of the Alzheimer type.	page 15
1.2	The scaffolding theory of aging and cognition	
	(STAC) – revised.	17
1.3	Global and domain-specific changes in cognition throughout	
	adulthood.	20
2.1	Brain reserve in AD and healthy aging.	34
2.2	Cognitive reserve in AD and healthy aging.	35
4.1	How different conceptualizations of variability in cognitive	
	aging might map onto underlying constellations of neurobiologica	al
	change.	66
4.2	Theoretical longitudinal trajectories that might result in increased	
	variability in cognitive aging.	76
5.1	Schematic overview of major neurotransmitter pathways.	85
5.2	Amphetamine benefits older adults on an updating working	
	memory task.	89
7.1	Event-related potentials associated with small-split and large-split	t
	problems in central sites of the scalp for young and older adults	
	during arithmetic problem verification tasks.	130
7.2	Strategy interference effects on current problems (performance	
	with the poorer minus with the better strategy) in young	
	and older adults, overall, or as a function of whether the poorer	
	or the better strategy was executed on the immediately preceding	
	problems.	137
7.3	Cortical activations revealed by MEG on current problems	
	in (A) young and (B) older adults, during the execution of a poore	
	strategy, as a function of whether the poorer or the better strategy	
	was executed on the immediately preceding problems.	138
9.1	The relationship between demands for top-down control	
	and compensation success.	167
10.1	(a) The human auditory system; (b) The pattern of high-frequency	1
	hearing loss commonly seen in older adulthood; (c) An example	
	of age-related change in the frequency-following response.	180

ix



x List of Figures

10.2	A framework for cognitive demands during speech understanding.	185
13.1	Processes contributing to emotional memory encoding.	237
13.2	A model for how emotion continues to influence the way events	
	are brought back to mind at the moment of retrieval.	243
20.1	Percentage of young and older adults in each of the four quartiles	
	for emotion recognition.	368
22.1	Stereotype threat effects on older and younger adults' memory.	402
23.1	Overview of brain reserve capacity (BRC) model showing	
	increased risk for cognitive decline and dementia disorders.	425
23.2	Conceptual model for the relation between prenatal factors	
	and cognitive aging.	431
24.1	Exemplar of developmental trends of cognitive abilities across	
	adulthood.	441
24.2	Differential preservation versus preserved differentiation in	
	activity-cognition associations.	446
26.1	Example of interactive activation in transmission deficit theory.	484
26.2	The bilingual language interaction network for comprehension	
	of speech (BLINCS) model.	489
29.1	Overarching conceptual model that dynamically links functioning	
	and development across adulthood and old age in the domains	
	of cognition and well-being.	534
30.1	Heritability of general memory based on forty-five studies.	553
30.2	Modification of APOE effects on executive functioning	
	by COMT and BDNF.	557
30.3	Epigenetic mechanism of deoxyribonucleic acid (DNA)	
	methylation.	560
31.1	Distribution of cognitive performance.	573
34.1	Age-related changes in polysomnography-measured sleep	
	fragmentation (a) and sleep stages (b).	630
39.1	Persona of Simone, a seventy-eight-year-old woman, illustrating	
	her interests, needs, and goals.	722
39.2	Persona of Robert, a sixty-eight-year-old man, illustrating his	
	interests, needs, and goals.	723
39.3	A joint persona for Sharon (84) and Gene (81), a married couple,	
	illustrating their interests, needs, and goals.	723



#### **Tables**

14.1	Proposed characteristics of bottom-up and top-down	
	processing of time	page 256
35.1	Studies examining objective metrics of overall physical activity	649
35.2	Studies examining objective metrics of physical activity intensity	652
37.1	Six factors for triggering cognitive development across the life	
	span, as proposed by Wu and colleagues (2017)	688
39.1	The potential of technologies to support personas in reaching	
	their goals	727



#### Contributors

NICOLE ALEA, University of California, Santa Barbara LARS BÄCKMAN, Karolinska Institute and Stockholm University CRISTINA BAÑUELOS, National Institute on Aging SARAH J. BARBER, Georgia State University JENNIFER A. BELLINGTIER, Friedrich Schiller University Jena KENNETH A. BLOCKER, University of Illinois Urbana-Champaign SUSAN BLUCK, University of Florida WÄNDI BRUINE DE BRUIN, University of Leeds KAREN L. CAMPBELL, Brock University LAURA L. CARSTENSEN, Stanford University KRISTINA COULTER, Concordia University RYAN T. DALEY, Boston College SUSANNE R. DE ROOIJ, University of Amsterdam RENÉE DECARO, Tufts University NANCY A. DENNIS, Pennsylvania State University SHEENA DEV, VA Boston Healthcare System JOHANNA DREWELIES, Humboldt University Berlin AUDREY DUARTE, Georgia Institute of Technology MICHAEL R. DULAS, University of Illinois Urbana-Champaign LUCILE DUPUY, University of Illinois Urbana-Champaign HOWARD J. FEDEROFF, University of California, Irvine MASSIMO S. FIANDACA, University of California, Irvine

xii



List of Contributors

xiii

KAREN L. FINGERMAN, The University of Texas at Austin

ANDERS M. FJELL, University of Oslo

JACLYN FORD, Boston College

DENIS GERSTORF, Humboldt University Berlin; Pennsylvania State University; German Institute for Economic Research (DIW Berlin)

TANIA GIOVANNETTI, Temple University

JOSHUA OON SOO GOH, National Taiwan University

ALAN J. GOW, Heriot-Watt University

ANGELA GRANT, Concordia University

PAMELA M. GREENWOOD, George Mason University

THOMAS J. GROSS, University of California, Irvine

FAITH GUNNING, Weill Cornell Medicine

ANGELA GUTCHESS, Brandeis University

KATHERINE M. HART, Montana State University

LYNN HASHER, University of Toronto; Rotman Research Institute

SCOTT M. HAYES, Ohio State University

NICOLE HEGBERG, VA Boston Healthcare System

THOMAS M. HESS, North Carolina State University

THOMAS HINAULT, Johns Hopkins University

SABINE HOMMELHOFF, Friedrich-Alexander University Erlangen-Nürnberg

MENG HUO, University of California, Davis

DEREK M. ISAACOWITZ, Northeastern University

HYESUE JANG, University of Michigan

ABHISHEK JAYWANT, Weill Cornell Medicine

ELIZABETH A. KENSINGER, Boston College

ANNE C. KRENDL, Indiana University

KRYSTAL R. LEGER, Brandeis University

PATRICK LEMAIRE, Aix Marseille University

HSIAO-WEN LIAO, Stanford University

CINDY LUSTIG, University of Michigan



xiv List of Contributors

KRISTY LUI, San Francisco State University

MARK MAPSTONE, University of California, Irvine

ELIZABETH MARFEO, Tufts University

MARA MATHER, University of Southern California

MICHELLE MEADE, Montana State University

DAVID MERRILL, University of California, Los Angeles

SOMAYEH MEYSAMI, University of California, Los Angeles

ISABELLE MOORE, Brandeis University

CRAIG MYRUM, National Institute on Aging

YEE TO NG, The University of Texas at Austin

SHEVAUN D. NEUPERT, North Carolina State University

LARS NYBERG, Umeå University

KATHRYN OSSENFORT, Northeastern University

GORAN PAPENBERG, Karolinska Institute and Stockholm University

JONATHAN E. PEELLE, Washington University in Saint Louis

VLADIMIR A. PERGA, Montana State University

NATALIE PHILLIPS, Concordia University

NATHANIEL RABB, Tufts University

BERNA RAHI, Lebanese American University

CYRUS A. RAJI, Washington University in St. Louis

PETER R. RAPP, National Institute on Aging

GEORGE W. REBOK, Johns Hopkins University

EMMA RHODES, Temple University

ANNA RIECKMANN, Umeå University

WENDY A. ROGERS, University of Illinois Urbana-Champaign

TED RUFFMAN, University of Otago

MICHAEL K. SCULLIN, Baylor University

YAAKOV STERN, Columbia University

JONELL STROUGH, West Virginia University



List of Contributors

ΧV

YU-SHIANG SU, National Taiwan University

SUDHAKAR RAJA SUBRAMANIAM, University of California, Irvine

RYAN SUTCLIFFE, University of Otago

TAYLOR TERLIZZESE, Baylor University

AYANNA K. THOMAS, Tufts University

EMILY TOUCHET, Tufts University

ELEANNA VARANGIS, Columbia University

KRISTINE B. WALHOVD, University of Oslo

CAROLINE WARD, Tufts University

NATHAN WARD, Tufts University

GERBEN J. WESTERHOF, University of Twente

JENNA M. WILSON, West Virginia University

RACHEL WU, University of California, Riverside

STEVEN H. ZARIT, Pennsylvania State University

