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Canadian Longitudinal Study on Aging, A Platform for Psychogeriatric Research

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Synonyms

CLSA; Cognition; Cohort; Depression; Mood; Personality traits; Psychopathology; PTSD

Definition

The recently launched CLSA is the largest and most comprehensive study of aging ever undertaken in Canada. Through its innovative design and advanced data collection methods, the study provides a unique opportunity to examine the aging process and factors that shape healthy aging. After describing the study design of the CLSA, an overview of the measures used to assess psychological functioning is provided. The chapter concludes with a discussion of how the CLSA provides a unique opportunity to investigate the internal and external factors that influence psychological functioning in mid- to late-life.

Introduction

The ability to maintain autonomy, perform everyday activities, and engage in society is highly dependent on the level of psychological functioning, and this relationship is magnified with age. Changes in cognitive functioning are a component of normal aging and begin in mid-life or even earlier. While some higher brain functions (e.g., processing speed) are highly sensitive to age-related change, other abilities are well preserved in healthy aging (e.g., comprehension of word meaning) (Park and Schwarz 2000). Changes may also be observed in the "pragmatics" of cognitive functioning, which are largely captured under the rubric of social cognition (i.e., how we perceive and interpret our world) (Baltes 1993).

Identifying the links between personality variables and wellness is also emerging as a predominant research topic. Research reveals complex

Noted at end of chapter On behalf of the CLSA Psychology Working Group (Table 2).

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associations between personality and well-being, both physical and mental. In part, these associations appear to be a function of the link between personality traits, mood states, and psychopathology and the resulting effects upon physical wellness. For example, negative emotional states appear to have a significant influence upon biological functions such as immune function and regulation (which become less efficient in later life), thus increasing the risk of many health problems (Kiecolt-Glaser and Glaser 2002).

Longitudinal research is critical in order to achieve a clear understanding of age-related changes in psychological function and the links between psychological function and wellness. The Canadian Longitudinal Study on Aging (CLSA) will follow 50,000 adults aged 45–85 for at least 20 years, collecting critical information on psychological and social function, as well as indices of physical and mental well-being. This will allow for examination of psychological processes as precursors and mediators in relation to measures of social, biological, psychological, and adaptive functioning (e.g., social participation, diseases, everyday functioning).

The Canadian Longitudinal Study on Aging

The recently launched CLSA is the largest and most comprehensive study of aging ever undertaken in Canada. Through its innovative design and advanced data collection methods, the study provides a unique opportunity to examine the aging process and the factors that shape healthy aging. The goal is to better understand the complex interplay among the many determinants of health through the examination of influences "from cells to society," providing the most accurate picture possible of the dynamic process of adult development and healthy aging. By collecting information on the changing biological, medical, psychological, social, lifestyle, and economic aspects of people's lives as they age, the CLSA will contribute to the identification of modifiable factors that can be used to develop interventions to improve the health of Canadians.

Most previous large-scale adult development and aging studies that address psychology have focused on the development of specific psychological processes such as memory and intelligence or have been conducted in the context of specific disorders, such as dementia. The CLSA will expand this domain of research by examining several psychological constructs as precursors or mediators of specific and global aspects of health and health-related outcomes. This chapter describes the study design and measures included in the CLSA, with particular emphasis on those that are focused on the assessment of the transitions and trajectories of psychological functioning over the latter half of the adult life course.

Methods

CLSA Study Design

An overview of the CLSA design and methodology was published in a special supplement to the *Canadian Journal of Aging* (Raina et al. 2009a). Additional papers describing the recruitment strategy (Wolfson et al. 2009), methods for ascertainment of chronic disease (Raina et al. 2009b), study feasibility (Kirkland et al. 2009), feasibility of biological sample collection (Balion et al. 2009), and linkage with health-care utilization databases (Raina et al. 2009c) were also included. The CLSA is a prospective cohort study of 50,000 residents of Canada aged 45–85 years at baseline and followed for at least 20 years. Of the 50,000 participants, 20,000 provided data through computer-assisted telephone interviews (CATI), and the remaining 30,000 participated in data collection that included an in-home interviewer-administered questionnaire and a comprehensive physical assessment at a dedicated data collection site. Major data collection is repeated every 3 years and in between waves, a short maintaining contact telephone interview is conducted in order to minimize the loss to follow-up and also to collect additional data as needed.

In addition to the psychological assessment, a vast array of common core information is collected through questionnaires (Table 1). For the 30,000 members of the CLSA who undergo

Canadian Longitudinal Study on Aging, A Platform for Psychogeriatric Research, Table 1 CLSA baseline measures

Measures	Cohort (n = 50,000)	
	Comprehensive face to face (n = 30,000)	Telephone interview (n = 20,000)
Psychological measures		
Memory		
Rey auditory verbal learning test	Q	Q
Executive function		
Mental alteration test	Q	Q
Prospective memory test	Q	
Stroop neuropsychological screening test	Q	
Controlled oral word association test	Q	
Animal naming	Q	Q
Psychomotor speed		
Simple and choice reaction times	T	
Mood and psychopathology		
Depression	Q	Q
Life satisfaction	Q	Q
Post-traumatic stress disorder	Q	Q
Psychopathology	Q	
Personality traits	Q	Q
Physical measures		
Lean muscle mass and body composition	PE	
Waist and hip circumference	PE	
Blood pressure	PE	
Bone density	PE	
Aortic calcification	PE	
Lung function	PE	
Electrocardiogram (ECG)	PE	
Carotid intima-media thickness	PE	
Vision	PE and Q	Q
Hearing	PE and Q	Q
Weight and height	PE	Q
Functional status	PE	Q
Functional performance (grip strength, timed up and go, balance, gait)	PE	
Basic activities of daily living	Q	Q
Instrumental activities of daily living	Q	Q
General health	Q	
Life space index	Q	Q
Women's health	Q	Q
Chronic conditions	Q	Q
Health-care utilization	Q	Q
Medication use	Q	Q
Dietary supplement use	Q	Q
Oral health	Q	Q
Injury and falls	Q	Q
Pain and discomfort	Q	Q
Sleep	Q	
Biological measures		
Blood	Collected	
Urine	Collected	
Social measures		
Social networks	Q	Q
Online social networking	Q	Q
Social support availability	Q	Q
Social participation	Q	Q
Care receiving (formal care)	Q	Q
Care receiving (informal care)	Q	Q
Caregiving	Q	Q
Retirement status	Q	Q
Preretirement labor force participation	Q	Q
Labor force	Q	Q
Retirement planning	Q	Q
Social inequality	Q	Q
Wealth	Q	Q
Transportation, mobility, migration	Q	Q
Built environment	Q	Q
Lifestyle and behavior		

(*continued*)

Canadian Longitudinal Study on Aging, A Platform for Psychogeriatric Research, Table 1 (continued)

Measures	Cohort (n = 50,000)	
	Comprehensive face to face (n = 30,000)	Telephone interview (n = 20,000)
Physical activity	Q	Q
Nutritional risk		Q
Nutritional intake	Q	
Tobacco use	Q	Q
Alcohol use	Q	Q

Q: assessed via questionnaire (either telephone or face-to-face administration)
T: measured using a performance test involving an interactive computer touch screen
PE: measured by physical examination at the data collection site

face-to-face assessment, the core information is supplemented by additional interview questionnaires about diet, medication use, chronic disease symptoms, and sleep disorders. Measures collected at the data collection site include tests of physical function (e.g., grip strength and 4-m walk test), anthropometrics (e.g., height and weight), and clinical status (e.g., vision and hearing) as well as cognitive function. Each participant also provides a blood and urine sample and signed consent to link their data to provincial health-care databases. In collaboration with Health Canada, air pollution exposures have been estimated for each participant in the CLSA. For the baseline, core chemistry biomarkers are available on all 30,000 participants, gene-wide genotyping on 10,000 participants, and targeted epigenetics on 5,000 participants. The data collection has been further expanded for the first follow-up of the CLSA to include measures of child maltreatment, elder abuse, hearing handicap inventory, oral health, subjective memory, metamemory, gender identity, health-care access, and unmet needs as it relates to health-care delivery.

Psychological Measures Within the CLSA

Expert working groups selected psychological, physical, biological, social, and lifestyle measures for inclusion in the CLSA. Measures were selected based on their relevance to adult development and aging, availability in English and French, psychometric properties (e.g., sensitivity and specificity), and feasibility in terms of the time to administer, the cost, and the need for unique resources or equipment. Table 1 presents a summary of the measures included at baseline and at the first follow-up. Furthermore, based on algorithms based on information from disease symptom questions and medication use, the CLSA is able to ascertain whether participants have a number of chronic diseases including cardiovascular diseases; diabetes; hypertension; cerebrovascular disease; arthritis of the knee, hip, and hands; osteoporosis; respiratory diseases such as COPD; hyper- and hypothyroidism; dementia including Alzheimer's disease and Parkinson's disease; and depression.

In CLSA, several instruments measuring various domains of psychological aspects of aging were used at baseline. These domains include cognition (memory, executive function, and psychomotor speed), mood, psychopathology, post-traumatic stress disorder (PTSD), depression, and personality traits (openness, conscientiousness, extraversion, agreeableness, and neuroticism).

Cognition

Cognition may be defined in terms of domains (e.g., memory, executive functions, speed of processing), each of which can be further characterized into component processes. Age-related changes are observed in many of these domains and processes; for example, robust age-related changes are observed in processing speed, whereas other domains, such as semantic memory (knowledge about facts and concepts in the world), remain relatively intact with aging. There can be great intraindividual variability within a testing session or across testing sessions, and there is reason to believe that marked variability may be predictive of early cognitive impairment.

Participants in the CLSA Comprehensive cohort are assessed in three domains of cognitive function: memory, executive function, and psychomotor speed. The cognitive battery takes approximately 27 min to administer. CLSA telephone-based participants are assessed in two domains of cognitive function, memory and executive function, by telephone only (approximately 8 min to administer).

Memory

Rey Auditory Verbal Learning Test (RAVLT) (Trial 1 and Delay Trial). The RAVLT (Rey 1964) is a 15-item word learning test that assesses both learning and retention. The list of words is read at the rate of one per second, and the participants' responses are recorded. One learning trial and one delayed recall trial (with a delay of 30 min) are used. The RAVLT has been shown to be extremely sensitive in detecting early cognitive decline.

Executive Function

Mental Alternation Test (MAT). The MAT (Himmelfarb and Murrell 1983) comprises two parts, A and B. Part A requires participants to count aloud from 1 to 20 and to say the alphabet as quickly as possible; the purpose is to ensure that participants can perform Part B. If a participant is unable to perform these tasks, then the MAT cannot be administered. In Part B, the participant is asked to alternate between number and letter (i.e., 1-A, 2-B, 3-C . . .) as quickly as possible for 30 s. The number of correct alternations in 30 s, discounting any errors, determines the score, which ranges from 0 to 51. The MAT is highly sensitive and specific for detecting cognitive impairment.

Prospective Memory Test (PMT). The PMT (Lowenstein and Acevedo 2001) contains both event-based and time-based prospective memory tasks that are cued after either 15- or 30-min delays. The scoring system is based on three criteria: intention to perform, accuracy of response, and need for reminders. There is increasing evidence that both time-based and event-based prospective memory decline with age and the PMT is sensitive to cognitive impairment.

Stroop Neuropsychological Screening Test (Victoria). The Stroop test (Golden 1978) is a measure of inhibition, attention, mental speed, and mental control. The Golden version (Golden 1978) of the Stroop test has three parts. First, the participant reads a list of words printed in black. In the second part, the participant is asked to name the ink color of printed "X"s. In the third part (interference condition), the participant is asked to quickly name the color of the ink in which color words are written in (e.g., say "blue" for the word "green" written in blue ink). There are 100 items in a trial for this version. Scoring may be by time, error, both, or the number of items read or named within a specified time limit.

Controlled Oral Word Association Test (COWAT). The COWAT (Spreen and Benton 1977) is a measure of verbal fluency based on an orthographic criterion. It requires the time-limited generation of words that begin with a given letter (e.g., participants are asked to name as many words as possible that begin with the letter "F"). Following standard protocols, CLSA administers three 1-min trials with the letters F, A, and S. The score is the total number of admissible words produced.

Animal Fluency Test. The animal fluency test (Himmelfarb and Murrell 1983) is a measure of verbal fluency based on a semantic criterion. Participants are required to name as many animals as possible in 60 s.

Psychomotor Speed

Computer-administered simple and choice reaction time tests (West et al. 2002) were used to assess psychomotor speed.

Choice Reaction Time (CRT) (Computer-Administered Test). In this test, participants receive a warning stimulus consisting of a horizontal row of four plus signs on a computer screen. After a delay of 1,000 ms, one of the plus signs changes into a box. The location of the box is randomized across trials. Participants are instructed to touch the interactive computer touch screen at the location of the box as quickly as possible. Although the instructions emphasize speed, participants are also instructed to minimize errors. The measures used are the latencies and percent correct for the 52 test trials (there are 10 practice trials).

Choice Reaction Time 1-Back (CRT-1) (Computer-Administered Test). This task uses the same stimulus display and computer touch screen as the CRT. However, in this version of the task,

when the plus sign changes into a box, participants are instructed to touch the screen at the location where the box appeared on the previous trial as quickly as possible. A total of 10 practice trials and 52 test trials are administered.

Mood and Psychopathology

Current research indicates complex associations between positive and negative mood states, psychopathology, and physical and mental well-being (O'Rourke 2002; Watson and Pennebaker 1989). Negative emotional states in themselves may increase susceptibility to an array of health conditions and are associated with poorer prognoses. For example, negative emotions appear to influence immune function and regulation (which become less efficient in later life), thus increasing the risk of a myriad of health conditions (Kiecolt-Glaser et al. 2002).

Social science research has been criticized for equating well-being with the absence of psychopathology (Stroller and Pugliesi 1989; Stull et al. 1994). In other words, persons deemed to be free of psychiatric distress were assumed to be well, happy, or satisfied with life. Implicit in such studies was the assumption that emotional experience existed along a single continuum. However, more recent research indicates that psychological well-being and psychopathology (and their correlates) are separable phenomena (Ryff et al. 1998). Therefore, to assume the existence of one on the basis of the absence of the other is empirically unsupported; both need to be assessed in order to arrive at a balanced understanding of emotional wellness.

Negative Mood State

Depressive symptoms are measured in the CLSA Tracking and Comprehensive cohorts using the short form of the Center for Epidemiologic Studies Depression (CES-D10) Scale (Andresen et al. 1994), which takes approximately 3 min to administer and has been used extensively in large studies.

Positive Mood State (Life Satisfaction)

Life satisfaction is measured using the Satisfaction with Life Scale (SWLS) (Diener et al. 1985), which comprises five questions and takes about 90 s to administer. The SWLS is one of the most widely used scales to measure the life satisfaction component of subjective well-being.

Post-traumatic Stress Disorder (PTSD)

The lifetime prevalence of PTSD in Canada has been estimated at 9.2%. The CLSA includes the four-item primary care PTSD (PC-PTSD) screening instrument (Pins et al. 2003), which takes about 30 s to administer. The CLSA has included this short tool as part of the CLSA Veterans Health Initiative, in which all CLSA participants are asked a set of veteran identifier questions.

Psychopathology

Nonspecific psychological distress is measured using the Kessler Psychological Distress Scale (K10) (Kessler et al. 2002), which was developed using the item response theory to maximize discriminant ability at the severe range of psychological distress. The K10 is becoming one of the most widely used screens for psychological distress in epidemiological surveys. It takes approximately 2 min to administer and is included only in the Comprehensive Maintaining Contact questionnaire.

Personality Traits

Personality traits are "enduring patterns of perceiving, relating to, and thinking about oneself and the environment that are exhibited in a wide range of social and personal contexts" (American Psychiatric Association 1994). The Big Five personality traits are five broad domains of personality (openness, conscientiousness, extraversion, agreeableness, and neuroticism) that have been extensively studied and are related to self-rated health. The CLSA measures personality traits using the Ten-Item Personality Inventory (TIPI) (Gosling et al. 2003), which takes approximately 1 min to administer and is included only in the Comprehensive Questionnaire.

All the measures described above and in Table 1 will be repeated in each follow-up wave of the CLSA, providing a rich source of information on changing risk factors as well the changing nature of disease, function, and psychosocial outcomes. However, the CLSA also provides the opportunity

to add new measures in each of the follow-up waves to investigate new and emerging areas of research. As noted previously, a new psychological measure of subjective cognitive decline has been added to the follow-up assessment. Complaints about memory are extremely common in middle-aged and older people. While these complaints can occur in the setting of cognitive disorders such as mild cognitive impairment or a dementia, they are also common in individuals without an overt cognitive disorder. The CLSA is an ideal vehicle to explore the natural history, risk factors, and conditions associated with subjective cognitive decline. The Multifactorial Memory Questionnaire (Troyer and Rich 2002) will be used to assess self-reported cognitive ability in everyday life. This reliable and valid measure examines subjective cognitive complaints to capture preclinical signs of cognitive impairment and has been validated in both English and French. Two additional questions have been included to capture perceived change in memory and whether this perceived memory change worries participants.

Psychological Factors as Precursors, Mediators, and Outcomes

The CLSA provides a unique opportunity to investigate the multitude of internal and external factors that influence the trajectory of psychological functioning from mid- to late life. These factors may act as **precursors** related to increased risk of illness. It is known that psychological variables such as depressive symptomatology can influence the onset and progression of illness. Research in the area of stress and psychoneuroimmunology speaks to these interrelations. CLSA provides the opportunity to examine stress-disease relationships in a large representative sample of Canadians. Similarly, CLSA data can be used to investigate questions where cognitive changes function as precursors to disease states. For example, is decline in cognitive functioning in mid- and later life associated with subsequent adverse health-related (or biological) outcomes (e.g., diagnosis of dementia, diagnosis of vascular disease, sleep fragmentation, or sleep disturbance)?

Psychological, social or environmental, and biological factors may also serve as **mediators** between illness and health outcomes. There is ample evidence that psychological characteristics such as attitudes are related to recovery from illness (Institute of Medicine Committee on Assessing Interactions Among Social BaGFiH et al. 2006). Similarly, environmental context can influence response to treatment and health outcomes (Institute of Medicine Committee on Assessing Interactions Among Social BaGFiH et al. 2006). CLSA will provide a unique opportunity to address research questions where cognitive performance functions as a mediator between biological and functional status, such as: How do cognitive functions mediate relations between biological/health status and adaptive functioning and/or social participation (e.g., what are the underlying mechanisms involved)?

As might be expected, there are numerous factors that influence health **outcomes** at different points in the life span. Cognition and disorders of cognition can be viewed as psychological outcomes that may be related to a number of different precursors and mediators. These changes in cognitive functioning occur in relation to aging and, as noted, may be influenced by many other factors including biological, psychological, and social factors. Thus, CLSA data may be used to address research questions such as: Are changes over time in cognition (memory, executive function, and psychomotor speed) associated with specific biological states and/or lifestyles?

CLSA as a Data Platform for Research

Data and Sample Access

A fundamental principle of the CLSA is to provide the research community with the collected data while protecting the privacy and confidentiality of study participants. The Data and Sample Access Committee (DSAC) reviews all applications for the use of CLSA data and is responsible for monitoring the approved applications for progress. Exclusive access to the platform cannot be granted to any applicant. Users are entitled to use the CLSA platform (i.e., data and/or biospecimens) only for the duration and purposes of the approved research as presented in the application. The user is not entitled to publish or otherwise disseminate any CLSA

Canadian Longitudinal Study on Aging, A Platform for Psychogeriatric Research, Table 2 Authorship: CLSA Psychology Working Group

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data, any assay data, or any derived variable data at the individual participant level.

Cross-References

- Aging and Psychological Well-Being
- Age-related Changes in Abilities
- Australian Longitudinal Study of Aging (ALSA)
- Cognition
- English Longitudinal Study of Aging (ELSA)
- Irish Longitudinal Study on Ageing (TILDA)
- Longitudinal Aging Study Amsterdam
- Life and Living in Advanced Age, A Cohort Study in New Zealand, Te Puawaitanga o Ngā Tapuwae Kia Ora Tonu (LiLACS NZ)
- Life Span Developmental Psychopathology
- PTSD and Trauma
- Resilience and Aging

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Career Development and Aging

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Synonyms

Aging workforce; Late career development; Older workers

Definitions

Career development is defined as the developmental process of an employee along a path of experience and employment in one or more organizations (Baruch and Rosenstein 1992) or a "lifelong process of managing work experiences within or between organizations" (Business Dictionary 2015). Late career development is thus the career development of older workers. Some authors define the late career stage as early as from age 40, but usually it is defined as the career of employees aged from 50 years old up to retirement (Hedge and Borman 2012).

Traditional Views on Late Career Development

Career development over the life-span is usually described by career stage theories. These career development theories describe career development over the life-span as a continuous sequence of stages through which the individual gradually passes. The most influential of these theories are the theories of Super (Super 1990), Levinson (1986), and Cron (1984). Super's life-span model contains five large career stages: growth, exploration, establishment, maintenance, and decline (Super 1990). These stages pose distinct career developmental tasks which people need to fulfill in order to successfully master the next career stage. In the growth stage, one's self-concept needs to be developed and work-related attitudes and needs should be identified. In the exploration stage, the relevant tasks are to identify interests and capabilities, find a professional self-image, and establish an optimal fit between the self and work. In the establishment phase, career commitment needs to be increased, career advancement and growth achieved, and a stable work and personal life created. In the maintenance phase, one's self-concept needs to be maintained and people have to hold onto accomplishments achieved previously. Finally, in the decline phase, workers need to develop a new self-image that is independent of career success (Super 1990). In Levinson's life stage developmental model, the career developmental stages are determined according to one's age, and life periods of stability are usually followed by life periods of change (Levinson 1986). Levinson describes early (age 20–40), middle (age 40–60), and late adulthood (age 60 and over). These life stages have prescriptive developmental tasks: in early adulthood one needs to create and test initial choices about preferences for adult living, develop a sense of personal identity in the world of work and nonwork, and strive toward achievement of personal and professional goals. In middle adulthood one needs to review the life structure earlier adopted and make strong commitments to work, family, and community. In late adulthood one needs to recognize mortality and limits on achievements and answer the questions raised by these issues (Levinson 1986). Cron's career stage theory (Cron 1984) is the third influential theory that describes adult development in the work context. Cron describes career concerns, developmental tasks, personal challenges, and psychosocial needs of each career stage. The four career stages comprise (1) *exploration* (finding an appropriate occupational field), (2) *establishment* (successfully establishing a career in a certain occupation), (3) *maintenance* (holding on to what has been achieved, reassessing the career and possible redirection), and (4) *disengagement* (completing one's career) (Cron 1984). Whereas in the earlier stages of one's career, achievement, autonomy, and competition are important, in the later career stages, reduced competitiveness, higher need for security, generational motives (helping younger colleagues), and, finally, detachment from the organization and the organizational life are central topics.

These three stage models prescribe that older workers have to detach from work and gradually establish a self-identity independent of their career. The described developmental tasks reflect traditional career paths pursued in a small number of organizations, when after a linear and rather conformal working life, older workers are assumed to prepare for retirement.

However, a few decades have passed since the introduction of the delineated career theories, and the working environment underwent some

substantial changes in that time. Today, many countries and organizations are faced with an aging workforce and often longer-lasting careers (Schweitzer et al. 2014). In most developed countries, the number of late career employees is expected to grow substantially in the next decades due to declining birth rates and longer life expectancies (Van Der Heijden et al. 2008) meaning that companies are in need of healthy, productive, and motivated older workers to remain in the workforce longer in order to satisfy the demand for well-educated and experienced staff.

Changing Career Contexts

Whereas the traditional career theories assumed an intra-firm focus, environmental stability, and hierarchically advancing careers which progressed in a linear manner, today's work environment is characterized by increasing competitiveness and complexity, fewer opportunities for vertical mobility, higher levels of voluntary as well as involuntary inter-organizational mobility, and heightened probabilities of job loss at every career level and stage (Greenhaus and Kossek 2014; Sullivan 1999). Due to global competition, organizations increasingly need to be lean and flexible in order to compete internationally and increasingly opt for short-term transactional exchanges with their employees instead of traditional long-term employment relationships (Direnzo and Greenhaus 2011). This change is also reflected in new psychological career contracts (Hall and Mirvis 1995) which refer to the mutual expectations between employees and employers regarding their career and work. Traditional psychological contracts previously focused on loyalty between the employee and the organization and an expectation of job security in exchange for loyal service of the employee. The new career contract describes the shift from the formerly organizationally driven career to the employee-driven career and focuses on rather short-term transactions of work effort in exchange for career development opportunities (Hall and Mirvis 1995).

Protean Career Orientation: The Necessity of Self-Directed Career Management

As reviewed above, the traditional career theories introduced in the first section described the late career as a phase of general disengagement, decline, and finally withdrawal from work. These theories need to be complemented by newer understandings of late careers, especially considering the contextual changes in the work environment described in the previous section. The *protean career* describes such a modern type of career that corresponds to the demands that the before-mentioned changes in today's work environment pose on employees (Inkson 2006). The protean career orientation highlights the importance of individual and value-driven agency of the worker when developing one's career according to subjective success criteria (Direnzo and Greenhaus 2011). With careers being less predictable and structured by the organization, employees need to increasingly customize and self-manage their careers in order to balance out the risks of a growingly insecure work environment. Especially for late career employees who might have had a rather traditional career path and did not get accustomed to changes in the labor market, the risk of getting unintentionally laid off might be highly stressful and increases the importance to remain employable as an older worker. Because the protean career is primarily values driven and self-directed, holding a protean career orientation is an adaptive response to performance and learning demands in the current work environment (Sullivan and Baruch 2009).

Greenhaus et al. (2009) emphasize the importance of a protean, self-directed career orientation especially in the maintenance phase: late career employees need to remain productive and satisfy their needs for security and to feel useful as well as potential motivations for passing on their knowledge to younger colleagues through activities such as mentoring. In the late career, sustainability and meaningful work that is aligned with one's values becomes of higher subjective importance. To this end, Newman (2011) describes a model of

sustainable careers with three central propositions that can be of great value for older workers especially: (1) being *renewable* (renewing assignments, refocusing, re-education) in order to prevent burnout and create resilience and engagement in employees; (2) being *flexible* (continuous learning, adaptability) in order to prevent stagnation, facilitate innovation, and create an optimal alignment between employer and employee needs; and (3) being *integrative* (bringing disparate information together, knowledge management) in order to highlight the bigger picture, apply knowledge in new ways, create a meaningful contribution at work, and retain critical knowledge. Sustainable careers provide benefits for both organizations and employees: older employees can stay fully engaged and have the capacity to impart knowledge and use specialized knowledge in new ways. Late career employees are also well suited to integrate knowledge across units and functions as well as to mentor younger colleagues and can thus improve intergenerational relationships as well as facilitate the development of younger generations. From the employer's point of view, sustainable careers enable more productive, motivated, and healthier employees as well as lower employment costs through reduced turnover and better knowledge retention (Newman 2011).

Despite the necessity and benefits of enabling older workers to remain active and valuable at work, research demonstrated that late career employees receive less support from supervisors to participate in career development activities and have generally less access to organizational career support programs (Van Der Heijden 2006). Because older workers have often spent a significant part of their careers developing organization-based identities and job-specific skills, it is of particular importance for this population to acquire the skills needed for the protean, employee-driven career. Of highest importance is the acquisition of so-called meta-skills (Hall and Mirvis 1995). Meta-skills help to acquire new skills and encompass the knowledge of learning how to learn, developed through many career learning cycles – or continuous learning – instead of a single lifelong career stage cycle. According to Hall and Mirvis (1995), the most important of these meta-skills are identity awareness and heightened adaptability. Identity awareness is considered to be a fundamental resource for career development (Rosso et al. 2010). Because the work domain has a large importance in people's life, individuals identify with key characteristics of their work. Particularly older workers look for meaning in their life and in their work. This meaning can only be found if individuals find their own answers to their identity questions: Who am I? Who do I want to become? What is important to me in the work role? The traditional career paths provided a sense of stability and predictability for employees that facilitated addressing such identity issues. However, in the current work context, employees need to create stability within themselves (i.e., develop a clear professional identity that gives meaning to their work experiences) in order to successfully manage their careers in a self-directed manner. For older workers, who are more likely to be values driven (Briscoe et al. 2006), less likely to be motivated by extrinsic rewards, and more motivated to act autonomously (Ryff 1995), a clear self-concept may already be present. However, this self-concept needs to be constantly reexamined and reconstructed as work demands and typical career development tasks change in late career.

Career Adaptability

Apart from identity, career adaptability represents the second meta-competency for a self-directed career (Hall and Mirvis 1995). The reviewed career development stage theories imply a sequential and predictable order where experiences, skills, and competencies acquired in the stage before are sufficient preparation to enter the next stage. Thus inherent to stage models of career development is the notion of readiness to move to the next stage. In Super's work, for example, individuals who are ready to make educational and vocational choices are thought to possess career maturity (Savickas 1997). Career maturity was thought to be particularly relevant for adolescents, but the concept of adaptation seemed more

appropriate for adults (Super and Knasel 1981). This focus on adaptation highlights the "continual need to respond to new circumstances and novel situations, rather than to master a predictable and linear continuum of developmental tasks" (Savickas 1997, p. 254). Thus adaptation or adaptability are concepts well suited to the new career context where the capacity to adjust rapidly and display flexibility are prerequisites for career development. Adaptability specific to the career context, known as career adaptability, is a psychosocial coping resource, a set of self-regulation capacities or skills, important for problem solving, career transitions, responding to unexpected events, constructing a career reality, and participating in the work role (Savickas et al. 2009; Savickas and Porfeli 2012).

Because adaptability is a meta-competency (Hall and Mirvis 1995), adaptability permits individuals to develop the skills and competencies associated with a protean career orientation. Career adaptability may thus be a specially beneficial resource for older workers by enabling career orientations more suited to the new career context such as a protean orientation (Chan et al. 2015) and by helping them successfully address specific career development tasks. Because the challenges of reorienting and updating one's knowledge, skills, and abilities may be particularly evident for older workers, their career adaptability may be an especially useful resource in this regard. The psychosocial aspect of career adaptability is paramount and suggests a responsiveness to the context or environment where adaptability resources can be activated as needed, such as in response to unemployment or during career transitions (Ebberwein et al. 2004; McMahon et al. 2012).

Career adaptability consists of four dimensions: (1) *concern* about the future that includes the anticipation of demands and challenges; (2) *control* entails a personal responsibility for actively managing the self and the environment; (3) *curiosity* implies a broadening of options and self and environment exploration; and finally (4) the *confidence* to implement one's plans (Savickas and Porfeli 2012). Thus, using the meta-competency of adaptability, older workers can anticipate that changes may be required, can explore solutions and options to best implement these changes, and can confidently enact the necessary changes. This allows older workers to address the career development tasks of being flexible and open to professional reorientation. Although physical mobility is likely to decrease with age, psychological mobility remains unchanged with age (Segers et al. 2008) suggesting that opportunities for mobility still exist for older workers. Older workers' adaptability may help them envision more flexible work options that combine paid work with nonwork activities reflecting personal interests, made possible by the increased blurring of the boundaries between work and nonwork domains of life (Hall and Mirvis 1995).

Empirically, the specific subject of career adaptability in older workers has not yet received focused attention. However, a select number of qualitative studies with either mid-career employees (Ebberwein et al. 2004) or women aged above 50 (McMahon et al. 2012; Whiston et al. 2015) highlighted career adaptability as a theme associated to positive experiences at work and transitions. In a quantitative study among a sample of workers older than 54, Zacher and Griffin (2015) found that adaptability positively predicted job satisfaction over time (more strongly for those with still a few years left before retirement), suggesting that enhancing career adaptability may contribute to the retention of older workers.

Conclusions and Implications

An aging population and workforce provide the opportunity for many people to look forward to a longer, healthier, and more satisfying life and late career. Nevertheless the aging of the workforce also entails some challenges for late career employees as well as for organizations that need to be addressed. In the current chapter, we outlined traditional career development theories and their developmental tasks and put them in relation to new career concepts and changes in the work environment. Special emphasis was put

on the protean career orientation and career adaptability that represent very important career resources (Hirschi 2012) also for older workers. However, there is a need for more research to address how a protean career orientation and career adaptability are affected by age, how older workers understand career adaptability, what career development tasks in the late career (such as changing jobs) mean for older workers, and how a protean career orientation and career adaptability can help older workers cope with these challenges. Future research should also investigate how age influences relationships between protean career orientations, career adaptability, and outcomes over the life-span as well as the magnitude of these effects (Zacher and Griffin 2015).

Also, career counselors should highlight the importance of a protean career orientation and career adaptability for older workers and create interventions aimed at anticipating future demands and challenges. Interventions could emphasize the personal responsibility for actively managing the self and the environment, evoke self and environment exploration through demonstrating and brainstorming possible options, and finally foster the confidence of older workers to implement their plans.

Organizations and HR management should place special emphasis on late career employees and their career development. Most importantly, stereotyping against older workers should be counteracted and awareness about the potentials of older workers raised. A more heterogeneous workforce can be advantageous for organizations (Kunze and Böhm 2013). By providing generative opportunities for older workers (e.g., have older workers act as mentors for younger employees), older workers can feel needed and appreciated and make their work more meaningful. At the same time, younger workers get access to valuable experience and accumulated knowledge, and knowledge retention for critical know-how in the organization is enhanced.

In sum, if older workers stay self-reflective and curious about their career values, preferences, and needs, today's increasingly individualized and horizontal careers might be well suited to them (Wang et al. 2012) and enable a successful and sustainable late career phase. The meta-competencies of adaptability and identity can help older workers establish the skills and competencies associated with the protean career orientation and consequently extend a productive and satisfying career maintenance phase. When it comes time to fully or partially disengage from the work role, identity and adaptability meta-competencies will also support this transition.

Cross-References

- ▶ Proactivity and Aging at Work
- ▶ Sustainable Employability and Aging
- ▶ Training at Work and Aging
- ▶ Workplace Mentoring, Role of Age

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Caregiving and Carer Stress

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Synonyms

Burden; Stress process model; Transactional models of stress

Definition

Caregiving has been broadly defined as the act of providing unpaid or informal support and assistance to an older person with physical, mental impairment, or both. This assistance might include personal care, emotional support, household activities, financial management, shopping and transportation, and supervising/monitoring care. Informal caregivers are mainly family members. Usually, spouses offer more assistance than adult children, and adult children tend to provide more care than other groups of informal caregivers, such as family friends or neighbors. Caregiving can last for a short period of time or, more commonly, extend over years. The act of caregiving is now seen as a normative life event, at least for spouses and adult children in most Western countries.

Caregiving had been described mainly as a burden or stressful experience. However, there is a lack of consensus and rigor in defining burden. This has led to development of more sophisticated conceptual models about what happens when stress demands exceed coping abilities, also called transactional approaches to stress. The stress process model is one of such models and considers caregiver stress as a process of multiple interrelated conditions, involving the proliferation of stress from direct care-related dimensions to other caregiver's life domains.

Introduction

Forty years have passed since Fandetti and Galfand (1976) published one of the first articles about family caregiving in a prestigious scientific American journal dedicated to gerontology – *The Gerontologist*. The authors studied a sample of Italian and Polish residents to determine their attitudes toward caring for aged relatives. Since then, there has been a massive expansion of research on caregiving, which is still one of the most researched topics in gerontology.

As would be expected, along with the rapidly growing population of older adults worldwide, the number of persons with chronic diseases requiring ongoing support and supervision has also increased. Families provide the largest amount of informal long-term care and assistance. In the United States and most European countries, this family involvement in caregiving is due in part to the major emphasis of public policy aimed at promoting community care and delay institutionalization of dependent older persons. Thus, families have been considered the heart of these care systems.

A growing body of evidence has suggested the negative effects of caregiving on the caregivers' physical and psychological health, social life, leisure, and finances. Chronic conditions in the person receiving care entail high caregiving demands and long-term dependency lead to more strains for family caregivers. Contemporary societal changes have also intensified the strains on families' resources to provide care (Sales 2003; Zarit et al. 2007). First, older people are living longer after the onset of disabilities, which demands more extensive care. Usually, the caregiving role is assumed by an older spouse, who has frequently to cope with his/her own age-related limitations, or by adult children (often, a daughter) who have to deal simultaneously with several roles of worker, spouse, and parent of young children. Second, smaller family sizes and greater geographical distance may intensify the constraints of families to provide care. Third, changes in health-care policy, such as delaying institutional placement, have increased system's reliance on family caregivers.

Family caregiving has been conceptualized as a complex and multidimensional experience, primarily explained in terms of stress. The impact of the caregiving process on the caregiver has been described in terms of the "caregiver burden," a concept that encompasses multiple and inconsistent definitions. The following is an attempt to clarify the meanings and use of these two terms – burden and stress – which are often used interchangeably to describe the impacts of caregiving on the caregiver. The stress and burden approaches to understand the caregiving experience have informed, over the last two decades, the

development of interventions targeted to attenuate the negative outcomes of this event.

Caregiver Burden

The concept of caregiver burden has become one of the core concepts of interest in the field of gerontology. Caregiver burden is typically defined as the physical, emotional, psychological, and financial difficulties experienced by family or informal caregivers as a consequence of older person's disease and impairment. Researchers more or less agree on the need to distinguish the objective and subjective dimensions of burden. However, much less agreement is found about the conceptual definition of burden, which is often studied both as an outcome and a predictor of other caregiving outcomes. The lack of regular conceptualization and operational definition has led to inconsistency in burden measures and results across interventional studies. A clear understanding of burden has been further hindered by the tendency for researchers to use the term interchangeably with stress, impacts, consequences, or strain.

The concept of burden was first introduced by Grad and Sainsbury in regard to the community care for people with psychiatric disorders (Grad and Sainsbury 1996). The authors sought to assess how these patients affected their family life in terms of income, employment, social and leisure activities, domestic routines, health of the family members, and relations with neighbors. Not long after the work of Grad and Sainsbury, Hoenig and Hamilton (1966) suggested the need to distinguish between "objective" and "subjective" burden. The term "objective burden" was related to the adverse effects on the family, such as income loss, poorer health, or general changes in household routines. "Subjective burden" was defined as what families "felt and to what extent they considered the patient's illness had been a burden to them" (p. 287).

During the1970s and 1980s, Zarit and colleagues (1980) made great strides in establishing and clarifying the concept of burden. Within their work on dementia caregiving, they have defined burden as the caregiver's feelings about their emotional, physical health, social life, and financial status as a result of caring for their family members. Zarit et al. (1980) viewed caregiver burden as a subjective process and not necessarily as a negative consequence of caregiving. The authors developed one of the most widely used measures of caregiving burden: the Zarit Burden Interview. This self-reported inventory covered several dimensions of burden, including caregiver's health and psychological well-being, social life, finances, and the relationship between the caregiver and the cared-for person.

Subsequent to the work of Zarit et al. (1980), several attempts to refine the conceptualization of caregiving burden had been made. For instance, Poulshock and Deimling (1984) considered burden as the caregiver's appraisal of "the tiring, difficult, or upsetting nature of caregiving tasks" (p. 233). George and Gwyther (1986) defined caregiver burden as the "physical, psychological or emotional, social, and financial problems that can be experienced by family members caring for impaired older adults" (p. 253).

Later, studies have tried to clarify the differences between objective and subjective caregiver burden. Objective burden refers to the events and changes in caregivers' various life domains which result from the caregiving role. These include the direct tasks of care (e.g., helping patients with the activities of daily living, supervising care), indirect tasks of care (e.g., domestic tasks or financial management previously performed by the patient), providing emotional support to the cared-for person, and the effects on other life roles (e.g., family routines, leisure, social relations, finances, job career) (Sales 2003). The subjective burden is related to the caregivers' reactions or emotional responses to care demands. Some argue that objective and subjective burden can be analyzed separately (Montgomery et al. 1985). Others consider that most measures of objective burden rely on caregiver's self-report/subjective perceptions of the extent of their caregiving tasks, which is far from being objective (Sales 2003). Furthermore, while some consider

the consequences of caregiving on various life domains as objective (Montgomery et al. 1985), others regard it as subjective (Braithwaite 1992).

The critical need to document caregiving burden has been shown by the variety of instruments developed to measure it. Some authors argue that burden is a unique domain of the caregiving experience that is not captured by more generic measures of well-being (Stull et al. 1994). There are currently about 30 instruments described in scientific literature to assess the caregiver burden (Van Durme et al. 2012). Most of these measures are multidimensional, assess both objective and subjective burden, and are administrated to the primary caregiver. However, as burden is conceptualized differently by various authors, the tools used to measure it differ as well, leading to findings that are difficult to integrate across studies and limiting the ability to inform clinical and policy settings (Bastawrous 2013).

Nevertheless, decades of research on chronic conditions such as dementia, cancer, or stroke have suggested that caregiver's burden increases the risk of negative physical, psychological, and physiological outcomes. However, a number of comparative studies propose that different chronic conditions present different caregiving demands; hence, research needs to distinguish each disease's specificities from the common aspects of caregiving. For instance, chronic diseases characterized by cognitive impairments (e.g., Alzheimer's disease) have been found to be more burdensome (Papastavrou et al. 2012). In addition, disorders with an unpredictable course (e.g., cancer) present more physical burden and psychological distress for caregivers than those with an expected trajectory (e.g., diabetes) (Kim and Schulz 2008).

While many earlier scientific studies on caregiver burden were not based in theory, more recent work has been developed in an attempt to anchor caregiver burden in a broader theoretical framework and to outline some of its basic dimensions, as well as the links among those dimensions. The stress process model, developed by Pearlin and his colleagues (1990), is one of those frameworks, where burden can be treated as a primary stressor. How burden fits within this model and other the stress process theories is explained in the following section.

Caregiver Stress in the Context of Transactional Models

Perhaps the first theoretical conceptualization of the term "stress" was introduced by Hans Selye (1956). He defined stress as a response to an antecedent stimulus or event. The underlying assumption is that stress is linearly determined by the nature of the event itself.

However, the experience of caring for an older family member has been conceptualized within the context of transactional models of stress. Among those models, Lazarus and Folkman's model of stress and coping (Lazarus and Folkman 1984) and Pearlin and colleagues' stress process model (Pearlin et al. 1990) have anchored family caregiving research on a stronger conceptual foundation. Lazarus and Folkman (1984) have defined stress as "a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (p. 17). This definition emphasizes the relationship between the person and the context, considering the characteristics of both. From this perspective, stress is viewed as a process rather than simply a reaction to an environmental stimulus. The authors acknowledge the role of individuals' cognitive appraisals which are more important than the actual stressors. So, an event only becomes a stressor if the person interprets it as such. Within their transactional model of stress, Lazarus and Folkman (1984) described three steps: *primary appraisal*, whereby a potential stress can be perceived as irrelevant, benign-positive, or stressful (harm/loss, threat or challenge); *secondary appraisal*, as the person identify coping strategies/resources and their effectiveness to deal with the potential stressor; and *reappraisal*, which refers to a changed appraisal considering the new information from the environment, from the person's own reactions, or both. This three-step stress and coping process involves asking: "Is this event something that I need to respond? Does

it pose a threat, harm or challenge?" If the answer is "no," then no action is necessary. But if the answer is "yes," then a secondary appraisal arises. By this time the question that occurs is: "Which strategies or resources do I have to cope with the event?" The person then selects the mechanism (coping) to deal with the stressor. Next, a reappraisal is made to see if the response has worked, thereby either reducing the perceived threat or leading to a new approach to coping strategies if the perceived threat is not sufficiently reduced (Nolan et al. 1996).

The caregiving literature has moved increasingly toward transactional models of stress. Largely grounded in sociological perspectives of stress, the stress process model proposed by Pearlin and colleagues (1990) is perhaps the most used approach to understand the caregiving experience. Both models proposed by Lazarus and Folkman (1984) and Pearlin et al. (1990) conceptualize stress in terms of transactions between the person and the environment. However, Lazarus and Folkman's work emphasizes cognitive appraisals and the microlevels of the stress process, whereas Pearlin and colleagues' stress process model is more concerned with the contextual and macro-levels (Kinney 1996). This stress process model presents caregiver stress as a multidimensional and interrelated process involving four components (Pearlin et al. 1990): background characteristics and context, stressors, moderators, and outcomes. According to the authors, the caregiving experience is shaped by key characteristics of the caregiver (e.g., gender, age, education, occupational and economic conditions), the caregiving history (e.g., relationship between caregiver and care receiver dyad), the family network, and program/resources' availability in the community. Pearlin et al. (1990) have defined stressors as "the conditions, experiences, and activities that are problematic for people" (p. 586). These are conceptualized as primary and secondary in nature. The *primary stressors* are those that arise directly from providing care to a dependent relative, involving both the *objective* conditions of caregiving (e.g., supporting ADL) and *subjective* reactions incited by these objective conditions (e.g., a sense of role overload or captivity). The *secondary stressors* consist of those difficulties that derive from the caregiving (but do not directly entail the provision of care) and *proliferate* into other dimensions of the caregiver's life. These include *role strains* that are found in activities and roles outside the caregiving situation (e.g., family conflict, financial strain, work conflict) and *intrapsychic strains* which, for the most part, involve dimensions of self-concept (e.g., doubts about one's competence or mastery). The *moderators* regulate not only the focal stressor-outcome relationships but also the processes whereby stressors generate more stressors. Coping skills and social support are usually regarded as the two main moderators. The final major components of the stress process are the *outcomes*, in terms of caregivers' well-being, physical and mental health, and their ability to sustain themselves in their social roles.

In the light of the stress process model, burden is treated as a primary stressor affected by the caregiver's background and the caregiving context. Burden, in turn, affects directly outcomes such physical and mental health, as well as indirectly through secondary role strains and intrapsychic strains. Coping and social support moderate these interactions and explain differences in outcomes among caregivers experiencing similar situations.

While Pearlin et al. (1990) conceptualize burden as a primary stressor; Yates et al. (1999) suggest that burden should be treated as a secondary appraisal variable based on the argument that it is equal to subjective burden perception. Yates et al. (1999) considered the primary stressors from the Pearlin model (e.g., number of hours of informal care) as a primary appraisal variable that leads indirectly to secondary appraisal of caregiver overload (burden) and depression.

Although the stress process model was developed from research on dementia caregiving, it is considered one of the most comprehensive caregiving theoretical frameworks and has been widely applied to conceptualize and interpret observational and interventional research in a broad range of other caregiving settings such as stroke (Cameron et al. 2014), cancer (Gaugler et al. 2005), and chronic liver disease (Nguyen et al. 2015).

Caregiving and Ethnicity

A growing body of research has explored how culture and ethnicity influence the caregiving experience. Despite apparent inconstancy in results, this research generally suggests that the caregiving role is experienced differently by different ethnic groups. Ethnic variations in the caregiving experience may be attributable to differences in the levels of stressors, coping strategies, social support, as well as different perceptions of family obligations. For instance, a number of systematic reviews have found that, compared to other ethnic groups, African-American caregivers appear to have lower levels of burden and depression (Pinquart and Sörensen 2005; Dilworth-Anderson et al. 2002) and higher levels of uplifts and subjective well-being (Pinquart and Sörensen 2005). Several studies reported that African-American caregivers receive more informal support than White caregivers. Others suggest that African-American caregivers might be better able to cope with caregiving because they have learned to cope with adversity in their lives and because of their strong religious orientation and the use of more positive reappraisal (Pinquart and Sörensen 2005).

Also, Asian-American caregivers were found to be more depressed than White-American caregivers (Pinquart and Sörensen 2005). Pinquart and Sörensen (2005) reported that Asian-American caregivers used significantly less formal support than Whites. Sampling bias or language barriers might account to partially justify these results. However, the cultural value of filial piety can also add some explanation to these findings. Filial piety is a fundamental Confucian value common among many Asian cultures and historically instructs people to be respectful to their parents, emphasizes intergenerational relationships, and places family needs over individual interests. Adult children are expected to sacrifice their financial, physical, and social needs for the benefits of their aging parents (Miyawaki 2015). In this sense, the cultural expectation of caring for aging parents might pressure some Asian caregivers to perceive the use of formal services as losing face or an evasion of one's own responsibility, resulting in an underutilization of formal support (Lai 2010). Filial piety was also found to significantly predict the appraisal of the caregiving experience as rewarding among Chinese-Canadian caregivers, although no significant direct effect on caregiving burden was found (Lai 2010).

Research has also explored the experience of caregiving for Latino or Hispanic-American caregivers. This research suggest that, compared to Caucasian-American caregivers, Latino dementia caregivers reported lower levels of perceived burden (Montoro-Rodriguez and Gallagher-Thompson 2009) and lower appraisals of stress (Coon et al. 2004). Latino caregivers also reported higher levels of self-efficacy in managing disruptive behaviors of the patients and controlling upsetting thoughts (Montoro-Rodriguez and Gallagher-Thompson 2009), as well as appraised caregiving to be a significantly more positive experience than Caucasian caregivers (Coon et al. 2004). These findings might be influenced by a cultural perspective that sees the act of caring for an older relative as congruent to the Latino cultural value of *familism* wherein reciprocity and solidarity among family members help support caregivers and their roles. In addition, Latino caregivers' appraisal of stress may be more related to the degree of disruption caregiving eventually brings to their families rather than to themselves as individuals. Also, Latino caregivers were more likely to rely on religious and spiritual activities, which may serve as effective coping strategies for them to help buffer against the daily stress of caregiving throughout their promotion of social integration, social support, and relationship with God (Coon et al. 2004).

The caregiving experience has also been researched in cross-country studies. For instance, high ratings of burden and lower health-related quality of life have been recently found among caregivers of people with dementia in eastern and southern European countries, compared to north or central European countries (Bleijlevens et al. 2015). Differences in health and social care systems may account for variation in these outcomes. In general, the provision of formal support is lower and informal care is higher in southern

and eastern European countries. In Spain, family caregiving plays a more central role compared to other countries. On the other hand, countries like the Netherlands or Sweden offer as extensive health and social care system, and long-term care is primarily considered a responsibility of country councils and municipalities (Bleijlevens et al. 2015).

Together, all these studies underscore the relevance of understanding how social and cultural factors influence both caregivers' outcomes and mediator variables.

Interventions for Caregivers

The last two decades has seen a substantial increase in the development of caregiver interventions designed to reduce both the adverse effects of care and early nursing-home placement of the dependent older person. Increasingly, these interventions have applied the transactional models of stress, particularly Pearlin's stress process model, to identify modifiable variables of the stress process that can lead to improved outcomes. The approaches to caregiver interventions can be divided into two main groups (Sörensen et al. 2002): (i) those aimed at reducing the objective burden or amount of care provided by caregivers (e.g., respite care) and (ii) those aimed to improve caregiver's well-being and coping skills, generally called psychosocial interventions (e.g., support groups, psycho-education, psychotherapy). More recently, an integrated approach has emerged, combining a range of strategies, and is classified as multicomponent.

Respite care was designed to relieve caregivers periodically or temporarily from the provision of care to their dependent relative. This rest allows the caregiver to take some time for his/her own and carry out other activities. The main types of respite services include (Figueiredo 2009):

(a) *In-home respite*, which provides relief in the home by workers with suitable training. Examples of the type of care provided are help with personal care and housework, companionship, and supervision. This is, perhaps, the most widely used type of respite services.
(b) *Day care centers*, which are structured, comprehensive community-based centers that provide a variety of social and health-care services in a supervised setting during part of the day, freeing the caregiver for other activities or rest.
(c) *Overnight respite*, which involves the admission of the dependent person for a night, weekend, or longer in a residential care facility or nursing home, depending on the needs of the caregiver.
(d) *Institutional respite* and *vacation/emergency respite*, which includes round-the-clock substitute care, usually used for longer, continuous periods of time, often when caregivers need to be away for short periods of time (e.g., when they need a holiday, become temporarily ill, or in emergency situations such as a death in the family).

In general, there is some evidence that caregivers do not use respite services or use them too little or too late in the caregiving trajectory (Figueiredo 2009). Yet, while Sörensen et al. (2002) observed respite care effectiveness in terms of dementia caregiver burden, depression, or subjective well-being, more recent reviews (Schoenmakers et al. 2010) found that respite was associated with an increase in burden, probably due to family caregivers' concerns about respite care quality and difficulties to accept handing over their dependent older relative. Also, Mason et al. (2007) observed that the effects of all types of respite care upon caregivers were generally small, with better-controlled studies finding modest benefits only for certain subgroups. Further, empirical evidence suggests that respite does not delay institutional placement.

Psycho-education includes structured interventions designed to provide information on the disease process, symptoms management and community support resources, and training to provide care and respond to disease-related problems. It also includes a supportive component aiming to normalize experiences, give mutual support, and

provide problem-solving and emotional-management strategies for coping with the disease demands. Systematic reviews and meta-analysis studies have shown that psycho-educational interventions have consistent short-term effects on a wide range of dementia caregiver's outcome indicators (Sörensen et al. 2002; Pinquart and Sörensen 2006; Parker et al. 2008). Similar findings were found for stroke family caregivers; however, evidence is limited (Cheng et al. 2014).

Support group interventions might include both professionally led and peer-led unstructured support which focuses on building up a rapport among participants and developing opportunities to share experiences of caregiving. In these groups, peers provide emotional support as well as insights into successful strategies for dealing with several aspects of the caregiving role. In contrast to psycho-educational programs, support group interventions are seldom standardized and education is not their primary focus. In their meta-analysis, Chien et al. (2011) found that support groups had a significant positive effect on dementia caregivers' psychological well-being, depression, burden, and social outcomes.

Psychotherapy involves establishing a therapeutic relationship between the caregiver and a trained professional. Most psychotherapeutic interventions with caregivers adopt a cognitive-behavioral approach in which therapists aim to (Sörensen et al. 2002) improve self-monitoring, challenge negative thoughts and appraisals, help caregivers to develop problem-solving skills, and reengage in positive experiences. As with psycho-educational interventions, Sörensen et al. (2002) found that psychotherapy have the most consistent short-term effects over different types of outcomes. Specifically, cognitive-behavioral therapy was found to have a large effect on decreasing depression and a small to moderate effect on lowering burden (Pinquart and Sörensen 2006).

Multicomponent interventions include the combination of several strategies (e.g., education, respite, psychotherapy) and target multiple outcomes. Multicomponent interventions seem to be more effective in improving caregivers' well-being and reducing burden compared to more narrowly targeted interventions (Sörensen et al. 2002; Parker et al. 2008).

Caregivers can rely on several of interventions and services developed to help them to cope with the caregiving role. However, intervention studies designed to prevent stress and alleviate burden present inconsistent results and have shown only modest effects. No single intervention is completely successful in responding to all the needs and difficulties of caregivers. Some interventions (psycho-education, psychotherapy, multicomponent) seem to have broad, nonspecific effects over several outcomes, while others have more specific effects on target outcomes (respite).

Conceptual and methodological issues have been identified as main reasons to explain inconsistency in results. Some argue that the outcome measures used may be sensitive to change to greater or lesser degrees (e.g., caregiver burden appears to be less changeable than subjective well-being). In addition, studies frequently include outcome measures that do not have obvious relationship or that do not match the intervention goals. Moreover, caregivers are a heterogeneous population with diverse risk profiles, cultural backgrounds, resources, and experiences of stress and burden. Thus, the "one size fits all" approach is not appropriate for caregiving intervention (Zarit and Femia 2008). In some cases, studies use multidimensional measurements of burden but fail to address the distinction between objective and subjective burden, which might mitigate the findings of interventional research (Bastawrous 2013). Finally and perhaps the most basic constraint in caregiving intervention research is viewing caregiving as if it were a psychiatric disorder like major depression (Zarit and Femia 2008). This means that, basically, participants are enrolled in the intervention studies because they are caregivers, independently of feeling or not feeling burdened, depressed, or having other negative outcomes. There are two major consequences of this approach. First, when the goal of treatment is to reduce burden depression, but some of the participants are not burdened or depressed, that means that a part of the sample will not show improvements after the treatment, leading to a loss of statistical power to

detect change. Second, it is possible that treating participants for a problem they do not present may actually worsen their situation (Zarit and Femia 2008).

Many other factors related to intervention characteristics, the caregiving situation, or research design can mediate the effectiveness of interventions, such as the dosage and length of treatment, individual interventions as opposite to group interventions, the characteristics of the cared-for person (e.g., interventions for caregivers of people with dementia are less successful than those designed for caregivers of older people with other chronic conditions), the relationship with the care receiver (adult-children interventions as opposed to spouse interventions), and the extent to which participants adhere to the treatment (regularity of attendance or dropout rate).

Future Directions

With the current demographic trends on the growth of older people population, the role of informal caregivers is expected to continue to assume a great importance. Research has conceptualized informal caregiving as a stressful event, likely to involve significant burden. Based on this approach, several burden indicators have been developed, and findings have showed that many caregivers experience high levels of burden, depression, anxiety, social isolation, and financial strain. Conceptualizing the caregiving experience in the light of stress and burden paradigms has unquestionably become a major contributor to understanding this complex phenomena, but has also hindered the opportunity to find out more about the neutral and the positive aspects of care and to promote them. There is, however, growing evidence that positive outcomes or rewards, such as a sense of reciprocity or personal growth, can be derived from the caregiving experience, despite of the stressful situation. The rewards of providing care have been associated with better caregivers' well-being (Cohen et al. 2002), but their role in buffering stress is still unexplored. Furthermore, as theoretical models for the negative caregiving outcomes have been strongly developed, there is a need for conceptual frameworks that explain and predict positive outcomes.

Viewing caregiving as stressful and burdensome event has encourage researchers and practitioners to develop interventions based on a deficit approach in which caregivers are assumed not to have the necessary resources, skills, and competences to cope successfully with their stressful situations (Figueiredo 2009). This negative view, alongside research design and methodological issues, might in part explain the incongruent findings of intervention studies. A more salutogenic approach could provide a focus on the strengths rather than on the burdens, in order to enhance caregivers' resilience and personal empowerment.

Moreover, the stress/burden paradigm can be reductionist. It has emphasized individuals in their caregiving role and had not really examined the cared-for person and the family as a system, as data has been obtained mainly from the primary caregiver. A family systems approach would be focused on the analysis of family dynamics and adaptations, relationships, and patterns of interactions, providing a more comprehensive picture of the caregiving experience. Interventions should be targeted at the family as a system, involving all family members, as they all take part in the adjustment to care demands.

Finally, the dominant focus has been on the use of cross-sectional designs, ignoring the changes in the cared-for person needs and chronic disease trajectory over time. The challenges of families when dealing with the diagnosis or acute phase are different from those of the chronic or terminal phase of the disease. These cross-sectional data hinders to understand how the demands, needs, and coping mechanisms of all family members change over time.

Cross-References

- ▶ Family Therapy
- ▶ Respite care, Current Status and Future of
- ▶ Stress and Coping in Caregivers, Theories of
- ▶ Stress and Coping Theory in Geropsychology

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Challenging Behavior

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Synonyms

Maladaptive behaviors; Neuropsychiatric symptoms of dementia; Problem behaviors

Definition

Challenging behaviors among individuals with dementia are defined as maladaptive behaviors that contribute to a diminished quality of life for an individual or constitute a danger to the individual, other residents, or caregivers. Challenging behaviors typically include verbally or physically aggressive behavior, agitation, sexually inappropriate behavior, or wandering. Interventions discussed in this entry include medications, behavioral interventions, systematic individualized interventions, cognitive/emotion-oriented interventions, sensory stimulation interventions, and psychosocial interventions. For each intervention, a brief description is provided and the effectiveness of the intervention discussed.

Introduction

In 2013 the number of individuals with dementia worldwide was estimated to be 44.4 million, and this number is expected to increase substantially over the next 15 years (Alzheimer's Disease International 2015). Dementia is often accompanied by a variety of challenging behaviors. For example, approximately 50% of individuals with dementia exhibit agitated behaviors every month (Livingston et al. 2014). These behaviors often have consequences for the quality of life of both the individual with dementia and the caregivers. A variety of pharmacological and non-pharmacological interventions have been used to treat these challenging behaviors, with mixed results. The evidence for interventions that focused on the most commonly targeted challenging behaviors in residential care facilities, with an emphasis on the ones for which there is at least promising evidence to support efficacy, was reviewed. Additionally, a few interventions for which there is limited support, based primarily on reviews that require randomized control trials (RCT), are included. Finally, some interventions with virtually no empirical support are included because they appear to be used in spite of the paucity of support. This is a selected rather than an exhaustive review of all interventions for all challenging behaviors associated with dementia.

Most studies addressed multiple challenging behaviors. Literature reviews (e.g., systematic reviews, meta-analyses, Cochrane reviews) described outcome measures, but many of these

were scores on behavior rating scales that included multiple behaviors or categories (e.g., aggressive behavior, wandering, agitation). Therefore, it was difficult to organize this presentation around specific challenging behaviors. In light of that and in the interest of brevity, much of this discussion is devoted to studies of specific interventions that are often used to address a variety of challenging behaviors.

Pharmacological Interventions

While the principal focus is non-pharmacological interventions, it is also important to briefly mention these interventions and address some of the issues associated with this approach to behavior management. The US Food and Drug Administration (FDA) has not approved pharmacological interventions for challenging behaviors associated with dementia. Pharmacological interventions are therefore used off-label. The safety and efficacy of pharmacological interventions for dementia-related problems have been questioned for several years. The 1987 Omnibus Budget Reconciliation Act brought about a substantial reduction in the use of psychotropic medications to control dementia-related challenging behaviors in the USA. Strong appeals for reconsideration of pharmacological interventions have come from the UK as well, for example, the NICE Guidelines (National Institute of Clinical Excellence 2007). Clinicians must weigh the benefits against the potential adverse effects of the medications.

First-generation antipsychotic medications (e.g., haloperidol, loxapine) have been used to manage challenging behaviors for many years, but they have associated severe adverse effects (e.g., cardiovascular problems, extrapyramidal symptoms, tardive dyskinesia, increased risk of death). Atypical antipsychotic medications (e.g., risperidone, olanzapine) also have significant adverse effects that vary across medications (e.g., extrapyramidal symptoms, sedation, metabolic syndrome, orthostatic hypotension). Several antidepressant medications (e.g., sertraline, citalopram) have been used to manage challenging behaviors, but there is limited support for their use (Seitz et al. 2011). In addition, adverse effects are associated with the use of antidepressants (e.g., nausea, drowsiness, sedation), with these effects varying across specific drugs. Sedative-hypnotic medications (e.g., the benzodiazepines) have been used to treat acute cases of agitation, but they increase the risk of impaired cognitive functioning and falls. Mood stabilizers (e.g., carbamazepine, valproate, gabapentin) have been used to manage challenging behaviors, but only carbamazepine has research support. However, carbamazepine has significant adverse effects (e.g., sedation, hyponatremia). The deliberations and recommendations of a panel of experts regarding the use of psychotropic medications to manage neuropsychiatric symptoms of dementia (NPS) were summarized by several researchers (Kales et al. 2014). They concluded that "Given the limitations in the evidence-base, the panel consensus was that psychotropic drugs should be used only after significant efforts have been made to mitigate NPS using behavioral and environmental modifications and medical interventions if needed, with three exceptions" (p. 767) (Kales et al. 2014). These included situations in which there was "significant and imminent risk" to the individual or others.

Behavioral Interventions

Behavioral interventions for the management of challenging behaviors are variously termed behavior modification, behavior therapy, behavioral problem-solving, and functional analysis-based interventions. These can involve direct interventions by staff and alteration of the environment to reduce the frequency or duration of challenging behaviors or to increase more adaptive behaviors. Interventions emphasize the function of the challenging behavior and typically involve the identification of the variables controlling the target behavior. This includes identification of the antecedent stimuli (A) that set the occasion for (trigger) the challenging behavior (B), which is strengthened or maintained by specific consequences (C). The analysis and intervention is usually individualized, as the controlling variables can differ between individuals. In recent years some researchers have conceptualized challenging behaviors as arising from unmet needs, with the intervention aimed at meeting those

needs. As with earlier behavioral conceptualizations, the focus remains on the function of the challenging behaviors, but the interventions are individualized and conducted across large sample sizes.

One of the difficulties of reviewing this literature was that some researchers employed multiple interventions that focused both on the individual and the environmental determinants of the challenging behaviors. A variety of different caregivers (e.g., nurses, nurses' aides) have been employed as well. Finally, the outcome measures have varied considerably across studies. Some studies focused on the frequency or duration of specific behaviors (e.g., wandering, hitting, biting), some on classes of behaviors (e.g., aggression, agitation), and others on scores obtained on rating scales that incorporated several different behaviors and yielded a total score that included all behaviors.

Several reviews have found mixed results for the effectiveness of behavioral interventions. Results of studies in which an intervention was applied to groups of participants have yielded mixed results even with studies employing similar interventions and outcome measures. In addition, it is difficult to offer an overall judgment regarding the effectiveness of these approaches in light of the variety and combinations used in the literature. The interventions employing what is variously termed a behavior analytic (Spira and Edelstein 2006) or functional analytic approach (Moniz-Cook et al. 2012) appear to have some of the clearest supporting evidence. Studies employing single-case designs with individuals have demonstrated support for the use of stimulus control interventions for wandering behavior. These interventions involved manipulating environmental stimuli (e.g., disguising doors, installing visual barriers, covering doorknobs, placing grids on floors) that contributed to wandering behavior. Several single-case studies have been published demonstrating the effectiveness of individual interventions (e.g., reinforcement of appropriate behaviors, differential reinforcement of other behaviors) for a wide range of challenging behaviors. However, all of these studies need to be replicated to establish the generalizability of the findings. Overall, there is promising support for the effectiveness of many behavioral approaches to reducing the frequency of challenging behaviors associated with dementias (Moniz-Cook et al. 2012).

Systematic Individualized Intervention

This approach appears to have been developed from a behavioral perspective and is based on the notion that one can reduce agitated behaviors associated with dementia by addressing unmet needs of the individual that are thought to be the basis for the behaviors (e.g., pain, feelings of loneliness or isolation, boredom, sensory deprivation). As previously noted, this approach is similar to other behavioral approaches that focus on the function of the challenging behavior and identify the antecedents and consequences of challenging behaviors. However, the studies of this approach have combined characteristics of group (nomothetic) and individualized (idiographic) approaches with large numbers of participants. This large-scale approach has been used exclusively with agitation. In two placebo-controlled studies, agitation was directly observed. Agitated behaviors included physically agitated (e.g., repetitive movements) and verbally agitated (e.g., screaming) behaviors. Interventions were individualized and included, for example, individualized music, family videotapes and pictures, stress balls, electronic massagers, and pain treatment. The results revealed significant reductions in agitation when compared to the control groups. Although these studies were not included in recent reviews, this approach has sufficient evidence, including one randomized, placebo-controlled study, to support its effectiveness. Please note there is some overlap between some of the stimuli used in these studies and those used in simulated presence therapy, described in a subsequent section.

Cognitive/Emotion-Oriented Interventions

Cognitive/emotion-oriented interventions, such as reminiscence therapy, simulated presence therapy, and validation therapy, have been examined as treatment for a range of challenging behaviors, including agitation/aggression and comorbid

disorders, such as depression and anxiety (O'Neil et al. 2011). Although the effectiveness of these cognitive/emotion-oriented interventions in reducing challenging behaviors is mixed, each intervention will be briefly reviewed (O'Neil et al. 2011).

Reminiscence Therapy

Reminiscence therapy for older adults grew out of the work of Robert Butler on "life review." Life review is conceived as a naturally occurring process of recalling past experiences, including unresolved conflicts. Reminiscence therapy involves a progressive awareness of one's past experiences, which affords older adults the opportunity to examine these experiences, resolve conflicts, and place their lives in perspective. Various forms of this approach with dementia patients appear in the literature. Common features include, for example, discussions of past experiences accompanied by familiar objects (e.g., old photographs) that are used to stimulate discussions. There is considerable support in the literature for the reduction of depression (Woods et al. 2009) but little evidence to support the reduction of challenging behaviors associated with dementia.

Simulated Presence Therapy

Similar to reminiscence therapy, simulated presence therapy involves the recalling of a patient's positive life experiences and memories (Zetteler 2008). However, in simulated presence therapy, the recalling of positive life experiences is accomplished through the use of audiotaped or videotaped recordings of conversations with a patient's family members (Zetteler 2008). The purpose of these recordings is to bring comfort to the patient by serving as a reminder of the patient's family (Zetteler 2008). There is mixed evidence regarding the effectiveness of simulated presence therapy. Additionally, there is evidence that simulated presence therapy can produce increases in agitation or disruptive behaviors (Zetteler 2008). Overall, these results suggest that simulated presence therapy may be effective in reducing challenging behaviors. However, current findings need to be replicated and extended.

Validation Therapy

Naomi Feil developed validation therapy for older adults with cognitive impairment, particularly those with dementia. Feil classifies cognitively impaired individuals according to four stages: mal orientation, time confusion, repetitive motion, and vegetation. The emphasis of the intervention is on acknowledging and dignifying the feelings and experiences of a person. A variety of techniques comprise the approach (e.g., paraphrasing, touching, linking behavior with unmet needs). Feil identified several principles that she believes underlie her approach (e.g., all people are unique and should be treated as such, there is reason behind the behavior of disoriented behavior of older adults, and older adults should be accepted nonjudgmentally).

Outcomes measured employed in studies of validation therapy have included cognition, behavior, emotional state, and activities of daily living. As previously noted (Neal et al. 2005), and unchanged today, there are few experimental studies of validation therapy, and their results are mixed, with insufficient evidence to support this approach.

Sensory Stimulation Interventions

Sensory stimulation interventions and complementary and alternative medicine (CAM) include interventions such as massage therapy, acupuncture, aromatherapy, light therapy, music therapy, Snoezelen or multisensory stimulation therapy, and transcutaneous electrical nerve stimulation (O'Neil et al. 2011). Sensory stimulation interventions and CAM therapies have both been investigated as interventions to reduce problem or challenging behaviors, including agitation/aggression, wandering, and inappropriate sexual behavior.

Massage Therapy

In general, massage or touch therapies involve applying pressure to the body. This application of pressure may include a variety of styles of touch, such as slow strokes, expressive touch, rubbing, kneading, and effleurage (Hansen et al. 2008; Moyle et al. 2012). Massage may also be applied to different body areas, including

the back, shoulders, neck, hands, lower legs, or feet (Moyle et al. 2012). Typically, massages are conducted by nursing staff or massage therapists (Hansen et al. 2008; Moyle et al. 2012). The limited number of studies precludes the ability to evaluate the effectiveness of massage therapy (Hansen et al. 2008; Moyle et al. 2012). However, the preliminary evidence suggests that massage therapy may reduce agitated behavior among older adults with dementia, at least in a short term.

Multisensory Stimulation Therapy

The goal of multisensory stimulation (MSS) or Snoezelen therapy is to promote balance of the sensory system through stimulation of the five senses by using a range of stimuli (e.g., music, aromatherapy) (O'Neil et al. 2011). In some cases, guidelines identify specific stimuli that should be included in treatment. Alternatively, patient preferences may be used to identify specific stimuli (Chung et al. 2009). The current evidence for the effectiveness of MSS is mixed. There is preliminary evidence that disruptive behavior decreases during MSS treatment. However, these effects are not maintained when treatment is discontinued (Livingston et al. 2005). Other research concluded that there is no evidence for the effectiveness of MSS on agitation/aggression among individuals with dementia (Chung et al. 2009). Further, the evidence for the effectiveness of MSS on wandering is inconclusive (O'Neil et al. 2011). In sum, the limited evidence available suggests that MSS may be effective in reducing some challenging behaviors (i.e., disruptive behavior).

Music Therapy

Music therapy typically involves listening to music or playing musical instruments, but may also involve having patients compose music or dance (O'Neil et al. 2011; Livingston et al. 2005). In active music therapy, patients and providers participate in the intervention (e.g., composing, singing, dancing, and playing instruments). Receptive music therapy involves having patients listen to music and therefore involves less interaction (McDermott et al. 2013). Similar to other sensory stimulation interventions, music therapy may be implemented as a stand-alone intervention or integrated in other activities (O'Neil et al. 2011). Music therapy may be individualized by employing the patient's favorite music. In contrast, standardized music therapy protocols typically employ relaxing, quiet, classical, and big-band music (Livingston et al. 2005; McDermott et al. 2013).

Music therapy is effective in producing short-term (during and immediately following the intervention) decreases in disruptive behavior (i.e., agitation and aggression) (O'Neil et al. 2011; Livingston et al. 2005; McDermott et al. 2013). However, there is no evidence that the decreases in agitation and aggression are maintained (McDermott et al. 2013). Evidence regarding the effectiveness of music therapy in reducing other challenging behaviors is mixed (O'Neil et al. 2011). Despite the promising findings of several reviews, poor methodological quality and reporting of studies prevented the ability to draw conclusions about the effectiveness of music therapy (Vink et al. 2011).

Light Therapy

Light therapy increases exposure to bright and naturalistic light and is therefore hypothesized to help regulate circadian rhythms and reduce fragmented or disrupted sleep, which in turn is hypothesized to reduce challenging behaviors (i.e., agitation, cognitive dysfunction, functional impairment, and depression) (Forbes et al. 2014). Light therapy involves use of varying levels of brightness (e.g., between 2500 and 10,000 lx). Recent research suggests that light therapy should involve exposure to light in the short wavelength range (i.e., 450 to 500 nm, the blue to green range) as this is the light range at which melanopsin cells are stimulated to shift circadian rhythms (Forbes et al. 2014). Exposure to light can be produced by using a light box, wearing a light visor, light fixtures, or dawn-dusk simulation (Forbes et al. 2014). One advantage of light therapy is that few adverse effects have been reported (Forbes et al. 2014). Overall, there is a lack of sufficient evidence to support light therapy as an effective treatment for reducing challenging behaviors (O'Neil et al. 2011; Forbes et al. 2014).

Transcutaneous Electrical Nerve Stimulation

Transcutaneous electrical nerve stimulation (TENS) has also been explored as a potential treatment for challenging behaviors, such as aggressiveness, among individuals with dementia. TENS involves the application of biphasic pulsed waveform, pulsed electrical currents, to the skin and can produce muscle contraction depending on the intensity of the current (O'Neil et al. 2011; Cameron et al. 2009). When TENS is used to treat individuals with dementia, electrodes are applied to the head or earlobes, which produce cranial electrical stimulation (Cameron et al. 2009). TENS is associated with minor side effects, such as dull pain in the head, and therefore may be advantageous as compared to other interventions (Cameron et al. 2009). Literature examining the effects of TENS on challenging behaviors is limited. One Cochrane review noted a lack of sufficient data limited the ability to draw conclusions about the effects of light therapy on challenging behaviors, specifically aggressiveness (Cameron et al. 2009).

Reality Orientation Therapy (Cognitive Stimulation)

Reality orientation therapy was originally developed for the rehabilitation of war veterans and later used to address the disorientation of older adults in hospitals. This approach is typically directed at individuals with dementia and involves the presentation of information regarding time, place, and person with the goal of reorienting the individual. Clocks and calendars are often employed to assist with this endeavor. One review examined all randomized controlled trials (RCTs) of cognitive stimulation for dementia that focused on cognitive change outcomes (Woods et al. 2012). These included studies in which the following terms were used to describe the intervention: cognitive stimulation, reality orientation, memory therapy, memory groups, memory support, memory stimulation, global stimulation, and cognitive psychostimulation. Cognitive stimulation, the overarching term, was defined as "engagement in a range of activities and discussions (usually in a group) aimed at general enhancement of cognitive and social functioning"(Woods et al. 2012, p. 2). Outcome assessments of challenging behaviors were based on care provider ratings of participant behavior. More specifically, ratings of general behavior and behavior scales were used as outcome measures. No differences in challenging behaviors were found between intervention and control groups. Consequently, reality orientation therapy cannot be recommended as an intervention for challenging behaviors.

Psychosocial Interventions

Psychosocial interventions, such as animal-assisted therapy and exercise, promote social interaction and communication and have been examined as interventions to reduce challenging behaviors.

Animal-Assisted Interventions

Animal-assisted interventions are a broad category, which includes three main types of interventions, animal-assisted activities, animal-assisted therapy, and service animal programs (Bernabei et al. 2013). Animal-assisted interventions can involve the use of living animals such as, dogs, cats, or even fish. Alternatively, these interventions may employ nonliving animals, such as robot animals or toy animals (e.g., plush dog or cat). Animal-assisted activity involves the use a companion animal. Animal-assisted therapy employs therapy animals, is typically provided by health or human service professionals, and addresses specific treatment goals (Kamioka et al. 2014). Service animal programs employ service animals (Kamioka et al. 2014). Research suggests that exposure to animals has beneficial effects on health, may reduce depressive symptoms, and may improve socialization and interaction (Bernabei et al. 2013). Moreover, animal-assisted interventions reduced challenging behaviors, such as aggressiveness and irritability, although it is unclear whether these effects were maintained (Bernabei et al. 2013).

Physical Exercise Interventions

In general, there are several types of physical exercise/activity programs, including mobility training (e.g., walking), isotonic exercises,

strength training, or mixed modalities (e.g., chair exercises, aerobic dance class) (Heyn et al. 2004). These exercise programs may be delivered as an independent activity or may be incorporated into recreational activities/programs. The primary goal of these types of programs is to increase older adults' ability to perform tasks of everyday living (Forbes et al. 2013). An additional goal of some exercise interventions is to increase socialization. Similar to other psychosocial interventions reviewed, the effects of exercise on challenging behavior are mixed (Forbes et al. 2013; Eggermont and Scherder 2006). Currently, there is insufficient evidence to determine if exercise reduces aggressive/agitated or wandering behavior among individuals with dementia (Forbes et al. 2013).

Summary and Conclusions

The primary focus of this entry is psychosocial interventions for challenging behaviors associated with dementia in residential care. Additionally, pharmacological interventions are briefly addressed. Reliance on pharmacological interventions continues in spite of limited support and potential adverse effects. Psychosocial interventions offer safer alternatives, but conclusions regarding several of the psychosocial interventions are limited for a variety of reasons, including methodological problems and inconsistencies in findings across studies. Most reviews of this literature have relied primarily upon large-scale studies that meet standards that are challenging for research with dementia-related problems. These include, for example, large sample size, equivalent control group, blindness of participants, and assessor to intervention (Cohen-Mansfield et al. 2012). Single-case design studies, which often clearly demonstrate the effects of interventions, have insufficient sample sizes and inadequate design characteristics to be included in most reviews. Cohen-Mansfield et al. (2012) have argued against restricting reviews to studies employing stringent inclusion criteria, such as those for RCTs. They argue that the resulting reviews fail to contain considerable useful information that is often more externally valid than that obtained from studies with very strict inclusion criteria. The conclusions of this entry are driven largely on the basis of major reviews of the relevant literature. Further, research that does not meet the standards for RCTs (e.g., reviews of behavior analytic interventions) was also reviewed when possible. The conclusions tend to be mixed, which is consistent with the findings of most of the reviews cited in this entry. The most promising approaches to managing challenging behavior appear to be the ones that are individualized in general and those that attempt to address the antecedents and function of the challenging behaviors in particular. Future research should offer a balance of methodologies; address the lack of a consistent operationalization of challenging behavior and use of inconsistent outcome measures; and explore whether the reductions in challenging behaviors are maintained once treatment is terminated. In addition, reviewers should consider the implications of eliminating empirically sound and externally valid studies which may not meet all of the criteria previously required for inclusion.

Cross-References

- ▶ Behavioral and Psychological Symptoms of Dementia
- ▶ Contextual Adult Life Span Theory for Adapting Psychotherapy (CALTAP) and Clinical Geropsychology
- ▶ Environmental Influences on Aging and Behavior, Theories of
- ▶ Gerontechnology
- ▶ Psychological Theories on Health and Aging
- ▶ Small-Scale Homelike Care in Nursing Homes
- ▶ Stress and Coping in Caregivers, Theories of

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China Health and Retirement Longitudinal Study (CHARLS)

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Synonyms

CHARLS

Definition

This entry provides an overview of the China health and retirement longitudinal study, focusing on its value in geropsychology research in China. The entry starts with an introduction on CHARLS Sampling and Implementation including the background, the sampling procedure and design, tracking protocol, data release, and demographics of the respondents. It then describes the contents of the questionnaire, followed by psychologic measurements. This entry is concluded with future plans.

Introduction

China has the largest aging population in the world and also one of the highest aging rates in the world today. It is projected that the proportion of those aged 60 or over will increase from 13% of the population in 2010 (National Bureau of statistics of China 2011) to 33% in 2050 (United Nations 2013), whereas the elderly support ratio (the number of prime-age adults aged 20–59 divided by the number of adults aged 60 or above) will drop from about 4.9:1 in 2010 to 1.4:1 in 2050 (United Nations 2013).

With the rapid aging of Chinese population, the problem of providing for the aged population is becoming increasingly important. One feature of rapid economic growth is that lifetime incomes for younger people tend to be considerably higher than they were for their elderly parents, making the elderly one of the largest disadvantaged groups in China. At the same time, China's birth control policy means that China's elderly today have fewer children to support them than in the past. How to deal with problems of support for the well-being of the elderly is one of the greatest challenges to the fast-booming Chinese society in the decades to come.

In face of challenges posed by population aging, the health status of the elderly population is of great importance. A healthy older population can not only reduce the financial and personal care needs but can also contribute to the family and society in the form of working or helping to take care of the young children.

Of all dimensions of health, psychological health is at least as important as physical health to the functionality of older persons. Depression is already listed as a major cause of death and disability in China (Yang et al. 2013; Phillips et al. 2002). In the United States, dementia or cognitive impairment has been shown to cause major caring burdens to the family (Hurd et al. 2013).

At present, scientific studies of China's aging psychological health problems are still at an early stage, the greatest obstacle being a lack of sufficient micro-longitudinal data. The existing data tend to be small scale in parts of China, not collecting the breadth of data necessary for good social scientific analysis of psychological health of the older population. China Health and Retirement Longitudinal Study (CHARLS) is the first nationally representative survey of the older population that enables the study of psychological health of the older population in China patterned after the Health and Retirement Study (HRS) in the United States, English Longitudinal Study of

China Health and Retirement Longitudinal Study (CHARLS), Table 1 Response rates: 2011 Baseline, Wave 2, 2013

	Wave 1 2011	Wave 2 2013			
	Households[a]	Total	2011 household respondents[b]	Refresher Households	Households who did not respond in 2011
Response rate (%)	80.5	N/A	91.0	81.6	51.6
No. of households	10,257	10,832	9,022	615	1,129
No. of respondents	17,708	18,648	15,684	1,107	1,857

[a]Household response rate: the ratio of number of responded households to the number of age-eligible households
[b]2013 Individual R-rate: respondents who completed at least one module/(total individuals in 2011 minus 2011 respondents who died by 2013)

Ageing (ELSA), and the Study of Health, Ageing, and Retirement in Europe (SHARE).

This entry will give a comprehensive introduction of the CHARLS data set, its sampling method, longitudinal tracking protocol, the content of the questionnaire especially existing psychological measures, and plans for future data collection.

CHARLS Sampling and Implementation

Baseline Sampling

CHARLS is a biennial survey that aims to be representative of the residents of China aged 45 and older, with no upper age limit. The CHARLS national baseline survey was conducted in 2011–2012 and wave 2 in 2013. CHARLS is a nationally representative survey that includes one person per household aged 45 years of age or older and their spouse, totaling 17,708 individuals in wave 1, living in 10,257 households in 450 villages/urban communities (Zhao et al. 2013, 2014). At the first stage, all county-level units were sorted (stratified) by region, within region by urban district or rural county, and by GDP per capita (Tibet was the only province not included). Region was a categorical variable based on the NBS division of province area. After this sorting (stratification), 150 counties or urban districts were chosen with probability proportional to population size (Zhao et al. 2013). For each county-level unit, three PSUs (villages and urban neighborhoods) are randomly chosen with probability proportional to population (Zhao et al. 2013). Hence, CHARLS is nationally represented for both rural and urban areas within China. Counties and districts in 28 provinces are included in the CHARLS sample (Zhao et al. 2013).

In light of the outdated household listings at the village/community level due to population migration, CHARLS designed a mapping/listing software (Charls-GIS) that makes use of Google Earth map images to list all dwelling units in all residential buildings to create sampling frames.

The response rate for the baseline survey was 80.5%, 94% in rural areas and 69% in urban areas, lower in urban areas as is common in most surveys undertaken in developing countries (Table 1) (Zhao et al. 2013). A description of the sample for waves 1 and 2 is provided in Table 1. After applying sampling weights created using the sampling procedure, the CHARLS sample demographics mimics very closely that of population census in 2010 (Zhao et al. 2013).

In each sampled household, a short screening form was used to identify whether the household had a member meeting the age eligibility requirements. If a household had persons older than 39 and meeting the residence criterion, one of them will be randomly selected. If the chosen person is 45 or older, then he/she became a main respondent and his or her spouse was interviewed. If the chosen person was between ages 39 and 44, he/she was reserved for refresher samples for future waves. In wave 2, respondents who were aged 43–44 in wave 1 (plus their spouses) were

China Health and Retirement Longitudinal Study (CHARLS), Table 2 Number and age/sex structure of individuals: 2011 Baseline and Wave 2, 2013

	Baseline, 2011			Wave 2, 2013		
	Total	Male	Female	Total	Male	Female
−50	4,277	1,806	2,471	4,178	1,754	2,424
51–55	2,848	1,412	1,436	2,712	1,302	1,410
56–60	3,523	1,697	1,826	3,523	1,702	1,821
61–65	2,695	1,372	1,323	3,124	1,574	1,550
66–70	1,802	913	889	2,037	1,032	1,005
71–75	1,214	652	562	1,442	732	710
76–80	790	386	404	787	410	377
80+	548	231	317	830	374	456
OBS	17,708	8,476	9,232	18,648	8,882	9,766

Note: There are 11 individuals in 2011 and 15 individuals in 2013 lacking age information

added from the refresher sample. The same for wave 3 (4) will be done in 2015 (2017), out of those aged 41–42 (39–40) in wave 1. Starting in wave 5 (2019), a new mapping/sampling exercise will be conducted to replenish the sample with appropriate aged cohorts.

Tracking Protocol

Respondents and spouses will be tracked if they exit the original household. While the original CHARLS sample is of the noninstitutionalized elderly population, if a respondent becomes institutionalized, such as entering a nursing home or hospital for a long stay, CHARLS follows them. This potentially matters for obtaining prevalence rates for dementia since it might be that some of the population with dementia is institutionalized. However, in China, the institutionalized population is very small, so in practice for CHARLS, this is unlikely to be an important issue.

Main respondents and spouses in the baseline survey are followed throughout the life of CHARLS or until they die. If a main respondent or spouse remarries, the new spouse is interviewed so long as they are still married to the baseline respondent at the time of the specific wave. In wave 2, only 25 couples split up because of divorce.

For respondents in the baseline, after deaths, 91% of them were recontacted (Table 1). Four hundred twenty-seven exit interviews were conducted on respondents who died between the baseline and wave 2 (464 deaths), including verbal autopsies using the 2012 version from the World Health Organization. In addition, the households which were not found in the baseline were revisited. One thousand one hundred twenty-nine of these (51.6% of those households who had age-eligible members living in nonempty dwellings) were contacted. The households that split because of divorce or moving were also followed. The total household size in wave 2 is 10,832 households with a total of 18,648 individuals (main respondents plus spouses). The age distribution of respondents in baseline and wave 2 is shown in Table 2.

Data Release

The national baseline data and documentation were released publicly, on the CHARLS website (www.charls.ccer.edu.cn/en), in early February 2013, less than 1 year after the fieldwork was completed. The second wave of the national CHARLS sample was fielded in the summer and through the fall of 2013. It was released publicly at the end of this January.

Demographics of the CHARLS Sample

Table 2 describes the age/sex composition of the CHARLS sample. There are 17,708 individuals in the national baseline sample, of which 52.1% are female. While most of the samples are the younger old, 40% are aged 60 years and older. Of the sample, 91.3% were directly interviewed and

8.7% were interviewed by proxy respondent (Table 2).

Content of the Household Survey

Household Survey Instruments

The core survey consists of the following sections: (1) demographics; (2) family structure/transfer; (3) health including biomarkers; (4) health insurance and healthcare utilization; (5) work, retirement, and pension; (6) relative income; (7) family income, wealth, and expenditures; (8) personal income, assets; and (9) housing characteristics. All interviews are conducted using the computer-assisted personal interview (CAPI) technology. The health modules will be described in detail.

Health Status: Self-Reports and Assessments

The self-reports start with the respondent rating health on a scale of excellent, very good, good, fair, and poor or instead very good, good, fair, poor, and very poor. As in HRS, respondent's self-assessment is asked twice, using each scale, once at the start of the module and once at the end of the sub-module asked randomly determined within CAPI. This is followed by questions asking about diagnoses by doctors of a set of chronic diseases, including stroke and separately psychology diseases, and the timing of diagnoses of specific conditions. Where relevant, current medications and treatments for each specific condition are also collected. Questions about eyesight, hearing, and dental health are asked next and then questions on hedonic well-being. The CHARLS team follows this subsection with a section to obtain information on activities of daily living (ADLs), instrumental activities of daily living (IADLs), and physical functioning. For those who have been identified as having difficulties in ADL or IADL, the care givers are collected. Up to three names are chosen from all of list of family members. Time of care and financial arrangement are asked. Sections on depressive symptoms and cognition follow.

In addition to self-reported health outcome variables, information is collected on several health behaviors. This includes detailed information on smoking, drinking, and physical activities.

Health Status: Biomarkers

Following ELSA and HRS, detailed biomarkers, blood and non-blood, were collected. Non-blood biomarkers such as anthropometrics and blood pressure were collected in waves 1 and 2 and will again be in wave 3. Then the blood biomarkers was collected in wave 1 and will be collected in every other wave, to harmonize with HRS and other aging surveys. In CHARLS the data are collected on height, lower leg and upper arm lengths (useful to get measures related to height not contaminated by shrinkage), waist circumference, blood pressure (measured 3 times), grip strength (measured by a dynamometer two times for each hand), lung capacity measured by a peak flow meter, and doing a timed sit to stand (5 times starting from a full sit position on a common, plastic stool). The balance tests are also conducted, just the same as those used in HRS, and a timed walk at normal speed for 2.5 m again follows HRS.

Healthcare Utilization and Insurance

Indicators of curative and preventive healthcare utilization and health insurance coverage are collected in this module. A separate section on health insurance is asked to collect details of current and past coverage and whether coverage was lost. Healthcare utilization of outpatient care for the last 1 month is asked, with details about last visit. Inpatient utilization over the past 1 year is asked, with details about last visit. The questions include from whom and at what location medical care was received, how much was total cost, what was out of pocket cost, whether insurance was used, if others help pay for the care, whom, and how far respondents traveled.

Life Histories

A special wave to collect life histories was fielded in 2014. Life histories can greatly add to aging surveys because they help to fill in very important details regarding earlier periods in the respondent's life, which are germane to understanding outcomes when older. Ways to minimize recall

China Health and Retirement Longitudinal Study (CHARLS), Table 3 CES-D questions

English	Mandarin
DC009 I was bothered by things that don't usually bother me	我因一些小事而烦恼。
DC010. I had trouble keeping my mind on what I was doing	我在做事时很集中精力。
DC011. I felt depressed	我感到情绪低。
DC012. I felt everything I did was an effort	我得做任何事都很劲。
DC013. I felt hopeful about the future	我对未来充满希望。
DC014. I felt fearful	我感到害怕。
DC015. My sleep was restless	我的睡眠不好。
DC016. I was happy	我很愉快。
DC017. I felt lonely	我感到孤独。
DC018. I could not get "going"	我得我无法继续我的生活

error have been greatly improved primarily through the use of calendars that are anchored to key lifetime or calendar events (both national events, like the Cultural Revolution and local, like a major flood) that are salient to respondents' memory. Such calendars have been developed.

The CHARLS life histories are developed using as a base the ELSA and SHARE life histories, the most complete life histories of the HRS-type aging surveys. The CHARLS life history includes retrospectives on domains that cover family background when the respondent was a child, child health and health care, work and retirement, marriage, childbirths, migration, some retrospective information on income, wealth and poverty status when young, and schooling is collected. Some special history issues germane to China are also included, such as experiences during the Cultural Revolution and the Great Famine and during local events such as a major local flood. These life histories will be especially useful for linkage with the CHARLS ADAMS 2 data.

Community Survey Instrument

One special feature of CHARLS that is new to the HRS-type surveys is to collect detailed panel data from community-level informants (e.g., formal and informal community leaders). Basic community information is collected on, for example, land and its allocation, population, and the most populous surnames and their numbers. More standard information is also collected, such as details about local infrastructure and public facilities such as roads, electrification, water and sanitation infrastructure, and the availability of schools; health insurance and health facilities; and pensions and prices. In addition, the Policy Questionnaire collects details of social welfare programs such as pensions and health insurance, In addition, at the county level.

Psychological Health Measures

Depression

CHARLS uses the ten-question version of the Center for Epidemiologic Study depression (CES-D) battery (The CES-D ten questions are reported in Appendix Table 3, and CHARLS uses the Chinese translation provided at the Center for Epidemiologic Studies website). The answers for CES-D are on an f-scale metric, from rarely, to some days (1–2 days), to occasionally (3–4 days) to most of the time (5–7 days).

Lei et al. (2014a) provides a descriptive analysis of the depressive symptoms as revealed in CHARLS. They scored these answers using the metric suggested by Radloff (1977). Numbers from 0 for rarely to 3 for most of the time are used for negative questions such as "do you feel sad." For positive questions such as "do you feel happy," the scoring is reversed from 0 for most of the time to 3 for rarely. A validation exercise of answers to these questions indicates a reasonable level of internal consistency. Lei et al. (2014b) report that in 2011/12 a high fraction of Chinese people 45 and older, both men and women, are suffering from high levels of depressive symptoms, with some 30% of men and 43% of women having CES-D scores 10 and over (out

China Health and Retirement Longitudinal Study (CHARLS), Table 4 Word recall list, English and Mandarin

List A	List B	List C	List D
A01. RICE 米	B01. STOOL 凳子	C01. MOUNTAIN 山	D01. WATER 水
A02. RIVER 河流	B02. FOOT 脚	C02. STONE 石头	D02. HOSPITAL 医院
A03 DOCTOR 医生	B03. SKY 天空	C03. BLOOD 液	D03. TREE 树木
A04. CLOTHES 服	B04.MONEY 金钱	C04. MOTHER 妈妈	D04. FATHER 爸爸
A05. EGG	B05. PILLOW 枕头	C05. SHOES 子	D05. FIRE 火
A06.CAT 小猫	B06. DOG 小狗	C06. EYE 眼睛	D06. TOOTH 牙
A07. BOWL 碗	B07. HOUSE 房子	C07. GIRL 女孩	D07. MOON 月亮
A08. CHILD 小孩	B08. WOOD 木头	C08. HOUSE 房子	D08. VILLAGE 村子
A09. HAND 手	B09. SCHOOL 小学	C09. ROAD	D09. BOY 男孩
A10. BOOK 书	B10. TEA 茶	C10. SUN 太阳	D10. TABLE 桌子

of 30 as a maximum). Rural residents have substantially higher levels of depressive symptoms than urban residents.

Cognition

In the first two waves, CHARLS used a reduced form of the Telephone Interview for Cognitive Status, TICS (Brandt et al. 1988). This includes recognition of date: month, day, year, season (lunar calendar is allowed in addition to Gregorian calendar), day of the week, how the respondent rates their own memory on an excellent, very good, good, fair, poor scale, and serial subtraction of 7s from 100 (up to five times). The respondent is asked to redraw a picture of overlapping pentagons. In addition, immediate and delayed word recall is used, using ten nouns randomly chosen from a list of four groups of words, with approximately 5 min between the immediate and delayed answers. The words will not be read out a second time before the delayed recall (the word lists are reported in Appendix Table 4).

CHARLS shows a steep decline of cognitive functions with age (Lei et al. 2014b). There exist large sex-related differences in cognition to the disadvantage of women, with the large sex-related gap in education being the primary reason for this. These sex-related disparities are eliminated in younger cohorts.

Future Plans

Starting in wave 3 (2015), CHARLS will be introducing a number series test of fluid intelligence, patterned on the HRS number series test (Fisher et al. 2013; Prindle and McArdle 2013).

In CHARLS wave 4, it is scheduled to diagnose dementia and impaired of cognition among the CHARLS respondents aged 65 and older. This will be done in two steps. First, a formal validation sample will be collected from which both interviewer assessment and doctor diagnosis will be conducted. From these data, a statistical model will be built to use interview tests to predict dementia and CIND. This information will be used to inform the final choice of tests and the estimation of weights and cutoff points specific to China with which to classify CHARLS respondents as having dementia and CIND. Among the tests currently planned are the mini-mental state exam (MMSE); immediate and delayed word recall; a measure of verbal fluency, animal naming; the symbol digit modalities test; and backwards digit span.

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Cross-References

▶ English Longitudinal Study of Aging (ELSA)
▶ Health and Retirement Study, A Longitudinal Data Resource for Psychologists

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Chinese Longitudinal Healthy Longevity Study

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Synonyms

Centenarian study; Chinese study; Psychological resilience; Psychological traits

Definition

This entry aims to introduce the centenarian subsample of the Chinese Longitudinal Healthy Longevity Survey (CLHLS) and present some key findings on psychological traits of centenarians.

Background: Centenarian Studies in the World

Tireless efforts are made to explore the secret of human longevity throughout history. However, it is not until very recent that science-based studies on the mechanism of longevity appeared with sufficient sample sizes and multidisciplinary perspectives have been launched (Poon and Cheung 2012). One shortcoming of most existing longevity research projects is that little research has been done for those who survive to age 100 and

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beyond, namely centenarians (Poon and Cheung 2012; Zeng 2012).

The urgent call to study centenarians is largely due to the increasing importance of this special subpopulation. Because of the steady decline of mortality at very old ages (Vaupel et al. 1998; Wilmoth et al. 2000), the number of centenarians is booming in the world (Robine et al. 2010; Wilcox et al. 2008, 2010) and is projected to exceed three million by 2050 and possibly 20 million by 2100 in a conservative estimation of the United Nations Population Division (2015). More importantly, with the world population aging, centenarians come to be considered as a model of successful aging or healthy aging (Andersen-Ranberg et al. 2001; Poon et al. 2010). But why could some people live up to age 100 and beyond, while others die at much younger ages? Why could some people live so long but still remain healthy? Although there has been a consensus among researchers that socioeconomic, behavioral, environmental, and biological factors jointly determine one's longevity and health, to what extent and how exactly these factors contribute to centenarians' exceptional long and healthy life is mostly unknown.

There have been a number of centenarian studies around the world to attempt to address such research questions. For example, the longest ongoing centenarian study in the contemporary world is the Okinawa Centenarian Study (OCS), which was launched in 1975. The OCS has heretofore collected over 900 centenarians and several thousands of their siblings of septuagenarians, octogenarians, and nonagenarians in Okinawa, Japan. The Georgia Centenarian Study (GCS) is the longest centenarian study in the USA, which started in 1988. In the Phase I (1988–1992), the GCS collected 76 centenarians with 92 octogenarians and 89 sexagenarian as comparisons; 250 centenarians were further included with 80 octogenarians as comparison in the Phase III (2001–2009). The largest centenarian study in the USA is the New England Centenarian Study (NECS), which was launched in 1995. The NECS has collected data from about 1,600 centenarians in the USA with 500 children (in their 70s and 80s) and 300 younger controls since 1995. Several European countries have also launched centenarian studies since the early 1990s such as the Italian Multi-center Study on Centenarians (IMUSCE) (around 2,000 centenarians) and the Longitudinal Danish Centenarian Study (about 300 centenarians) (Koenig 2001; Poon and Cheung 2012). These centenarians and all other relevant studies have resulted in a boom in centenarian studies and improved understanding about their secret of longevity.

However, nearly all centenarian studies are from developed countries. There was almost no scientific research project with a sufficient sample size of centenarians in developing countries before the late 1990s (Zeng et al. 2001). Because the contributions of sociodemographics, psychological factors, and behavioral factors to longevity vary in different cultures and societies with different development stages (Poon et al. 2010; Kolovou et al. 2014; Willcox et al. 2006), it would be interesting to study centenarians from developing countries where the socioeconomic resources, healthcare service, and technology are limited. Furthermore, while there were about 50 centenarians per million in Western Europe (Jeune and Vaupel 1995; United Nations Population Division 2015), there were less than three centenarians per million in China in the 1990s (United Nations Population Division 2015). The genomes of long-lived individuals from China may be more enriched for disease-preventive genes than their counterparts in the West, because they survived the brutal mortality regimes of the past when famine, civil wars, and starvation affected their birth cohorts of many millions. In addition, the genetic composition of the Han Chinese ethnic group is relatively homogeneous. Unlike Western countries that received many immigrants from other parts of the world and thus provide relatively heterogeneous genetic compositions even within the same ethnic group, China received very few international immigrants. Consequently, the Han Chinese are relatively genetically homogenous, compared to the Western counterparts. For example, it was estimated that "the average of genetic differences between Han Chinese population samples ($F_{ST} = 0.002$) was much lower than that among

European populations ($F_{ST} = 0.009$)" (Xu and Jin 2008). This is a comparative advantage to increase statistical power for studying effects of genetic and GxE interactions on healthy aging.

Another major limitation of existing literature on centenarian studies has been the lack of surveys with large sample sizes. To address above research questions, including investigating genetic variations in longevity and examining gene-environment interaction effects on longevity and health, large samples are required. Small sample sizes of surveys often produce results with insufficient statistical power or poor robustness; and in some cases, small-sized surveys on centenarians often lack representativeness when the size of underlying centenarian population is relatively large, such as in China. Yet, with few exceptions, the sample sizes of most centenarian studies around the world are less than 1,000 centenarians (Koenig 2001; Poon and Cheung 2012). To promote centenarians studies, there is thus a need for studies with large representative samples in developing societies, such as in China which homes about 1.3 billion population or about 19% of the world total population.

Research Objectives of the CLHLS

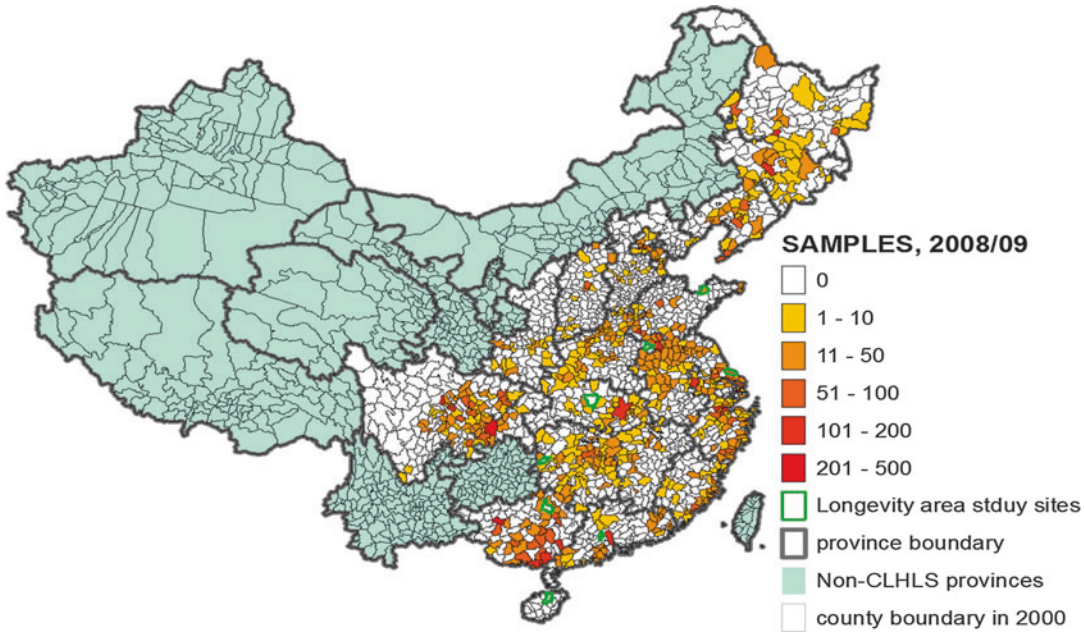
Launch of the CLHLS

While it is very useful and important to uncover the secrets of human longevity to study centenarians, it is also equally important or even more prominent to study the oldest-old population aged 80 or older. This is because the remarkable increase in the number of oldest-old population in the recent years and near future presents a serious public health challenge to promote the quality of life. Because their large consumptions of social and medical care services and benefits of research on them are far out of proportion to their size, the oldest-old population in aging and longevity studies has received increasing attention over the past decades. In this context, Drs. Yi Zeng and James W. Vaupel launched a nationwide project in China on determinants of healthy longevity in 1998, titled as the Chinese Longitudinal Healthy Longevity Survey (CLHLS). This project received financial supports from the National Institute on Aging, the National Natural Science and Social Sciences Foundations of China, UNFPA, and other resources.

The CLHLS aims to collect extensive data on a large sample of the oldest-old aged 80 years and older with a comparison group of younger elders aged 65–79. The project also collected information on the offspring of the elderly in 2002 and 2005 to better investigate the role of intergenerational transfers and its association with human longevity. Starting in 2009, adult children of centenarians and controls of nonrelatives of centenarians in seven longevity areas (later becoming eight longevity areas in 2012 and 2014) were included in the CLHLS (see section "Centenarian Sub-Sample in the CLHLS" below). More specifically, the objectives of the CLHLS research project are threefold: (1) to shed light on the determinants of healthy longevity and to discover social, behavioral, environmental, and biological factors that may have an influence on the healthy longevity of human beings, as well as to answer questions such as why some people survive to very old age without much suffering while others suffer considerably; (2) to fill in the data gap and gain a better understanding of demographic and socioeconomic conditions, as well as of the health status and care-giving needs of the oldest-old population; and (3) to provide a scientific base for sound policy making and implementation, so as to improve the system of care-giving services and, ultimately, the quality of life of the elderly.

Sampling Strategy of the CLHLS

The CLHLS is conducted in a randomly selected half of the counties and cities in 22 of China's 31 provinces. The 22 provinces are Liaoning, Jilin, Heilongjiang, Hebei, Beijing, Tianjing, Shanxi, Shaanxi, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Sichuan, and Chongqing (see Fig. 1). The exclusion of nine provinces in the North-West parts of China, where ethnic minorities represent a high proportion of total population, was based on concerns about the inaccuracy of age-reporting among



Chinese Longitudinal Healthy Longevity Study, Fig. 1 Spatial distribution of the sampled counties/cities in the CLHLS, the 2008 wave. Note: This map was made by the authors based on a county boundary map from the National Bureau of the Statistics of China. The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, or area or of its authorities or concerning the delimitation of its frontiers or boundaries

local elders. Previous studies have evidenced major inaccuracy (mainly exaggeration) in age reporting at old ages in these nine provinces (Coale and Li 1991; Huang 1993). In contrast, in the 22 provinces as chosen, local people, mostly Han, tend to use the Chinese lunar calendar and/or Western solar calendar to specify their birthdays, which largely reduces the inaccuracy of age reporting. The accuracy and reliability of age reporting for Han Chinese is related to the fact of their cultural tradition that the exact date of birth is significant for them in making decisions on important life events such as matchmaking for marriage, date of marriage, and the date to start building a house, among other events (Coale and Li 1991; Zeng 2012). The total population of the survey areas constituted about 85% of the total population in China in 2000 and 82% in 2010. So far, seven waves in 1998, 2000, 2002, 2005, 2008/09, 2011/12, and 2014 have been conducted.

In the sampling areas, the CLHLS aims to interview all centenarians who voluntarily agreed to participate in the study. For each centenarian interviewee in each wave, the CLHLS interviewed one nearby octogenarian (aged 80–89 years) and one nearby nonagenarian (aged 90–99 years) with predefined age and sex. "Nearby" is loosely defined – it could be in the same village or in the same street, if available, or in the same town or in the same sampled county or city district. The predefined age and sex are randomly determined, based on the randomly assigned code numbers of the centenarians, to have comparable numbers of males and females at each age group. In the first two waves (1998 and 2000), the CLHLS did not collect data from elders aged 65–79 years. Since the 2002 wave, the CLHLS extended its sample to include elders aged 65–79 under same sampling strategy with approximately three nearby elders aged 65–79 of predefined age and sex in conjunction with every two centenarians. Respondents who were younger than age 100 at an interview but subsequently died before a subsequent wave or resettled or refused to

be interviewed at a subsequent wave were replaced by new interviewees of the same sex and age (or within the same 5-year age group). However, such a strategy was not applied to the sixth and seventh waves where only follow-ups were performed due to shortage of budget, except the eight longevity areas where new participants were recruited to replace the deceased or the refusals.

To avoid the problem of small subsample sizes at the more advanced ages, the CLHLS oversampled respondents at more advanced ages, especially among male elders, in addition to recruiting all centenarians with a consent agreement. Consequently, appropriate weights were generated based on the age-sex-rural/urban-specific population distribution in the census. The method for computing the age-sex-rural/urban-specific weights and the associated discussions are presented in Zeng et al. (2008) and available at the CLHLS web page.

The questionnaire design was based on international standards and was adapted to the Chinese cultural/social context and carefully tested by pilot studies. The CLHLS collects various information covering demographics, socioeconomic conditions, psychological traits, health practice, and various health condition. All data were collected via in-home visits. The basic physical capacity tests were performed by a local doctor, a nurse, or a medical student.

Centenarian Subsample in the CLHLS

Subsample of the Centenarian Interviewees

In the research design of the CLHLS, the group of centenarians is one of the major components. As shown in Table 1, the CLHLS from 1998 to 2014 interviewed 10,804 centenarians in total with 2,130 male centenarians and 8,674 female centenarians. The total number of interviews of these centenarians is 16,582, of which 3,876 centenarians have two interviews and 1,360 centenarians have three interviews; only 372, 117, 39, and 14 have 4, 5, 6, and 7 interviews, respectively.

Data Quality of the Centenarians

Accurate age reporting is crucial in centenarian studies. The CLHLS has employed different methods to verify centenarians' ages, including birth and marriage certificates if available; household registration information; ages of their siblings, children, and relatives; genealogical record; any relevant document from local communities if available; and reported ages in Chinese zodiac. (The Chinese zodiac is a repeating cycle of 12 years, with each year being represented by an animal according to the Chinese lunar calendar. These zodiac animals are used to record one's date of birth). Based on the solid comparisons of various demographic indices, it was concluded that although the age reporting quality of centenarians of Han Chinese was not as good as in Sweden, Japan, England, and Wales, it is almost as good as in Australia and Canada, slightly better than in the USA (white, black, and other races combined), and much better than in Chile (see Zeng et al. 2008).

The systematic assessment of data quality of the CLHLS indicates that there was no substantial underreporting of deaths, and most variables or items in the questionnaire were in high quality. However, the causes of death of centenarians reported by next-of-kin might not be reliable, because nearly 60% of reported deaths had no information on causes of death (Zeng et al. 2008). This might be due to that significant portion of the centenarians did not go to the hospital to diagnose/treat the disease prior to death or they in fact died without specific disease.

In-Depth Study of Longevity Areas Including Adult Children of Centenarians

The CLHLS launched a subproject for an in-depth study in seven longevity areas where the density of centenarians is exceptionally high in 2009 as part of the 5th wave of the CLHLS, and in eight longevity areas (the previous seven plus a new one) in 2012 and 2014 as part of the 6th and 7th waves of the CLHLS, to investigate why some areas have a much higher proportion of healthy and long-lived individuals than other areas. The seven areas in 2009 were Chenmai County (Hainan Province), Yongfu County (Guangxi

Chinese Longitudinal Healthy Longevity Study, Table 1 Sample distributions of centenarians in the 1998, 2000, 2002, 2005, 2008–2009, 2011/12, and 2014 waves of the CLHLS

	Waves							
	1998	2000	2002	2005	2008–2009	2011–2012	2014	Total
Men								
New recruits	481	256	420	360	519	62	32	2,130
One follow-up	–	262	124	131	99	146	33	795
Two follow-ups	–	–	132	47	38	44	64	325
Three follow-ups	–	–	–	43	15	21	24	103
Four follow-ups	–	–	–	–	17	6	10	33
Five follow-ups	–	–	–	–	–	8	4	12
Six follow-ups	–	–	–	–	–	–	3	3
Total	481	518	676	581	688	287	170	3,401
Women								
New recruits	1,937	1,022	1,615	1,462	2,100	355	183	8,674
One follow-up	–	891	506	483	420	613	168	3,081
Two follow-ups	–	–	392	156	115	122	250	1,035
Three follow-ups	–	–	–	115	45	41	68	269
Four follow-ups	–	–	–	–	45	19	20	84
Five follow-ups	–	–	–	–	–	20	7	27
Six follow-ups	–	–	–	–	–	–	11	11
Total	1,937	1,913	2,513	2,216	2,725	1,170	707	13,181
Both sexes								
New recruits	2,418	1,278	2,035	1,822	2,619	417	215	10,804
One follow-up	–	1,153	630	614	519	759	201	3,876
Two follow-ups	–	–	524	203	153	166	314	1,360
Three follow-ups	–	–	–	158	60	62	92	372
Four follow-ups	–	–	–	–	62	25	30	117
Five follow-ups	–	–	–	–	–	28	11	39
Six follow-ups	–	–	–	–	–	–	14	14
Total	2,418	2,431	3,189	2,797	3,413	1,457	877	16,582

Note: The number of centenarians at a follow-up wave includes those whose ages were in 90s or 80s in a previous wave of the CLHLS who are not presented in the table. For the number of sample distribution for other ages, please refer to Zeng (2012:138)

Province), Mayang County (Hunan Province), Zhongxiang City (Hubei province), Xiayi County (Henan Province), Sanshui City (Guangdong Province), and Laizhou City (Shandong Province). Rudong County (Jiangsu Province) was added since 2012. The criteria of section for longevity areas come from the Committee of the China's Longevity Areas associated with the Chinese Society of Gerontology, including high density of centenarians and nonagenarians, high life expectancy, and a series of within-area consistency checks including good health status and good environment quality, etc. One biological child of each centenarian interviewee in the longevity areas was recruited since the 6th wave. The purpose of such design is to collect data on factors associated with longevity by comparing longevity transmission between families with and without centenarians. In addition to the regular home-interviews, the in-depth study on these longevity areas includes more sophisticated health exams and blood and urine sample collections for biomarker analysis.

In 2002, with support from the Taiwan Academy Sinica and Mainland China Social Sciences Academy, the CLHLS collected a sample of 4,478 adult children aged 35–65 of the elderly interviewees in eight provinces out of the 22 CLHLS

Chinese Longitudinal Healthy Longevity Study, Table 2 Distributions of deceased centenarians between adjacent waves from 1998 to 2014, CLHLS

	Wave interval						
	1998–2000	2000–2002	2002–2005	2005–2008/ 2009	2008/ 2009–2011/ 2012	2011/ 2012–2014	Total
Men	348	292	450	429	437	203	2,159
Women	1,213	930	1,635	1,502	1,722	692	7,694
Both sexes	1,561	1,222	2,085	1,931	2,159	895	9,853

Note: The number of centenarians at death during two adjacent waves includes those whose ages were in 90s in a previous wave

sampled provinces: Guangdong, Jiangsu, Fujian, Zhejiang, Shandong, Shanghai, Beijing, and Guangxi (mostly eastern coastal provinces). Of 4,478 dyadic pairs of data, there are 440 pairs for centenarians and their adult children in these eight provinces. Unlike the dyadic pairs of dataset in the longevity areas which deals with familial transmission of longevity, this dyadic dataset focused on the family dynamics of adult children and their intergenerational transferring. One follow-up survey for these 4,478 adult children was conducted in the 2005 wave. Such a study design is rare and valuable, as these dyadic datasets are particularly useful for studying familial factors that are associated with healthy aging.

Deceased Centenarian Interviewees Between Surveys

One unique feature of the CLHLS is the relatively comprehensive information collection on the extent of disability and suffering before dying of each centenarian (also of each respondent of other age groups) who died between two adjacent waves. The information was retrospectively collected from the next-of-kin or the primary caregiver of those deceased centenarians as well as other died respondent. The information includes dates and causes of death, and health and healthcare conditions from the last interview to the time of death, such as chronic diseases, activities of daily living (ADLs), number of hospitalizations, whether the centenarian had been bedridden, and whether the subject had been able to obtain adequate medical treatment when he/she was sick. Data on how many days before death the elder did not go outside and how many days before death the elder spent more time in bed than out of bed were collected as well. Information on socioeconomic and demographic characteristics, such as marital status, family structure, caregivers, financial situation, and living arrangement before death, as well as the caregiving costs within 1 month before the death were also collected.

Table 2 presents the number of the decreased centenarians between two adjacent waves from 1998 to 2014 in the CLHLS, which was 9,853 centenarians with 2,159 males and 7,694 females, for whom the data in the 2 years prior to death have been collected.

DNA Samples and Home-Based Health Examinations

The CLHLS collected DNA samples from 4,849 centenarians in addition to 5,190 nonagenarians, 5,274 octogenarians, 4,770 aged 65–79, and 4,609 aged 40–64. Health exams for a total of 2,035, 2,862, and 2,651 participants in the longevity areas were performed in 2008/09, 2011/12, and 2014, respectively, by local certified doctors and nurses who are affiliated with the China Center for Disease Control and Prevention (CDC) as contracted for this project. The medical personnel used standard instruments to check heart, lungs, breast, waist, lymph, limbs, and thyroid of the participants. They also wrote down impressions and symptoms of disorder if any, and furthermore enquired about the participants' family disease history and current medications.

In sum, the large population-based sample size, the focus on healthy longevity (rather than on a specific disease or disorder), the simultaneous consideration of various risk factors, and the use of analytical strategies based on demographic concepts make the CLHLS as an innovative project of demographic data collection and research (Zeng 2012).

Psychological Traits of Chinese Centenarians

Variables of Psychological Traits

In addition to the internationally standardized mini-mental status examination (MMSE) of cognitive function tests, the CLHLS contains seven variables relevant to psychological traits: (1) Do you look on the bright side of things? (being optimistic) (2) Do you keep things neat and clean? (3) Can you make your own decisions concerning your personal affairs? (self-determination) (4) Do you feel as happy as when you were young? (5) Do you feel fearful or anxious? (6) Do you feel lonely and isolated? (7) Do you feel useless? Each question above has six response options: always, often, sometimes, seldom, never, and unable to answer; proxy responses were not allowed. The first four questions reflect positive affect of psychological traits, while the latter three questions refer to the negative affect.

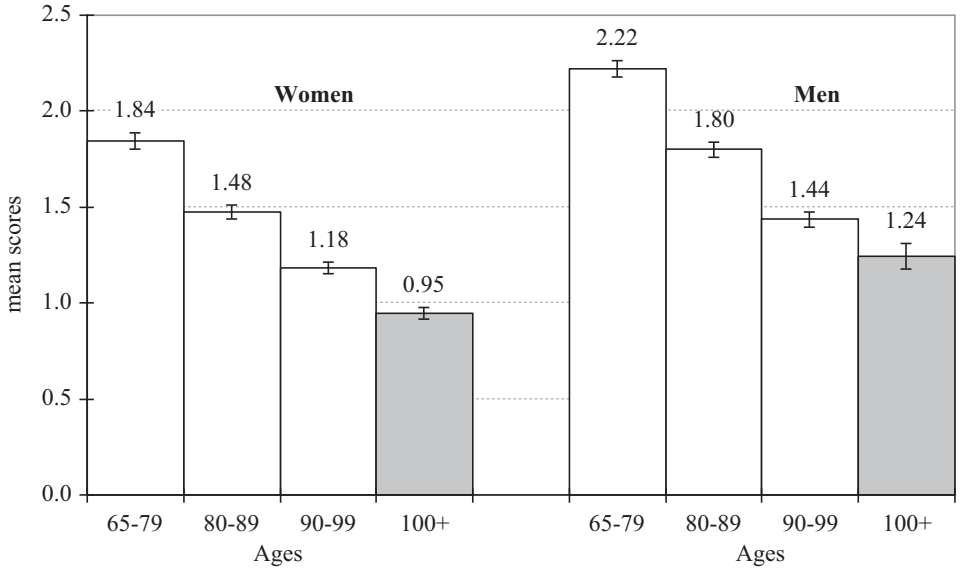
These questions are mainly derived from the Positive Affect and Negative Affect schedule (PANAS) scale and could also be considered a short version of a recently developed Scale of Positive and Negative Experience (SPANE). Both PANAS and SPANE scales mainly focus on the general adult population (see Diener and Biswas-Diener 2009). Different from the SPANE and PANAS scales, psychological traits questions in the CLHLS contain an option "unable to answer" for each question, which aims to accounting for the possibility that some oldest-olds may not be able to answer the question due to, for example, various health problems or difficulties in making up their minds. Based on the CLHLS data from the 1998 wave to the 2011/12 wave, this has been well justified by the fact that about 75% of the oldest-old respondents who were unable to answer these questions were due to health problems (this proportion was about 95% among centenarians who were unable to answer).

In order to better quantify the contribution of these psychological traits to exceptional longevity, these seven variables were dichotomized (coding 1 for answering "always" and 0 otherwise for positive affect called as "always positive affect", whereas coding 1 for answering "never" and 0 otherwise for negative affect called as "never negative affect") and then generated an index of always positive and never negative affect (abbreviated as APNNA) by summing these seven dummies, which ranges from 0 to 7. Because the wording of psychological traits questions in the 1998 wave is slightly different from that of the other waves and because the 2014 wave is not publicly available yet, in this section the focus of analyses of psychological trait of Chinese centenarians was on the waves from 2000 to 2011/12.

Positive and Negative Affect in Centenarians

Figure 2 shows that there was a clear decreasing trend with age in the score of the APNNA index. The overall mean scores of the index in centenarians were significantly lower than those in other age groups (Fig. 2). However, when demographics (age, urban–rural residence), socioeconomic status (education, primary lifetime occupation, economic independence), family and social support (marital status, coresidence with children), health practice (smoking, alcoholic intake, exercising), and health condition (ADLs, instrumental ADLs, cognitive function) were controlled, the pattern was reversed (results not shown). That is, centenarians had the highest mean scores of the APNNA, followed by nonagenarians and octogenarians, whereas the elders aged 65–79 had the lowest mean score. The difference between centenarians and older adults aged 65–79 was significant ($p < 0.01$) for males but not for females.

Table 3 reveals that with few exceptions (e.g., self-determination (column 3) and loneliness

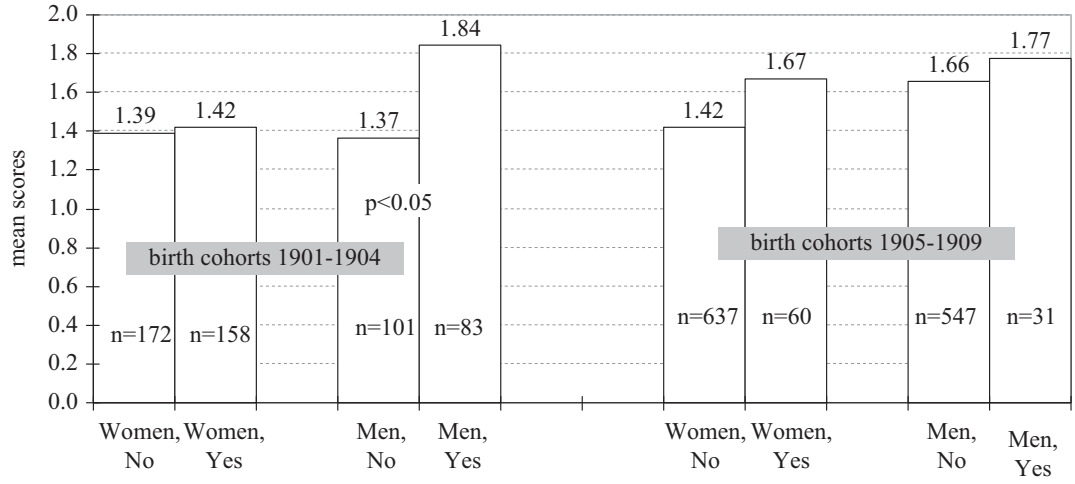


Chinese Longitudinal Healthy Longevity Study, Fig. 2 Mean scores of the APNNA index and their 95% confidence intervals for centenarians by sex in comparison with other ages, CLHLS 2002–2011/12. Note: The score of the APNNA index ranges from 0 to 7, which includes four always positive affect variables and three never negative affect variables

Chinese Longitudinal Healthy Longevity Study, Table 3 Percentage distribution of always positive affect and never negative affect among centenarians by sex in comparison with other age groups, CLHLS 2000–2011/12

	Always positive affect (%)				Never negative affect (%)		
	1	2	3	4	5	6	7
Men							
Ages 100+	11.3	8.1	20.6	18.6	30.1	25.2	14.1
Ages 90–99	10.7	9.0	27.3	20.2	32.9	30.2	14.6
Ages 80–89	11.8	10.6	37.4	22.8	38.8	38.2	16.9
Ages 65–79	15.4	12.1	49.6	29.3	43.9	46.7	23.9
Women							
Ages 100+	8.2	9.8	13.6	15.7	21.6	19.7	8.1
Ages 90–99	8.5	11.6	19.8	17.8	28.2	25.4	11.1
Ages 80–89	8.9	14.0	28.8	21.4	31.3	31.0	13.2
Ages 65–79	11.1	15.1	38.7	26.5	35.1	39.3	19.7
Both sexes							
Ages 100+	9.0	9.4	15.2	16.4	23.6	21.0	9.5
Ages 90–99	9.2	10.8	22.2	18.5	29.7	26.9	12.2
Ages 80–89	10.1	12.6	32.4	22.0	34.4	34.0	14.7
Ages 65–79	13.2	13.6	44.1	27.9	39.5	43.0	21.8

Note: (1) 1, being optimistic; 2, keeping things clean and neat; 3, self-determination; 4, as happy as when you were young; 5, feeling fearful or anxious; 6, feeling lonely; and 7, feeling useless. Please refer to definitions for positive affect and negative affect in section "Variables of Psychological Traits." (2) Percentages for positive affect refer to "always," while percentages for negative affect refer to "never."



Chinese Longitudinal Healthy Longevity Study, Fig. 3 Mean scores of the APNNA index by birth cohort, sex, and whether the respondents interviewed in 2000 who survived to age 100 (as indicated by yes for survival to age 100 and no for those who deceased before age 100) from 2000 to 2011/12. Note: (1) The score of the APNNA index ranges from 0 to 7, which includes four always positive affect variables and three never negative affect variables. (2) n, sample size. (3) Only the results from birth cohorts 1901–1904 were significant

Chinese Longitudinal Healthy Longevity Study, Table 4 Relative mortality hazards of the APNNA index of centenarians in comparison with other age groups, CLHLS 2000–2011/12

	Model I	Model II	Model III	Model IV
Ages 100+	0.95***	0.95***	0.96***	0.98**
Ages 90–99	0.92***	0.92***	0.93***	0.97***
Ages 80–89	0.89***	0.89***	0.90***	0.95***
Ages 65–79	0.84***	0.84***	0.85***	0.90***

Note: (1) Please refer to section "Variables of Psychological Traits" for definition of the APNNA index. (2) The results are almost identical for men and women across age groups and models and thus only results for both sexes are presented. (3) Model I controlled for demographic factors (singe-year of age, sex, urban/rural residence, ethnicity, marital status, and coresidence with children). Model II further controlled for socioeconomic factors (education, primary lifetime occupation, and economic independence). Model III additionally controlled for health practice (smoking, alcoholic taking, and doing regular exercise). Model IV added baseline health condition (function in activities of daily living (*ADL*), cognitive function, and chronic disease conditions) in Model III. All variables in the models were considered as time-varying covariates whenever possible. (4) The sample sizes are 8,036 for centenarians, 10,872 for nonagenarians, 11,593 for octogenarians, and 10,490 for septuagenarians and sexagenarians. Those who were lost to follow-up were excluded from the analyses (with 5,281 females and 3,746 males). (5) *p < 0.05, **p < 0.01, ***p < 0.001

(column 6)), the difference in percentage was not large for both male and female centenarians in comparison with their younger counterparts. Furthermore, Fig. 3 reveals that centenarians were likely more psychologically robust in terms of APNNA than their same cohort peers who died between ages 90 and 99. These results suggest that presence of positive affect and absence of negative affect among centenarians may have contributed to their exceptional longevity.

Psychological Traits and Healthy Longevity

Table 4 shows that each additional increase in the APNNA index (or each additional positive possession out of the seven psychological traits) among centenarians reduced mortality risk by 4–5% (Model I to Model III). Even after controlling for baseline health (function in activities of daily living, cognitive function, and chronic conditions), such a protective effect of psychological traits was still significant, although the effective

Chinese Longitudinal Healthy Longevity Study, Table 5 Odds ratios of onsets of ADL disability and cognitive impairment for the APNNA index for centenarians by sex in comparison with other age groups, CLHLS 2000–2011/12

	ADL disabled at follow-up			Cognitive impaired at follow-up		
	Model I	Model II	Model III	Model I	Model II	Model III
Men						
Ages 100+	0.95	0.94	0.93	0.81**	0.82*	0.85+
Ages 90–99	0.93**	0.92***	0.92***	0.86***	0.86***	0.89***
Ages 80–89	0.91***	0.90***	0.90***	0.87***	0.89***	0.89***
Ages 65–79	0.84***	0.83***	0.83***	0.87**	0.89*	0.89*
Women						
Ages 100+	0.94*	0.94*	0.94*	0.89**	0.89**	0.89**
Ages 90–99	0.93***	0.93***	0.93***	0.91***	0.91***	0.91**
Ages 80–89	0.96*	0.96*	0.96*	0.89***	0.89***	0.90***
Ages 65–79	0.89***	0.89***	0.89***	0.87**	0.88**	0.89**
Both sexes						
Ages 100+	0.94**	0.94**	0.94*	0.87***	0.88***	0.88**
Ages 90–99	0.93***	0.92***	0.92***	0.89***	0.89***	0.90***
Ages 80–89	0.94***	0.93***	0.93***	0.88***	0.89***	0.90***
Ages 65–79	0.87***	0.86***	0.87***	0.87***	0.89***	0.89***

(1) Please refer to section "Variables of Psychological Traits" for the definition of the APNNA index. (2) Model I controlled for demographic factors (singe-year of age, sex, urban/rural residence, ethnicity, marital status, and coresidence with children). Model II further controlled for socioeconomic factors (education, primary lifetime occupation, and economic independence). Model III additionally controlled for health practice (smoking, alcoholic taking, and doing regular exercise). All variables in the models were considered as time-varying whenever possible. (3) For onset of disability in activities of daily living (*ADL*) models, only those who were ADL not disabled were at a given wave were included. The sizes of the female sample are 1,327 for centenarians, 2,714 for nonagenarians, 4,387 for octogenarians, and 4,872 for septuagenarians and sexagenarians model, whereas the sizes of the male sample are 352 for centenarians, 2,065 for nonagenarians, 4,351 for octogenarians, and 5,144 for septuagenarians and sexagenarians. For onset of cognitive impairment models, only those who were cognitively unimpaired were included in a given wave. The size of the female sample are 951 for centenarians, 1,986 for nonagenarians, 3,464 for octogenarians, and 3,411 for septuagenarians and sexagenarians model, whereas the sizes of the male sample are 301 for centenarians, 1,587 for nonagenarians, 3,431 for octogenarians, and 3,552 for septuagenarians and sexagenarians. The cognitive impairment is measured by mini-mental status examination with the cut-off point at a score of 18. In all models of the both panels, those who were lost to follow-up were excluded from the analyses. (4) *p < 0.05, **p < 0.01, ***p < 0.001

size was reduced to 2% (Model IV). The protective effect of psychological traits on mortality was larger in other ages: the younger the age group, the greater the protective effect of psychological traits. The results further reveal (not shown) that the protective effect of psychological traits on mortality were the same for both males and females and for both centenarians and other age groups.

The left panel in Table 5 further reveals that each additional increase in the APNNA index among female centenarians reduced the odds of onset of ADL disability by 6%. Such a reduction was similar to those in female nonagenarians and octogenarians and persists even after controlling for a rich set of covariates. However, such a reduction was not significant in male centenarians, possibly due to the smaller sample size. The reduction in other, younger age groups of males was significant and mostly larger than in the corresponding age groups of females. The right panel of Table 5 shows that the reduction in onset of cognitive impairment due to one additional point of the APNNA index was about 11% in female centenarians and did not change in presence of covariates. Females in other age groups had a similar pattern. In contrast, for male centenarians, such a reduction was slightly larger than in female centenarians and other age groups of males, although the significance was weakened when covariates were added.

Concluding Remarks

Using data from more than 10,000 centenarians of mainland China, the largest centenarian sample in the contemporary world, this entry presents a summarized introduction of the CLHLS and a brief description on psychological traits of centenarians in comparison with other older adults. We find that centenarians were more psychologically robust than noncentenarian peers of the same birth cohorts when they were all in ages of 90s and further report a significant association between possession of positive psychological traits and mortality and health worsening in centenarians. These findings suggest that centenarians are better able to handle stress, depression, or other unfavorable condition than their cohort peers, which is in line with many other centenarian studies and that maintaining a good psychological well-being is an important pathway to reach age 100 (e.g., Gondo et al. 2006; Jopp and Rott 2006; Perls 2006; Poon et al. 2010).

The findings of the present study are also similar to one recent study by Zeng and Shen (2010) that applied a concept of psychological resilience to Chinese centenarians based on questions (1), (3), (5), (6), and (7) in section "Variables of Psychological Traits" and two other variables in the CLHLS (to whom the respondent usually talks most frequently in daily life? and who does the respondent ask first for help when having problems/difficulties?). That study reports that centenarians are more psychologically resilient than elders of young ages and that psychological resilience positively contributes to exceptional longevity. Indeed, when further accounting for the response option "unable to answer" for these questions, one recent study found that there are still about 6–9% of centenarians whose psychological well-being is as good as those elders aged 65–79 years (Gu and Feng 2016).

Recently, there is a call among scholars in studies of exceptional longevity, emphasizing the importance of both quantitative and qualitative methodologies, replication of mechanisms, interdisciplinary and systems perspectives, and generalizability of results (Poon and Cheung 2012). Among these new directions of the future studies in centenarians, scholars particularly concern about instable results from small sample sizes (Willcox et al. 2006). Moreover, more studies are encouraged to examine the association between psychosocial traits and longevity, relative to biologically based studies (Poon and Perls 2007). This entry uses the large-sized sample of the CLHLS to investigate how psychological traits are associated with longevity and subsequent health condition, which echoes the new initiatives above and adds new evidence highlighting the importance of psychological factors to exceptional longevity.

However, due to space limit, details about the role of other psychosocial factors to longevity were not discussed, although many of them were already included in the models as covariates. The interactions between psychological traits, environmental factors, and genetics in determining longevity were also not investigated. As Poon and Cheung (2012) pointed out, to eventually unearth the secrets of longevity, there is still much unexplored on what, how, and why some individuals survive to age 100 with good health. By the end of 2015, only a very small portion of studies focuses on centenarians out of 450 peer-reviewed publications in English, Chinese, and 76 Ph.D. and M.A. theses/dissertations that used the CLHLS data since 1998.

One limitation of the present study in analyzing centenarians' psychological traits and its association between subsequent survival is the way of coding of those who were not able to answer the psychological trait questions. In the case of always positive affect, they were classified into the group of those who did not always experience positive affect. In the case of never negative affect, they were classified into the group of those who never experienced negative affect. Such a coding system may somewhat underestimate the psychological traits in centenarians. As a consequence, the association between good psychological traits and subsequent survival among the centenarians may be somewhat biased. Nevertheless, as the majority of these respondents were in a very poor health condition, such biases would be only mild. Some researchers adopted an alternative approach by excluding those who were unable to answer the questions in the analyses (e.g., Zeng and Shen 2010). However, since

those who were not able to answer the questions were not missing at complete random, the exclusion approach may overestimate centenarians' good psychological traits to some extent. More research on this issue is clearly warranted.

In sum, more studies on centenarians are warranted in this field, and the CLHLS has been becoming an important resource for scholars in this field with a large and representative sample size of respondents at extremely old ages in a longitudinal context plus the voluminous psychosocial and biological data.

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Cross-References

▶ Health in Centenarians
▶ Well-being in Centenarians
▶ Resilience and Aging

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Clinical Issues in Working with Older Adults

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Synonyms

Rapport; Therapeutic relation

Definition

"Clinical issues" are the aspects that should be taken into consideration when performing clinical interventions with older adults. The term "clinical" is here used primarily for those professionals who work in behavioral health (i.e., nonsurgical, nonmedication), both at an assessments and intervention level, with older individuals.

Background

> Don't tell us, show us (Moreno's Psychodrama Dictum)

The importance of giving attention to clinical issues in working with older adults has been well emphasized in the last years in emblematic articles (Knight 2004) and in psychological association professional practice guidelines. A representative example is the *Guidelines for Psychological Practice With Older Adults* originally developed by the Division 12, Section II (Society of Clinical Geropsychology) and Division 20 (Adult Development and Aging) Interdivisional Task Force on Practice in Clinical Geropsychology and approved as an American Psychological Association (APA) policy in August 2003. Their main aim is to assist psychologists and gerontology practitioners in evaluating their own readiness for working with older adults, and in seeking and using appropriate education, training, and supervision to increase their knowledge, skills, and experience thought to be relevant for this domain of practice. The specific goals of these professional practice guidelines are to provide practitioners with (a) a frame of reference for engaging in clinical work with older adults and (b) basic information and further references in the areas of attitudes, general aspects of aging, clinical issues, assessment, intervention, consultation, professional issues, and continuing education and training relative to work with this age-group.

The APA Guidelines for Psychological Practice With Older Adults are organized into six sections; the third concerns "Clinical Issues" and comprises three specific guidelines: The first is Guideline 7, which states that "Psychologists strive to be familiar with current knowledge about cognitive changes in older adults." According to this guideline, from a clinical perspective, one of the greatest challenges facing practitioners who work with older people is acknowledging when to attribute subtle observed cognitive changes to an underlying neurodegenerative condition versus normal developmental changes. Multiple moderating and mediating factors, like lifestyle, contribute to age-associated cognitive changes, maintenance, or decline within and across individuals.

Guideline 8 states that "Psychologists strive to understand the functional capacity of older adults in the social and physical environment." Here it is strained that the majority of older adults maintain high levels of functioning, suggesting that factors

related to health, lifestyle, and the match between functional abilities and environmental demands more powerfully determine performance than does age (Baltes and Smith 2008). The degree to which the older individual retains "everyday competence" (i.e., the ability to function independently vs. rely on others for basic self-care) determines the need for support in the living environment. In adding aids in the older adult's living environment, it is important to balance with the person's need for autonomy and active and safe quality of life. Changes that have impact in functional capacity may immediately lead to modifications in social roles and may place emotional strain in the individual and informal carers. Older people must deal not only with the personal implications of these losses but also with the challenges of finding meaning in a more limited lifestyle. For some older adults, spirituality and other belief systems may be particularly important in dealing with these losses (Ribeiro and Araújo 2013).

Guideline 9 states that "Psychologists strive to be knowledgeable about psychopathology within the aging population and savvy of the prevalence and nature of that psychopathology when providing services to older adults." This last guideline stresses that although the majority of older adults have good mental health, it should be taken in consideration that approximately 20–22% of older adults may meet criteria for some form of mental disorder, including dementia. For those living in a long-term care setting during their later years, estimates are much higher, with almost 80% suffering from some form of mental disorder. Older adults may therefore present a broad array of psychological issues for clinical attention. These issues include the majority of the problems that affect younger adults and those experienced due to late life events and tasks. These represent challenges that are specific to late life and include developmental and maturational issues and social demands. As examples of developmental issues we can mention the decrease of sensory acuity and increased likelihood of losing significant people and, as a social demand, retirement.

Knight and Poon (2008) proposed CALTAP (Adult Lifespan Contextual Theory for Adapting Psychotherapy) with the aim of providing a metatheoretical framework to guide an integrated psychotherapeutic approach with the elderly. In this theory the author advocates that an intervention with older people should take into consideration the positive (i.e., cognitive and emotional complexity) and negative (i.e., physical decline) factors of the maturation process of the client, as well as specific sociocultural environments (i.e., values and beliefs), the surrounding context (i.e., living in an institution vs. community), the cohort effect (i.e., influences like education that affect the members of a particular generation), and the challenges of old age (i.e., chronic disease). Together, these contextual and individual factors contribute and influence the problem presented by the older client and his/her expectations and degree of involvement in psychotherapy, as well as to the options of intervention appropriate to a particular case. It is therefore crucial to recognize the intricate interaction between the older adult and his/her environment.

Therapeutic Relationship with Older Clients

To rightly respond to functional, personal, social, cognitive, and psychopathological challenges of older clients it is indispensable to establish a meaningful therapeutic relationship. For the therapeutic process with older adults to successfully unwind theoretical and technical expertise are also necessary. However, independently on the orientation of the intervention, the therapist must have the ability to establish a deep connection with the client – the therapeutic relationship (Fagan and Shepherd 1970; Duffy 1999; Haley 1999; Zarit and Knight 1996). Regardless of the elderly intervention context, the communication skills of the therapist are one essential ingredient to the success of the intervention (Woolhead et al. 2006). Listening and responding accordingly is always important, requiring more attention when the older person has hearing difficulties. Speaking in a simple, direct, clear, and objective way, taking into account the nonverbal communication and without using technical language, is essential. It is also important to be present in the relationship,

"not paddling against the current," with the therapist open to the flow of experience, recognizing their limits as professionals and with attention to their own prejudices.

Accordingly, geropsychologists must work to actively reduce ageism. Ageism as a pervasive discrimination against older adults is widespread. The nondominant group (older adults in this case) is viewed as homogeneous and portrayed as having a variety of negative characteristics. People in old age are viewed stereotypically as alike; alone and lonely; sick, frail, and dependent; depressed; rigid; and unable to cope (Frazer et al. 2011). This pervasive view portrays all older adults in a negative light, ignoring the incredible heterogeneity of aging and old age and the strengths and positive attributes of older adults. Those geropsychologists working in clinical settings must be particularly cognizant of their own ageist thoughts and beliefs, and acknowledge its impact and try to prevent and minimize them within the therapeutic relationship. Rogers (1951) formulated this issue in a fundamental way: Can the therapist meet with this other individual as a person in the process "of being," or will he stay tied to his own past or the client's past? If the therapist relates to the older client as old, rigid, limited, immature, ignorant, unstable, or sick, each of these concepts will limit the relationship. Confirm means accepting the potential totality of the other. If the therapist accepts the other as something fixed, as "diagnosed and classified," as shaped by the past, he will be doing his part to confirm this restrictive hypothesis. On the other hand, if he accepts the client as in process of "becoming," he will be doing what he can to confirm or make real the potential of the individual.

Instead of giving unconditional positive regard, most of us give "value conditions," depending on the satisfaction of our needs and expectations. When we care and we have no qualifications or conditions, there is the "unconditional positive regard." Rogers (1951) argued that this quality of absoluteness, along with congruence and empathy, would be essential to foster a more confident human being capable of enjoying life more fully. It is then the therapists' responsibility to create these favorable conditions for the flourishing of the older client. In this sense, the quality of the relationship has a major weight (though, certainly, other variables such as the therapeutic setting, client motivation, theoretical soundness, and the training and experience of the therapist are also important). By "quality of the relationship" it is meant the ability to establish good contact, i.e., the ability to listen to the other (literal and latent meanings), to produce a real action that can enhance change in the other, and to detect central aspects that can be worked through with the client with the aim of fostering well-being. The therapist's attitude is based on empathy, willingness to help, and mostly on accepting the patient's experience without judgment.

Fagan and Shepherd (1970) in a classic text on Gestalt Therapy refer to five aspects that the therapist should take into account for the clinical relationship to be effective: (1) accurate assessment and diagnosis; (2) having control of the therapeutic session (i.e., it is the therapist who wields the session for the client's benefit); (3) solid theoretical and practical knowledge; (4) humanity and compassion toward the client; and (5) commitment and openness to continue learning. To make a therapeutic intervention involves the therapist as a whole person and constitutes therefore a challenge. Nevertheless, it is a condition for fostering the well-being of the client and will enable the older client to build self-support skills and a more realistic and adaptive view of life.

Working with Older Adults

The therapist working with older adults should be able to work "outside the box," i.e., be more flexible concerning place, duration, and frequency of sessions and to have the ability to take on multiple roles (Haley 1999) in order to respond to customers that often have multiple physical and psychosocial problems and diverse and complex needs. Before starting a clinical intervention, the geropsychologist should pay attention to the entire therapeutic setting – i.e., all the details concerning the environment, the physical layout

of the room, and the prevention of possible interruptions (Frazer et al. 2011). If these aspects are attained and an environment where there is trust, openness, and acceptance is provided, patients will express themselves without fear of censorship and engage actively in the therapeutic process. This is why it is important to identify resistances, make them explicit, and not pretend they do not exist. The resistance decreases when people take responsibility for how the interaction functions (Egan 1986).

Depending on the case and on the theoretical framework of the therapist during the therapeutic process several techniques (e.g., challenging, clarification, breathing and body awareness techniques) may be used to explore the material provided in favor of the natural course of the session and, therefore, consolidate and increase awareness and individual power and responsibility, even when the older client is very frail and this seems nearly impossible. Techniques are means not ends and should not divert the therapist from the creative and unique relationship with the older client and from the attention required to the emerging themes and needs in a session. In this sense, there are no "recipes" that the therapist should follow but tools and flexible guidelines that can be used. Moreover, the use of techniques can often mask the quality of a relationship.

Change, support, and problem solving are not made only on the basis of technical aids but come mainly from the relationship between the therapist and the patient. It is the quality of the relationship that will dictate (adduced to the sensitivity of the therapist) the time to use certain techniques (e.g., role play). Accordingly, the personal qualities and advocated values of the therapist are the most important and powerful tools regarding the ease of the therapeutic process. In this sense, the therapist should trust in his/her intuition and be authentic, since the techniques are received in the light of the attitudes of the facilitators that employ them (Egan 1986; Corey et al. 1983; Corey 1990). In short, the techniques are valuable and important but should be used with caution (Yalom 2005; Corey et al. 1983). If the therapist has a solid background and supervised experience, it is less likely to abusively use the techniques (Corey et al. 1983). Those therapists working with older people also benefit in being more flexible in their roles (i.e., feeding the patient, helping to call for other people, fostering other relationships) and more active and participatory (i.e., speak about themselves, give examples) (Knight 2004).

The conceptual framework and the therapist's personality often dictate the choice of which technique to use, but this is also influenced by the link established with the client. There is always a huge variability of possibilities (i.e., the use of animals for people with dementia (Crowley-Robinson et al. 1996)), depending on age, purpose, and level of functioning of the patient but also on the expertise and creativity of the therapist. However, the therapist should recurrently question the appropriateness of a certain technique. When it is possible and meaningful, it is important to ask the client their willingness to participate and to acknowledge any possible resistance. The clinical/therapeutic setting is a field for authentic human interaction and learning. In this sense, the techniques should not be seen as tricks but tools to be used in support of patient needs.

The therapist's countertransference analysis ("how I feel with what the client said/did? What does it mean to me?") is crucial in a relationship that is often regulated by unusual changes on the therapeutic context. For instance, in many intervention cases the older client is bedridden (Altschuler and Katz 1999; Smith 2006). However, the transference and countertransference, which depend on the previous relationships of the client and of the therapist, may lead to therapeutic impasse and resistance to treatment (Knight 2004). Taboos (e.g., certain themes should not be spoken with older or younger people) and the complexity of the institutional contexts (e.g., the clinician can have different roles in the same institution; different professionals dealing with the client make clinical decisions more complex) can make the management of this dynamic an enormous challenge. In this sense, the therapist has the responsibility to examine personal prejudices in relation to age, disease and gender, and any beliefs or conflicts with their own parents and grandparents that he may bring as relational

patterns to the therapeutic relation. If this does not happen, the therapist may be limiting the possibilities of helping clients to develop. In general, the therapist is blocked where he/she often has difficulties as a person (Perls 1976).

When clients are considered experts in their own lives, they feel mobilized and encouraged to use their resources toward their goals (Smith 2006) and to be active and interventional agents in their own change process (Smith 2006). This perspective about patients as being a repository of resources, rather than being seen as a confluence of problems, favors the therapeutic alliance. To promote the quality of life of the elderly – in face of the complex amount of problems, difficulties, diversity of personality profiles, and the multiple needs and desires people often have to deal with in the last phase of their life cycle – the availability of a wide range of therapeutic possibilities is crucial. Numerous psychological therapies have been demonstrating their effectiveness in supporting older people. Attention to issues concerning education, training, and supervision are therefore core aspects in providing all the technical capacity to the therapist and in helping to understand each person within a biopsychosocial framework. It is also important to acknowledge that all geriatric care occurs within a team context (see the "► Interprofessional Care" entry for this purpose) and that integrated care is the preferable model. Clinical geropsychologists should additionally know how to use multiple methods of assessment, including brief assessment tools.

The focus on the relationship, the "meeting" that the encounter between two persons (therapist and client/group) allows, updates some of the principles that have been repeatedly confirmed by research and due to the vicissitudes of the context or of daily life therapists tend to forget. Such principles allow human flourishing and can be summarized in the importance of humanization of health services and interventions, the imperative need of adequate training and supervision in interventions with older patients, the importance of empowering and giving personal responsibility to the individual, and the crucial role of both creativity and dignity interventions. The answer to the wish to grow in all stages and contexts of life can be the authentic creative encounter that the therapeutic relationship enables and therefore should be promoted.

Cross-References

- ► Acceptance and Commitment Therapy
- ► Age Discrimination
- ► Interprofessional Care
- ► Training Psychologists in Aging

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Cognition

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Synonyms

Alzheimer's disease; Cognitive aging; Cognitive impairment; Dementia

Definition

This entry reviews the literature on the prevalence of dementia among centenarians, the cognitive function in centenarians without dementia, as well as risks and protective factors of cognitive function in very late life. Dementia prevalence among centenarians might be substantially higher than that among younger older individuals; however, the exact prevalence rate among centenarians is unclear. First, we examine the methodological problems to be considered in future studies. Large representative data sets and similar protocols across studies are needed to clarify the inconsistent results. Second, we discuss the characteristics of domain-specific cognitive functions in centenarians without dementia. In the future, an important goal is to further clarify the nature of cognitive changes among centenarians. Finally, we summarize risks and protective factors that might influence cognitive decline or dementia in centenarians. Findings from genetic, biomedical, and psychosocial perspectives can help clarify the mechanism of cognitive aging throughout the life span.

Taking into account the changing demographic structure in aging societies, the proportion of individuals aged 75 years and over is expected to increase substantially. As a consequence, the number of individuals presenting cognitive decline with and without dementia is also expected to increase. The World Health Organization and Alzheimer's Disease International (2012) reported an overview of the epidemiology of dementia and policy and plans in the world. It is estimated that the number of people aged 60 years and over with dementia worldwide doubles every 20 years, from 35.6 million in 2010 to 65.7 million in 2030 and 115.4 million in 2050 (World Health Organization and Alzheimer's Disease 2012). Thus, coping with dementia is a common challenge in aging societies. Dementia has received attention as one of the key health threats and social issues in the twenty-first century.

One of the major predictors of dementia is age. The age-specific prevalence of dementia nearly doubles every 5 years from 60 to 95 years old (Hofman et al. 1991). The Leiden 85+ study (Heeren et al. 1991) found that the prevalence of dementia was 15.2% in the 85–89-year-old age group, 32.5% in the 90–94-year-old age group, and 41.2% in the $\geq$95-year-old age group. Although the total number in the $\geq$95-year-old age group in the study was only 14, these findings suggested that the probability of a dementia diagnosis seriously increases in very old age.

In this entry, we focus on two topics relating to cognitive function among centenarians. Centenarian studies could provide information on the characteristics and degree of aging-related cognitive changes until the final stage of human life. At first, we will give an overview of dementia prevalence in centenarians; however, the exact

prevalence rate among centenarians is unclear. We will also state the methodological problems to be considered in future studies. Second, we will present the characteristics of domain-specific cognitive functions in centenarians, although there are few existing studies on this. Finally, we will summarize significant risk and protective factors that might influence cognitive decline or dementia in centenarians from genetic, biomedical, and psychosocial perspectives.

Prevalence of Dementia

Dementia prevalence among centenarians has been reported over the past 20 years in various countries. Three review papers on centenarians' dementia prevalence have been published (Calvert et al. 2006; Gondo and Poon 2007; Slavin et al. 2013). All three papers pointed out that dementia prevalence varies across studies, due to methodological problems. Based on the estimation of the age-specific prevalence of dementia (Hofman et al. 1991), prevalence among centenarians is assumed to range between 60% and 70%. Following reports of prevalence in previous reviews, we can roughly divide these findings into the following three categories: considerably lower than the estimated prevalence (e.g., less than 50%), almost within the estimated range (e.g., around 60%), and much higher than the estimated prevalence (e.g., more than 70%). Table 1 gives a detailed overview of 11 centenarian studies reporting on dementia prevalence. These studies showed that the dementia prevalence ranged from 33% to 100%, and the average prevalence was 62% (males; 48.5%, females; 66.1%). The study that presented the highest prevalence, the Dutch Centenarian Study (Blansjaar et al. 2000), included only 17 centenarians. On the other hand, the study with the lowest prevalence, the Finnish Centenarian Study (Sobel et al. 1995), excluded mild dementia. Except for one study, the Yamanashi prefecture study (Asada et al. 1996) showed only slightly more than 70%, and the other prevalence ranged from 50.7% to 67.6%. These results suggested that dementia prevalence among centenarians was very high, but there were dissociations in the prevalence across studies.

The varying prevalence of dementia across studies might indicate ethnic or cultural influences on the progression of dementia with aging. However, before we go on to discuss this issue, two essential problems need to be pointed out. One is related to methodology, and the other is gender differences. The methodological problems include sampling, definition of dementia, and assessment procedures in centenarian studies. Gender differences refer to the issue that the dementia prevalence in centenarian samples varies depending on the ratio of female and male centenarians.

A small sample size can lead to an overestimation or underestimation of results and yield inconsistent dementia prevalence among centenarians. Previous centenarian studies include sample size ranging from 17 to 304 (Table 1). Furthermore, there are often wide individual variations and possibilities of large amounts of missing data in cognitive tests on centenarians. A total number exceeding hundreds of participants might therefore be required for reliable statistical analyses and valid estimations (Calvert et al. 2006). In addition, researchers have to make an effort to obtain representative data and to carefully interpret results having a potential selection bias.

The definition of dementia is one of the fundamental problems in the comparison of results from different studies. Most studies have used standardized diagnosis criteria for dementia. However, these criteria emphasize different dimensions considered for evaluation, to enable identification of dementia. The third edition revised and fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R, DSM-IV) have often been used for the diagnosis of dementia. Pioggiosi et al. (2004) explored the variation in dementia prevalence among 34 nonagenarians and centenarians using four common diagnostic criteria. They found different prevalence rates applying these criteria to the same participants. The prevalence of dementia was 47.1% with the use of the DSM-III-R; 41.2% with the DSM-IV; 29.4% with the World Health Organization's International Classification of Disease, 10th revision (ICD-10); and

Cognition, Table 1 Prevalence of dementia in centenarian studies

Project name	Authors (publication year) countries	Subjects	Those who agreed (women: N, %)	Those who were tested (women: N, %)	Participated ratio (%)	Age range mean ± SD	Assessments	Cognitive status	Males	Females
Dutch Centenarian study	Blansjaar et al. (2000) The Netherlands	17 in three Dutch towns	17 (15, 88.2%) agreed, 2 females did not test	15 (13, 86.7%)	88.2	100–104 M = 101.2	CDR, Informant Questionnaire on Cognitive Decline in the Elderly, Amsterdam Dementia Screening Test, Clock Drawing, Explaining says	Dementia: 100% (15/15) CDR = 1: 20.0% (3/15) CDR = 2: 53.3% (8/15) CDR = 3: 26.7% (4/15)	Dementia: 100% (2/2) CDR = 1: 50% (1/2) CDR = 2: 50% (1/2)	Dementia: 100% (13/13) CDR = 1: 15.4% (2/13) CDR = 2: 53.8% (7/13) CDR = 3: 30.8% (4/13)
New England Centenarian Study	Silver et al. (2001) The United States	43 in Massachusetts state	36 (31, 86.1%) agreed, 2 females died before test	34 (29, 85.3%)	79.1	100–107	MMSE, CDR, DSM-IV, Mattis Dementia Rating Scale, Boston Naming Test, Trail-Making Test A & B, Clock Drawing, Drilled Word Span Test, Cowboy Story, Presidents since Franklin Delano Roosevelt, Spiers' Calculations, Geriatric Depression Scale, Telephone Interview for Cognitive Status, Test for Severe Impairment, Tactile Naming, Cognition and Health History, Psychiatry History	CDR = 0: 20.6% (7/34) CDR = 0.5: 11.8% (4/34) Dementia: 67.6% CDR = 1: 8.8% (3/34) CDR = 2: 29.4% (10/34) CDR = 3: 20.6% (7/34) CDR = 4: 2.9% (1/34) CDR = 5: 5.9% (2/34)	No gender data	No gender data
Yamanashi prefecture study	Asada et al. (1996) Japan	50 in Yamanashi prefecture	50 (39, 83.0%) agreed, 3 died before visit	47 (39, 83.0%)	94.0	100–109 M = 102	HDSR, DSM-III-R, NINCDS-ADRDA, ICD-10, physical examination, Barthel index, medical and psychiatric history, a family history, current health status, Hachinski Ischemic Scale score	Normal: 6.4% (3/47) Cognitive impairment without dementia: 23.4% (11/47) Dementia: 70.2% (33/47) Mild: 31.9% (15/47) Moderate: 23.4% (11/47) Severe: 14.9% (7/47)	No gender data	No gender data

(*continued*)

Cognition, Table 1 (continued)

Project name	Authors (publication year) countries	Subjects	Those who agreed (women: N, %)	Those who were tested (women: N, %)	Participated ratio (%)	Age range mean ± SD	Assessments	Cognitive status	Males	Females
Korean Centenarian Study	Choi et al. (2003) Korea	103 in Seoul, Kyungsang, Chunra, and Cheju; the mean age was 102.4 ± 2.6 years	89 (78, 87.6%)	89 (78, 87.6%)	86.4	100–115	CDR, physical and mental examination, laboratory tests	CDR 0: 6.7% (6/89) CDR 0.5: 31.5% (28/89) Dementia: 61.8% (55/89) CDR 1: 27.0% (24/89) CDR 2: 14.6% (13/89) CDR 3: 20.2% (18/89)	CDR 0: 18.2% (2/11) CDR 0.5: 36.4% (4/11) Dementia: 45.5% (5/11) CDR 1: 36.4% (4/11) CDR 2: 9.1% (1/11) CDR 3: 0% (0/11)	CDR 0: 5.1% (4/78) CDR 0.5: 30.8% (24/78) Dementia: 64.1% (50/78) CDR 1: 25.6% (20/78) CDR 2: 15.4% (12/78) CDR 3: 23.1% (18/78)
Heidelberg Centenarian Study	Kliegel and Skwinski (2004), Kliegel et al. (2004b) Germany	156 from 60 km around Heidelberg	91 agreed, 1 did not test	90 (81, 90.0%)	57.7	100 M = 100.2 ± 0.41	A shortened MMSE (21 points max.), GDS	No cognitive impairment 22% Very minor: 7% Minor: 12% Moderate: 10% Substantial: 21% Severe: 16% Very severe: 12%	No gender data	No gender data
Northern Italian Centenarian Study	Ravaglia et al. (1999) Italy	154 in Bologna and Ravenna	100, 1 woman died, 7 persons were out of the study setting	92 (56, 60.9%)	59.7	100–107 M = 101.8 ± 1.6	MMSE, CDR, DSM-IV, ICD-10, NINCDS-ADRDA	No dementia 20.7% (19/92) Cognitive impairment without dementia: 15.2% (14/92) Psychiatric diseases other than dementia: 2.2% (2/92) Dementia: 62.0% (57/92) CDR = 0.5: 6.5% (6/92) CDR = 1: 2.2% (2/92) CDR = 2: 7.6%	No dementia: 30.6% (11/36) Cognitive impairment without dementia: 19.4% (7/36) Psychiatric diseases other than dementia: 0% (0/36) Dementia: 50.0% (18/36) CDR = 0.5: 5.6% (2/36)	No dementia 14.3% (8/56) Cognitive impairment without dementia: 12.5% (7/56) Psychiatric diseases other than dementia: 3.6% (2/56) Dementia: 69.6% (39/56) CDR = 0.5: 7.1% (4/56) CDR = 1: 1.8% (1/56) CDR = 2: 7.1% (4/56)

								(7/92) CDR = 3: 17.4% (16/92) CDR = 4: 14.1% (13/92) CDR = 5: 14.1% (13/92)	CDR = 1: 2.8% (1/36) CDR = 2: 8.3% (3/36) CDR = 3: 19.4% (7/36) CDR = 4: 11.1% (4/36) CDR = 5: 2.8% (1/36)	CDR = 3: 16.1% (9/56) CDR = 4: 16.1% (9/56) CDR = 5: 21.4% (12/56)
Finnish Centenarian Study	Sobel et al. (1995) Finland	271 in Finland	185 were interviewed	179 (151, 84.4%) took blood sample	66.1	100+	Pfeiffer's Short Portable Mental Status Questionnaire, DSM-III-R	Normal: 44.1% (79/179) Cognitive decline/mild dementia 22.9% (41/179) Dementia: 33.0% (59/179)	Normal: 57.1% (16/28) Cognitive decline/mild dementia: 25.0% (7/28) Dementia: 17.9% (5/28)	Normal: 41.7% (63/151) Cognitive decline/ mild dementia: 22.5% (34/151) Dementia: 35.8% (54/151)
Longitudinal Study of Danish Centenarians	Andersen-Ranberg et al. (2001) Denmark	276 in Denmark	207 (162, 78.3%)	207 (162, 78.3%)	75.0	100	ICD-10, CDR, MMSE, medical records, physical examination, ADLs, IADLs, proxy interview	CDR = 0: 25.1% (52/207) Probably no: 11.1% (23/207) CDR = 0.5: 7.7% (16/207) Dementia: 50.7% (105/207) CDR = 1: 16.9% (35/207) CDR = 2: 20.3% (42/207) CDR = 3: 13.5% (28/207) Not classified:5.3% (11/207)	No gender data	No gender data

(*continued*)

Cognition, Table 1 (continued)

Project name	Authors (publication year) countries	Subjects	Those who agreed (women: N, %)	Those who were tested (women: N, %)	Participated ratio (%)	Age range mean ± SD	Assessments	Cognitive status	Males	Females
Tokyo Centenarian Survey	Homma et al. (1992) Japan	509 in Tokyo	509 (379, 74.5%)	218 (155, 71.1%)	42.8	100+ M = 100.6 ± 1.3	HDS, CDR, family history, medical record, physical examination, ADLs	CDR = 0: 15.1% (33/218) CDR = 0.5: 16.5% (36/218) Dementia: 62.8% (137/218) CDR = 1: 21.6% (47/218) CDR = 2: 21.1% (46/218) CDR = 3: 20.2% (44/218) Unknown:5.5% (12/218)	CDR = 0: 31.7% (20/63) CDR = 0.5: 14.3% (9/63) Dementia: 42.9% (27/63) CDR = 1: 23.8% (15/63) CDR = 2: 15.9% (10/63) CDR = 3: 3.2% (2/63) Unknown: 11.1% (7/63)	CDR = 0: 8.4% (13/155) CDR = 0.5: 17.4% (27/155) Dementia: 71.0% (110/255) CDR = 1: 20.6% (32/155) CDR = 2: 23.2% (36/155) CDR = 3: 27.1% (42/155) Unknown: 3.2% (5/155)
Georgia Centenarian Study	Poon et al. (2012) The United States	about 1200 in Northern Georgia	244 (207, 84.8%), four females had missing data	240 (203, 84.6%)	20.0	98–108 M = 100.6 ± 2.04	GDS, MMSE, CDR, Wechsler Adult Intelligence Scale, Direct Assessment of Functional Status scale, Controlled Oral Word Association Test, Behavioral Dyscontrol Scale, ADLs, IADLs	GDS = 1–2 (no dementia): 22.4% (54/241) GDS = 3 (MCI): 25.3% (61/241) GDS = 4–7 (dementia): 52.3% (126/241)	GDS = 1–2: 20.9% (9/43) GDS = 3: 37.2% (16/43) GDS = 4–7: 41.9% (18/43)	GDS = 1–2: 22.7% (45/198) GDS = 3: 22.7% (45/198) GDS = 4–7:54.5% (108/198)

Tokyo Centenarian Study	Gondo et al. (2006) Japan	1194 in the 23 wards of metropolitan Tokyo	514	304 (239, 78.6%)	25.5	100–107 M = 101.1 ± 1.7	MMSE, CDR, GDS, scales for mental state and daily living activities for the elderly	CDR = 0:24.3% (74/304) CDR = 0.5: 13.8% (42/304) Dementia: 61.8% (188/304) CDR = 1:18.8% (57/304) CDR = 2: 9.5% (29/304) CDR = 3: 16.4% (50/304) CDR = 4: 8.9% (27/304) CDR = 5: 8.2% (25/309)	CDR = 0: 43.1% (28/65) CDR = 0.5: 15.4% (10/65) Dementia: 41.5% (27/65) CDR = 1: 16.9% (11/65) CDR = 2: 7.7% (5/65) CDR = 3: 7.7% (5/65) CDR = 4: 3.1% (2/65) CDR = 5: 6.2% (4/65)	CDR = 0: 19.2% (46/239) CDR = 0.5: 13.4% (32/239) Dementia: 67.4% (161/239) CDR = 1: 19.2% (46/239) CDR = 2: 10.0% (24/239) CDR = 3: 18.8% (45/239) CDR = 4: 10.5% (25/239) CDR = 5: 8.8 (21/239)

Note: *ADLs* activities of daily living; *CDR* clinical dementia rating; *DSM-III-R* the revised third edition of the Diagnostic and Statistical Manual of Mental Disorders; *DSM-IV* fourth edition of the Diagnostic and Statistical Manual of Mental Disorders; *GDS* the Global Deterioration Scale; *HDS* Hasegawa Dementia Scale; *HDSR* Hasegawa Dementia Scale Revised; *IADLs* instrumental activities of daily living; *ICD-10* the World Health Organization's International Classification of Disease, 10th revision; *MMSE* the Mini-Mental State Examination; *NINCDS-ADRDA* the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association

38.2% with the Cambridge Examination for Mental Disorders of the Elderly (CAMDEX). The ICD-10 criteria for dementia yielded the lowest rate of dementia among the four criteria. This dissociation appears to be due to requirements for evaluation. The ICD-10 criteria always required impairments in three executive functions. On the other hand, the DSM-III-R criteria, leading to the highest rate, required at least one or more impairments in abstract thinking or judgment or impairment of higher cortical functions or personality changes. The DSM-III-R is less restrictive than the DSM-IV in assessing cognitive function except for memory. Consequently, the DSM-IV criteria, including impairments in executive function or condition of having central nerve damage, such as aphasia, lead to the second highest rate. The CAMDEX, with the second lowest rate, has different characteristics in requirements of progressive deterioration for the diagnosis and of impairments in behavioral and emotional functions. This is why the proportion of dementia by the ICD-10 seems to be lowest among these criteria. As mentioned in a later section, centenarians tend to show large dissociations in the decline of different cognitive domains. This characteristic might increase the chances of variations occurring as a result of the use of different definitions.

Differences in exclusion criteria of cases with questionable dementia were also observed. Some studies, for example, excluded in their reports cases where the criteria to identify dementia were not sufficient and the diagnosis was uncertain. In the Longitudinal Study of Danish Centenarians (Andersen-Ranberg et al. 2001), a comprehensive survey was conducted on all individuals living in Denmark who were aged exactly 100 during the survey period. One-hundred sixty-two out of 222 women and 45 out of 54 men participated in this study. According to the criteria of ICD-10 and the Clinical Dementia Rating scale (CDR), the identified prevalence rate of dementia, including mild, moderate, and severe dementia, was 51% in 100-year-old individuals. They excluded cases with the probably no dementia cases and the questionable cases. If they had treated these cases as the category with dementia, the prevalence would have increased. Some studies have also considered individuals with visual or hearing disabilities as questionable cases. These sensory impairments are very common in very old age and are likely to hinder the understanding or following of instructions of the cognitive tests, which may result in overestimating the cognitive issues in centenarians. Thus, dementia prevalence is influenced by how researchers define and use these questionable cases in their studies (e.g., considering them as part of the dementia group will lead to an increase of the prevalence, while treating them as a part of the group without dementia will decrease the prevalence).

Gender differences can also result in varying prevalence. The Northern Italian Centenarian Study (Ravaglia et al. 1999) reported different prevalence rates, depending on gender and severity of dementia. Their reports on dementia prevalence were based on the DSM-IV criterion and included questionable cases. At 69.6% (N = 39/56), dementia prevalence among women was higher than that among men, at 50.0% (N = 18/36). However, there was no significant difference in prevalence rate and severity of dementia between female and male centenarians, likely due to the small case number in each subgroup. Using a larger sample of 304 individuals, the Tokyo Centenarian Study (Gondo et al. 2006) reported different prevalence rates for dementia according to gender. In this sample, the ratio of women to men was roughly 1:3.6, which was almost similar to the total centenarian population in this research area. They showed that the dementia prevalence was 61.8% (188/304) of the total, 67.4% (161/239) among women, and 41.5% (27/65) among men, based on a CDR score with the range of 1–5 to determine dementia. The findings showed clear differences in prevalence between female and male centenarians. The higher the percentage of female centenarian sample, the higher the dementia prevalence in the overall sample. Thus, gender-specific data should be reported to interpret results while taking into account the gender ratio.

Currently, the direct comparison of dementia prevalence across centenarian studies is problematic due to the issue mentioned above. For precise comparisons, researchers should collect data from larger representative samples, with uniform

procedures and definitions of dementia. Adopting this kind of careful assessment procedures would reduce errors in identification of dementia among centenarians. Otherwise, discussion of cohort, regional, and cultural differences in dementia prevalence among centenarians is likely to lead to questionable conclusions.

Cognitive Function in Non-demented Centenarians

As described above, there is a very high prevalence of dementia among centenarians. Most centenarian studies have assessed cognitive function, using dementia screening tests such as the Mini-Mental State Examination (MMSE), CDR, or the Global Deterioration Scale (GDS). The mean of MMSE scores among 244 individuals aged 98–108 years old was 16.2 ± 8.80 (SD) (Dai et al. 2013), indicating that mean cognitive function in non-demented centenarians was much lower than that among younger older individuals. Considering 68 centenarians who had a CDR score of 0, the mean of MMSE was 22.3 ± 3.32 (Inagaki et al. 2009). These findings showed global cognitive function in centenarians to be equal to or only slightly lower than the established clinical cutoffs in younger older individuals. At the same time, large individual differences were reported among non-demented centenarians.

To date, no study has reported trajectory of domain-specific cognitive aging from younger older individuals to centenarians. Descriptions of domain-specific conditions in centenarians can contribute toward an understanding of normal, aging-related cognitive change and stability in very old people. Few studies mentioned this issue. The Georgia Centenarian Study provided norm data of domain-specific abilities in verbal abstract reasoning, fluency, and memory (Mitchell et al. 2013). They reported that centenarians obtained cognitive performance averages that were lower than those of octogenarians. Moreover, age differences in verbal abstract reasoning, fluency, and recognition were smaller than those in immediate and delayed recall. Using data from the Tokyo Centenarian Study, Inagaki et al. (2009) compared the scores of centenarians and younger controls on five cognitive domains, as measured by the MMSE. They reported that concentration, language and praxis (i.e., reading and obeying, listening and obeying, writing a sentence, copying pentagons, and naming), and repetition among centenarians were not lower, compared to those of individuals in the younger age groups. Both studies showed small age differences in the domain relating to language, but large age differences in episodic memory. These findings might indicate that a fundamental characteristic of intellectual aging, namely, a smaller decline in the pragmatic domains and a larger decline in the mechanic domains are well-known phenomena, was still preserved among centenarians.

The Georgia Centenarian Study examined the role of intelligence, memory performance, and problem-solving ability in cohorts aged from 60 to 80 and to 100 years old (Poon et al. 1992). The study showed that centenarians had maintained their everyday problem-solving abilities, measured by the nine real-life problems encountered at home on an everyday basis. Furthermore, the study also showed that problem-solving abilities had an effect on mental health as well as personality and coping. Moreover, centenarians with high cognitive function obtained high levels of activity of daily living. These findings suggested that the maintenance of the mechanic domains of cognitive function might be possible in centenarians and that it might enable them to manage and cope with old-age adversity.

Risk for Cognitive Decline and Dementia in Centenarians

Recently, the risk factors for dementia and cognitive decline among individuals in very old age have received increasing attention. The disclosure of risk factors might contribute toward the development of strategies for a healthy long life. To date, few centenarian studies have addressed this issue. Interestingly, limited findings suggest that centenarians and younger older people may not

have the same risk factors. Complex and mutual relationships among risk factors for cognitive decline and dementia are still not clear, even for the younger older adults. Findings from centenarian studies might help clarify these conundrums. We will describe this issue by focusing on brain aging in centenarians from genetic, biomedical, and behavioral viewpoints.

Genetic Factor

The apolipoprotein E (*APOE*) gene, recognized for its important roles of transporting and delivering lipids, is one of the most commonly investigated gene polymorphisms. Among three common alleles, including ε2, ε3, and ε4, the ε4 allele might facilitate ineffective repair and protection from neuronal damage. The presence of the ε4 allele has been identified as a major risk factor for the development of AD in younger older adults (Ashford and Mortimer 2002). However, whether the *APOE* ε4 has an effect on cognitive function among individuals in very old age is still controversial. While there was a significant negative association between the ε4 allele and cognitive function among 103 Korean centenarians (Choi et al. 2003), this association was not observed in 179 Finnish (Sobel et al. 1995) and 33 Japanese centenarians (Asada et al. 1996). Compared to younger older people, centenarians tend not to have the *ε4* allele. Thus, the survival effect for individuals with the *APOE ε4* might hamper the evaluation of the effect of the *APOE* on cognitive function in centenarians.

Cardiovascular Factors

Hypertension, a cardiovascular disease, is a significant risk factor for cognitive impairment. However, some centenarian studies have shown higher blood pressure (BP) to be associated with better cognitive performance and survival. Richmond et al. (2011) showed that systolic BP (SBP) positively correlated with the MMSE score in centenarians ($r = 0.37$, $p = 0.001$), also showing a pulse pressure (PP) range that was narrower in individuals with dementia, as compared to those without it. Moreover, Szewieczek et al. (2015) reported that centenarians with SBP>=140 mmHg and with diastolic BP (DBP)>=90 mmHg had higher likelihood for a subsequent 180-day survival. The association between SBP and MMSE scores was expressed in an inverted-U-shaped curve, whereas that between DBP and MMSE scores was best in a liner curve. These results indicate an association between high BP and good cognitive function, depicting a contradictory relationship to that found among individuals in younger older age. Centenarians with moderately high BP might show better cognitive performance.

Nutrition Factors

As factors related to metabolic activities of the brain, we must focus attention on nutrition in old age. The Georgia Centenarian Study examined the role of diet for cognitive function in centenarians (Johnson et al. 2013). Significant relationships were observed between cognitive performance and dietary carotenoids, including serum lutein, zeaxanthin, and β-carotene in the serum and brain. However, these relationships differed from those observed in other studies for the younger older population.

Arai et al. (2015) showed that well-nourished centenarians who showed high serum albumin levels had significantly higher MMSE scores. In addition, the study found that high serum albumin levels and inflammation suppression were associated with low CRP and IL-6 levels among centenarians. Although the nutritional status in the blood serum shows a relationship with cognition, no study has shown a direct relationship between food intake and cognitive function among centenarians. They speculated that inflammatory reactions occurring along with aging might lead to a low nutritional status and low cognitive function in very old age. In the future, there is a

need for a comprehensive study focusing on the associations between food intake, nutrition level in the blood serum, and cognitive function among centenarians.

Psychosocial Factors

In addition to the factors mentioned above, recent gerontology studies have started considering psychosocial factors as pathways to maintenance of cognitive function in old age. Specifically, studies examined the effect of life antecedents, such as education, work, and leisure activities, on late-life cognition and the risk of dementia. Studies addressing the complexity of work engaged throughout their main lifetime reported that highly demanding work was associated with a low risk of cognitive impairment in younger older age. A review paper showed the positive effects of high control and work complexity on cognition in late life (Then et al. 2014). Moreover, many findings support the notion that physical activities, social engagements, and intellectual stimulation in leisure activities could promote cognitive function in old age (Hertzog et al. 2008). There is a need to examine whether complexity of work in midlife and engagement in leisure in old age could affect cognitive function among centenarians.

A prospective study is recommended for such research topics; however, it is not feasible in centenarian studies. In one centenarian study, centenarians and their proxies were interviewed, with their lifelong engagements in cognitive activities retrospectively evaluated (Kliegel et al. 2004a). The study demonstrated that higher education and the number of intellectual activities engaged in predicted higher cognitive function in centenarians. Moreover, the number of intellectual activities that adults engaged in mediated the association between childhood education and cognitive function in centenarians. A prior active lifestyle might be an important predictor of cognitive ability, even in centenarians. Further retrospective studies assessing the activities performed during their 80s and 90s, in order to link these to the cognitive performance when reaching centenarian status, are necessary to enable a better understanding of healthy cognitive aging in very old age.

Summary and Future Directions

This entry has summarized findings on the prevalence of dementia among centenarians, the cognitive function levels in non-dementia centenarians, as well as risk and protective factors of cognitive function in very late life. Findings suggest that dementia prevalence among centenarians was substantially higher than that among younger older individuals and that women tended to have higher prevalence rates than men did. However, large differences in dementia prevalence rates across different studies have also been observed. A large representative database and similar protocols are needed to clarify the inconsistent results previously obtained. Furthermore, researchers should examine the influence of genetic, biomedical, and environmental factors on cognitive function and dementia among centenarians. As protective factors, nutrition in the serum and an active lifestyle across the lifespan might maintain cognitive function until very old age; however, few studies relating to this have been conducted. In addition to the abovementioned issues, the following topics will also be important in clarifying the nature of cognitive aging among centenarians.

Gene–Environment Interaction

More recently, the role of gene–environment interactions in older adults' cognitive function has gained interest. Wang et al. (2012) reported that higher education might modify the effect of the *APOE* ε4 on the risk of dementia among participants aged ≥65 years. In the study, among the ε4 allele carriers, if they had more than 7 years of education levels, the risk of dementia was reduced by half, compared to those with less than 8 years of education levels. Environmental factors must be controlled for, to enable

clarification of the effect of genetic factors on cognitive function even in very old age.

Neuropathology in the Brain and Cognition

Autopsy studies in very old age suggest that there is some level of dissociation between the neuropathological change of the brain and cognitive performance. The prevalence of neuropathology associated with AD ranged from about 20% to about 40% when individuals met at least several criteria for AD-related neuropathology (Price et al. 2009). The result suggests that some people in very old age might be in the pre-stage of AD, although they had not yet exhibited clinical expression.

The Sydney Centenarian Study was designed to relate cognitive function with neuropathological parameters assessed via magnetic resonance imaging in centenarians (Sachdev et al. 2013). Future findings might indicate the uniqueness of the relationship between neuropathology and cognitive function in very old age. Gondo and Poon (2007) proposed the following four phenotypes in centenarians, based on the level of cognitive function and pathological condition: supernormal (i.e., no symptoms of brain pathology and higher cognitive status), cognitive reserve, late-onset dementia, and early-onset dementia. Considering neurological and cognitive aspects simultaneously may provide a useful model of cognitive aging in very old age.

Micro-longitudinal Studies

Longitudinal assessment and neuropathological examination of the brain are recommended, in order to improve our understanding of centenarians' cognitive status. For instance, the Iowa Centenarian Study examined mental performance status and changes therein over time, using Pfeiffer's Short Portable Mental Status Questionnaire. The study examined the individual level of change and found four patterns of short-term longitudinal performance, including stability, enhancement, decrement, and variability in scores across the 8-month testing period (Margrett et al. 2012). Examining intraindividual changes or patterns of cognitive changes would be recommended because it might prove more sensitive to cognitive impairments than would a one-shot assessment of cognitive performance.

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Cognitive and Brain Plasticity in Old Age

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"What seemingly was often overlooked is that the brain itself is a dependent variable*, something that is co-shaped by experience and culture, something that does not operate within an environmental vacuum, but that at any moment is subject to environmental constraints and affordances."*

Paul B. Baltes, Patricia A. Reuter-Lorenz, & Frank Rösler, 2006
*(*Italics added*; Lifespan Development and the Brain, p. 4)*

Synonyms

Aging; Cognition; Dopamine; Plasticity; Stimulation; Training

The Challenge of Demographic Change

A recent report from the World Health Organization on world population prospects forecasted an unprecedented demographic shift in human history: the number of people aged 65 or older will outnumber children under the age of 5 before 2020. In most developed countries, the average life expectancy at birth has increased from about 45 years in the 1800s to above 75 years in the twentieth century. This remarkable 30-year gain in physical health is, however, not necessarily accompanied by cognitive fitness and mental well-being into old age. Faced with the rapid growth of aging populations worldwide and an ever-expanding prevalence of dementia and other aging-related neuropathologies, understanding basic mechanisms of the still preserved cognitive and brain plasticity in old age in order to uphold and delay functional declines of the aging mind has become a key challenge for cognitive neuroscience, psychology, and gerontology in the 21st century.

As foreshadowed in the quote from Baltes et al. (2006) above, cognitive interventions and brain plasticity are closely interwoven. This brief review will first introduce theoretical concepts of plasticity that are pertinent for geropsychology, followed by a selected overview about cognitive plasticity in key domains of cognition, focusing specifically on episodic memory, working memory, and executive control. Using memory plasticity as an example, dopaminergic neuromodulation, the frontal–parietal circuitry, and neurogenesis involving the brain-derived neurotrophic factor (BDNF) will be highlighted as intermediate mechanisms that link brain and cognitive plasticity. In the last section, plasticity in populations with aging-related neuropathologies as well as potential noninvasive brain stimulations as additional intervention approaches beyond cognitive and physical fitness interventions will be reviewed.

Theoretical Propositions of Developmental Plasticity

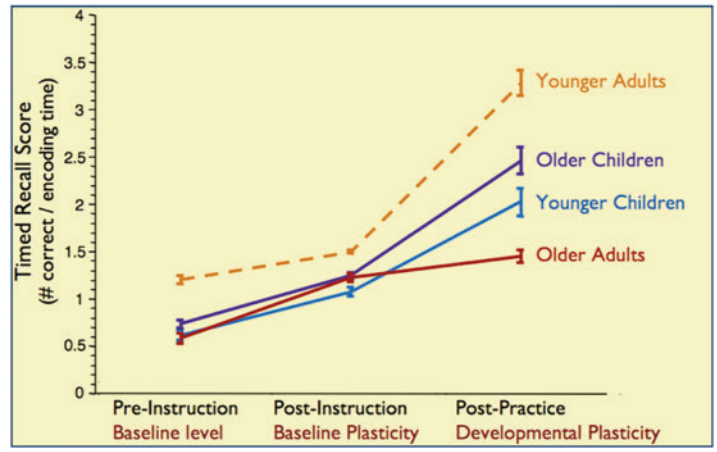
The concept of plasticity has a long history in psychology and neuroscience. In his classical volume, *The Principles of Psychology*, William James (1980) considered neural mechanisms of the mind to be endowed with substantial potentials to be influenced by experiences and learning. Around the same time, Santiago Ramón y Cajal (1894) in neuroscience also contemplated about the possibilities of mental exercises as means for facilitating the connections between neural networks.

Among modern concepts of plasticity, in our view, the following propositions are particularly relevant from the perspectives of lifespan development and geropsychology. First is the concept of *developmental reserve capacity* in old age (Baltes 1987): notwithstanding declines in their neurocognitive resources, older adults still possess considerable latent reserve capacity, such that if suitable environmental supports or interventions could be provided, their performance could be maintained or even improved. This concept underlies much of the training and intervention research conducted cover the past decades, which aims at maintaining or enhancing cognition in old age by cognitive and/or physical fitness training and lifestyle enrichments (see Hertzog et al. 2009 for a review). A second notion is that prolonged mismatches between task demands and supplies of neurocognitive resources can trigger alternations in cognitive and brain processes (Lövdén et al. 2010). Recognizing that the demand–supply balance is an important factor in driving plasticity implicates that programs or methods for enriching older adults' cognitive and physical experiences need to closely adjust the balance between task demands and individual abilities during the course of training for optimal intervention results. A third proposition is that flexible adaptions to declines in neurocognitive resources and increases in task demands can lead to reorganizations of cognitive processes (Li et al. 2004), and brain mechanisms (Park and Reuter-Lorenz 2009) that go beyond effects on the levels of performances or functions. Indeed, the correlations among sub-facets of intellectual functioning (e.g., perceptual speed, reasoning, memory, and verbal knowledge) or basic cognitive processes (e.g., working memory and episodic memory) are higher in old age than in early adulthood, indicating dedifferentiation in the organization of cognitive processes in old age (Li et al. 2004). At the brain level, extant evidence also indicates that, relative to young adulthood, brain processes of various cognitive functions in old age tend to activate more diffused networks or recruit additional brain regions (see Park and Reuter-Lorenz 2009 for a review).

Cognitive Plasticity

Notwithstanding evidence for developmental reserve capacity in old age, cognitive intervention research over the past decades also revealed that the potential for training gains is more limited in old age relative to other periods of the lifespan. The degree of plasticity limitation, however, varies between cognitive domains. In terms of the extent of training gains in episodic memory, evidence from research that applied mnemonic strategies for training the encoding and retrieval of associative memory revealed substantially reduced plasticity in old age relative to younger adults and children (Brehmer et al. 2007; Shing et al. 2008). Specifically, the so-called baseline plasticity – i.e., the potential to benefit from being instructed with memory strategies (e.g., method of loci or paired associates) – was comparable between different age groups, whereas the plasticity in implementing those respective memory strategies through practice to strengthen associative memory was much more limited in older adults compared to younger adults and children (see Fig. 1; Brehmer et al. 2007). In contrast, the plasticity of working memory and executive control functions seem to be less age dependent. A recent meta-analysis (Karbach and Verhaeghen 2014) revealed comparable effect sizes (around 0.6) of training gains in these two domains of functions in younger and older adults.

Beyond training or practice gains, whether the training benefits would transfer to other untrained



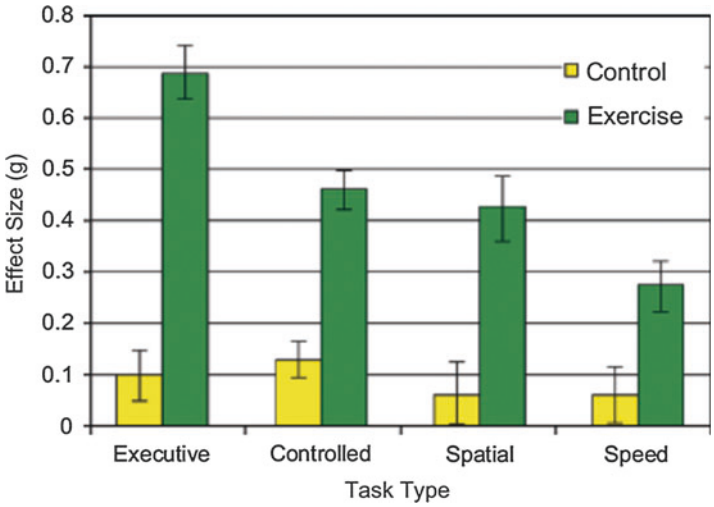
Cognitive and Brain Plasticity in Old Age, Fig. 1 Lifespan age differences in episodic memory plasticity (Data adapted from Brehmer et al. (2007) with permission; copyright American Psychological Association 2007)

tasks is an additional indicator that is of practical relevance when considering interventions for maintaining or improving older adults' daily cognitive competence. Results from a meta-analysis showed that in older adults transfer of training benefits at the level of specific tasks is usually in the range of moderate effect sizes (0.2–0.4) for working memory or episodic memory functions (Karbach and Verhaeghen 2014). Relatedly, a unique extensive cognitive intervention study (Schmiedek et al. 2010, the COGITO study) compared transfer effects of an intensive training on multiple domains of cognitive functions (i.e., over 6 months of 1-h daily practice of perceptual speed, working memory, and episodic memory tests). Of note, in both younger and older adults, transfer effects were not only observed with respect to individual tests but also for cognitive abilities represented as latent factors. This indicates that training benefits can be observed at the level of cognitive abilities, instead of just at the level of specific tests. However, the transfer effects at the level of latent cognitive abilities were more limited in older than in younger adults.

Other than cognitive interventions, aerobic physical fitness trainings have been shown to yield transferrable benefits to cognition, beyond physical functions. Specifically, a recent review of physical intervention research over the last decades (Prakash et al. 2015) points to positive cross-domain transfer effects of enhancing aerobic physical fitness on executive control and memory functions in older adults. Similar to cognitive intervention effects, the effects of physical fitness training on older adults' cognitive performance also differed between domains of functions, with executive control processes (e.g., working memory, inhibition, and multitasking) showing the largest training benefit (Colcombe and Kramer 2003; see Fig. 2).

Linking Levels of Memory Plasticity: From Brain to Cognitive Plasticity

This section focuses specifically on plasticity of working memory and episodic memory to highlight the multiple levels of mechanisms involved, from neurobiological to behavioral plasticity. A number of relevant neurochemical mechanisms have been identified. Specifically, neurotransmitters such as acetylcholine, norepinephrine, and dopamine are implicated in the modulation of long-term potentiation (LTP), which is an important molecular mechanism of memory (Squire and Kandel 1999). Given that dopamine and other neurotransmitters are involved in affecting synaptic plasticity, lifespan age differences in the efficacy of neuromodulation thus would have direct implications on experience-dependent tuning of synaptic connections. Over the past two decades, studies investigating the impact of aging on the brain's neurochemical processes have yielded the consensus of substantial age-related declines in the efficacy of various neurotransmitter systems. Of particular interest here are aging-related



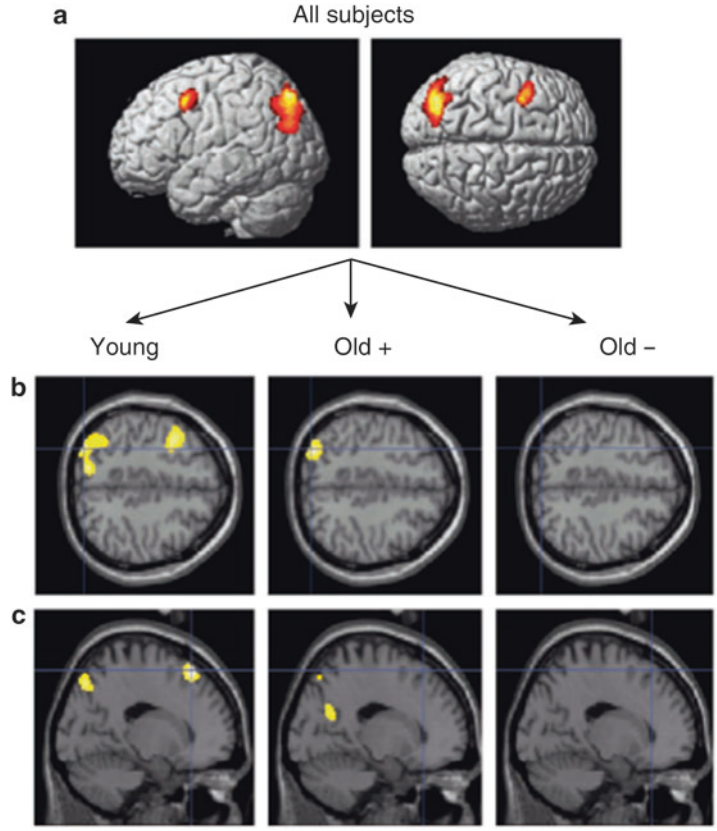
Cognitive and Brain Plasticity in Old Age, Fig. 2 Effect sizes of aerobic fitness training on cognitive performance in older adults for different types of cognitive tasks. Plotted are mean differences in pre- and post-training cognitive performances of the training and control groups (Data adapted from Colcombe and Kramer (2003) with permission; copyright American Psychological Society 2003)

declines in different components of the dopaminergic system. Estimates based on currently available cross-sectional evidence indicate about 10% decline in dopamine receptor functions per decade starting from the age of early 20s (see Bäckman et al. 2006; Li and Rieckmann 2014 for reviews).

Frontal–striatal dopamine signaling is closely involved in regulating working memory and executive control functions. In healthy young adults, better working memory performance has been associated with higher capacity of striatal and extrastriatal dopamine synthesis (see Li and Rieckmann 2014 for review). Regarding aging, a recent study (Rieckmann et al. 2011) showed that functional connectivity between the prefrontal and parietal cortices, key regions of the network that underlies working memory, was reduced in older compared to younger adults. Importantly, in older adults, interindividual differences in the frontal–parietal connectivity correlated positively with striatal caudate D1 receptor density: those older adults whose D1 receptor availability was higher relative to same-aged peers showed higher frontal–striatal functional connectivity during working memory. These results suggested that age-related losses in striatal DA receptors could contribute to age-related decline in functional brain dynamics of working memory.

Of particular interest, two recent positron emission tomography (PET) receptor imaging studies established the first empirical links between memory training and changes in dopamine signaling in various brain regions that are crucial for working memory functions. In younger adults, working memory training over 5 weeks was associated with changes of dopamine D1 receptor binding potential in the prefrontal and parietal cortex (McNab et al. 2009) as well as D2 receptor binding in the striatum (Bäckman et al. 2011). Furthermore, individuals who showed larger performance improvements as a function of working memory training also exhibited a greater training-related change in receptor binding potential (McNab et al. 2009).

The direct effect of aging-related decline in dopaminergic modulation on memory plasticity has thus far not yet been empirically established, but a theoretical link has already been suggested for more than a decade. Modeling aging-related decline in dopaminergic neuromodulation by stochastically attenuating the gain control of the sigmoidal activation function that models presynaptic to postsynaptic input–response transfer, computational stimulations results accounted for the reduced associative memory plasticity and working memory capacity in old age (Li et al. 2001; see also Li and Rieckmann 2014 for a recent review). Although without direct measures of dopamine synthesis or binding, a recent functional brain imaging study showed that reduced striatal activity may contribute to reduced transfer effects of working memory training in

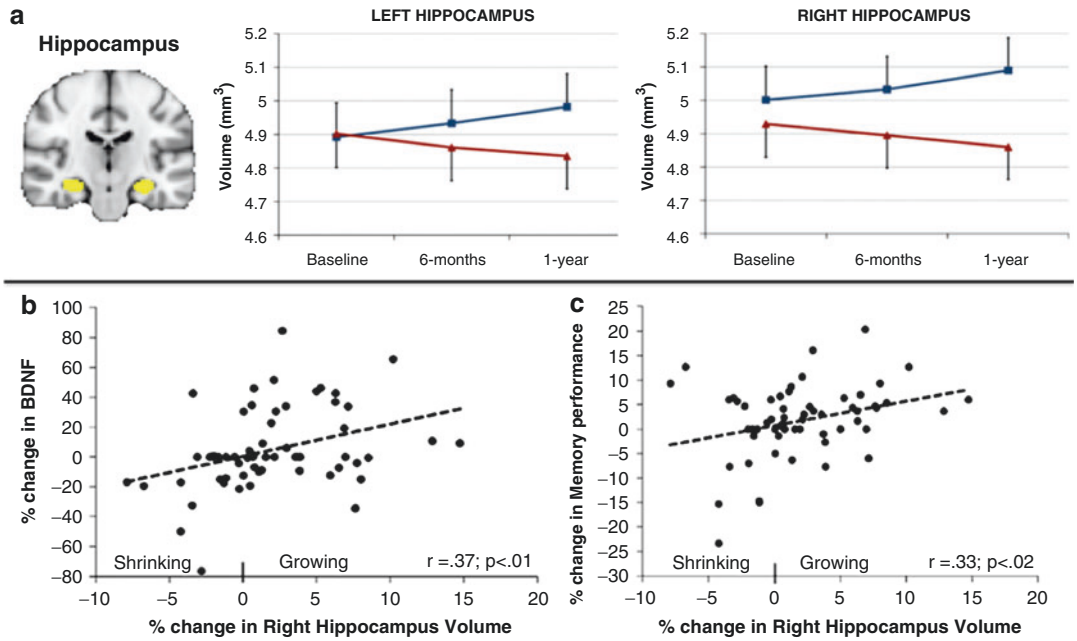


Cognitive and Brain Plasticity in Old Age, Fig. 3 (**a**) The left dorsal frontal cortex and the left occipitoparietal cortex showed increased activity after the "method of loci" memory training relative to a pretest baseline. (**b**) Group differences in the comparison of "method of loci" use with pretest. The younger and the improved older adults, but not the unimproved old, activated the left occipitoparietal cortex. (**c**) Age differences in the comparison of "method of loci" use with pretest. The young but not the old adults activated the left dorsal frontal cortex (Data adapted with permission from Nyberg et al. (2003); copyright the National Academy of Sciences, USA, 2003)

older adults (Dahlin et al. 2008). Given that dopamine pathways extensively innervate the striatum, this finding hints at the possibility that aging-related decline in transfer effects of working memory training may be related to impaired striatal dopaminergic modulation.

Regarding brain correlates of episodic memory plasticity in old age, the plasticity of the frontal–parietal network as a function of memory training has also been investigated (Nyberg et al. 2003). After being instructed to use the method of loci as a mnemonic strategy, increased brain activities in frontal as well as occipito-parietal regions were observed in younger adults. In contrast, accompanying their reduced episodic memory plasticity as indicated by the reduced training gain, older adults did not show training-related increase in frontal activity, and only those older adults who benefited from the memory training showed increased occipitoparietal activity (see Fig. 3). A recent study further investigated effects of dopaminergic modulation on episodic spatial memory in a crossover pharmaco (ON/OFF)-behavioral design. Using Parkinson's disease as a model disorder which is characterized by severe and progressive degeneration of nigrostriatal dopamine, the authors showed that dopaminergic medication facilitated striatum-dependent spatial learning based on cue-location associations. A positive medication effect on hippocampus-dependent spatial memory relying more on relations between object locations and a local spatial boundary depended on prior experience with the navigation task (Thurm et al. 2016). Given these results, aging-related decline in the dopamine system might differentially affect spatial memory plasticity and transfer effects of navigation trainings might depend upon the task-relevant underlying brain structures.

Turning to effects of aerobic physical fitness training on episodic memory (see Prakash et al. 2015 for a recent review), a study of



Cognitive and Brain Plasticity in Old Age, Fig. 4 (**a**) Effects of aerobic fitness training on hippocampal volume in older adults. (**b**) Positive effects of exercise on increased serum BDNF level are correlated with increased hippocampal volume in older adults. (**c**) Increased hippocampal volume is correlated with memory performance improvement in older adults (Data adapted from Erickson et al. (2011) with permission; copyright the National Academy of Sciences, USA, 2011)

particular interest (Erickson et al. 2011) showed that aerobic exercise (3 days/week over 1 year) increased the volume of the hippocampus in older adults by 2%, thus effectively reversed the age-related loss in hippocampal volume by 1 to 2 years (see Fig. 4). Moreover, the increase in hippocampal volume was associated with improved spatial memory performance and with greater serum levels of brain-derived neurotrophic factor (BDNF). The hippocampus is central for episodic and spatial memory and is rich in BDNF, which is a putative mediator of neurogenesis and dendritic expansion. Early animal studies showed that voluntary wheel running enhances BDNF gene expression, neurogenesis, and cell proliferation in the hippocampus of mice and rats (Adlard et al. 2005; Neeper et al. 1995), decreases beta-amyloid plaque load in the brains of transgenic Alzheimer mice, and increases the animals' spatial memory performance (van Praag et al. 1999). Thus, the findings of aerobic fitness training increasing the level of circulating BDNF and hippocampal volume suggest that cell proliferation or increased dendritic branching might contribute to the training-related increases in hippocampal volume and memory function in older adults (see Erickson et al. 2011 for review).

Cognitive Plasticity in Aging-Related Neuropathology

A range of neuropathological conditions are age associated. Therefore, this section focuses on cognitive plasticity in populations manifesting aging-related neuropathology. Mild cognitive impairment (MCI) refers to a transitional zone between normal and pathological cognitive aging. Older adults with MCI or caregivers of individuals with MCI usually report subjective memory deficits. Furthermore, cognitive declines in these populations have been objectively confirmed by neuropsychological tests in at least one cognitive domain (Winblad et al. 2004). In general, daily

functioning of older adults with MCI remains intact, and they do not yet fulfill clinical criteria of dementia. However, older adults with MCI have an increased risk of developing Alzheimer's disease (AD). About 10–15% of those seniors with classified MCI convert to AD within 12 months compared to only 1–2% of the general, age-matched population (e.g., Petersen et al. 1999). AD is the most common form of dementia in late life with complex multifactorial pathogenesis. AD leads to progressing memory deterioration and further exacerbates deficits in other cognitive domains, including executive functions and visuo-motoric, visuospatial, and language abilities that impair independent living and quality of life. Idiopathic Parkinson's disease (PD) is another aging-related neurodegenerative disease, which in its initial stages is rather recognized by motor than cognitive deficits. PD is associated with a drastic degeneration of dopaminergic neurons, especially in the substantia nigra pars compacta (SNc) and its terminals in the dorsal striatum (caudate and putamen). With disease progression, the loss of dopamine further affects the ventral tegmental area (VTA) and its terminals in the ventral striatum (nucleus accumbens) as well as the mesolimbocortical dopamine system (Agid et al. 1993).

Many cognitive intervention studies targeting the training of either compensatory cognitive strategies or specific cognitive abilities in older adults with MCI and AD reported performance improvements in the trained tasks but failed to provide relevant long-term transfer effects on other cognitive functions or abilities needed in daily life (e.g., Belleville et al. 2006; Davis et al. 2001). More recent neuroplasticity-based cognitive trainings have yielded promising results in some studies with healthy older adults, but yielded contradicting results in older adults with increased risk of dementia and MCI (e.g., Barnes et al. 2009). Cognitive training and intervention studies with PD patients provide a similar picture with small to moderate improvements mainly in trained fronto-striatal tasks (e.g., Nombela et al. 2011), without transfer to other untrained functions. Taken together, randomized controlled cognitive training or intervention studies in MCI, AD, and PD are few and inconclusive at the current stage.

Outlook

In light of aging- and pathology-related decreases in training gains and transfer effects, it is important to investigate other options for improving cognitive and brain plasticity in old age. Repetitive transcranial magnetic stimulation (rTMS) and anodal transcranial direct current stimulation (atDCS) are noninvasive brain stimulation methods that could have transient facilitative effects on cognitive function (see Freitas et al. 2013 for a recent review). Very recently, a few explorative studies have begun to use noninvasive brain stimulations in older adults. Some preliminary successes in terms of ameliorating cognitive aging deficits could be demonstrated. For instance, atDCS applied over the left inferior frontal gyrus improved performance in a semantic word generation task that implicates frontal cognitive control and working memory in old adults. Moreover, atDCS also reduced the nonspecific recruitment of the right prefrontal regions in older adults, thus modified functional brain activity of older adults to more resemble those observed in younger brains (Meinzer et al. 2013). Regarding effects on episodic memory consolidation, atDCS over the right temporoparietal cortex further improved object-location learning and delayed free recall after one week in old adults (Flöel et al. 2012).

Research over the past decade indicates that the facilitating effects of rTMS or atDCS on cognition might not be restricted to healthy young and older adults. Application of rTMS improved face–name association memory in older adults with subjective memory complaints and amnestic MCI (e.g., Turriziani et al. 2012). In AD patients with early to more advanced cognitive deficits, rTMS and atDCS have been shown to improve memory functions (e.g., Cotelli et al. 2014). In PD patients, atDCS stimulation has also been shown to improve working memory (Boggio et al. 2006). These initial progresses notwithstanding, further research is needed to gain better understandings

about the underlying mechanisms of noninvasive brain stimulations, their long-term effects, and potential risks, in order to develop appropriate protocols for gerontological applications.

Cross-References

- ▶ Alzheimer's Disease, Advances in Clinical Diagnosis and Treatment
- ▶ Berlin Aging Studies (BASE and BASE-II)
- ▶ Cognition
- ▶ Cognitive Neuroscience of Aging
- ▶ Executive Functions
- ▶ Life Span Developmental Psychology
- ▶ Life Span Developmental Psychopathology
- ▶ Learning in Older Adults
- ▶ Memory, Episodic
- ▶ Memory Training Methods and Benefits
- ▶ Mild Cognitive Impairment
- ▶ Neurocognitive Markers of Aging
- ▶ Plasticity of Aging
- ▶ Physical Activity and Aging
- ▶ Working Memory in Older Age

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Cognitive Behavioural Therapy

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Synonyms

Evidence-based treatment; Psychotherapy

Definition

Cognitive behavioral therapy (CBT) refers to a psychotherapeutic framework in which cognitions and behaviors are theorized to be the underlying core factors in the development and maintenance of psychological distress. According to the CBT model, maladaptive cognitions, or schemas, about the world and oneself result in emotional distress and problematic behaviors in the individual. The goal of cognitive behavioral therapy is to alter an individual's maladaptive cognitions and problematic behaviors, which result in the alleviation of psychological distress.

Introduction

Cognitive behavioral therapy (CBT) is a psychotherapeutic intervention focused on the alteration of maladaptive cognitions and behaviors in the alleviation of psychological distress. CBT blends elements from both behavioral and cognitive therapies into a cohesive intervention in which both behaviors and thoughts are theorized to effect, and to be effected by, an individual's emotional state. CBT is considered an evidence-based treatment for a multitude of mental disorders, including anxiety, depression, bipolar disorder, eating disorders, anger control, insomnia, and substance abuse, and there is growing evidence for the use of CBT with personality disorders and schizophrenia (Sorocco and Lauderdale 2011; Hofmann et al. 2012). In the treatment of depression, CBT has been found to be at least as efficacious as medication alone. A combination approach of medication and CBT has growing support to be considered as the most effective approach for short-term changes in mood, although CBT continues to demonstrate the most enduring results for mid-life samples (Sorocco and Lauderdale 2011). There is growing evidence for the effectiveness of CBT in geriatric samples. Recent studies have demonstrated the efficacy of CBT in treating older adults suffering from depression, anxiety, insomnia, and pain (Sorocco and Lauderdale 2011), although the effects found for insomnia may not be as long lasting in older adults as in mid-life adults (Hofmann et al. 2012) and there is some debate about the effectiveness of CBT for anxiety disorders when compared to other treatment modalities.

Outline of CBT

CBT interventions often occur in three main phases: psychoeducation, skills acquisition, and relapse prevention (Sorocco and Lauderdale 2011). Psychoeducation involves teaching the patient about the CBT model for their particular disorder or symptoms and may take place over one or several sessions. Psychoeducation for older adults may take longer than for younger adults due to an increased unfamiliarity with psychosocial interventions (Sorocco and Lauderdale 2011).

Next, therapy moves on to teaching new skills. Skill acquisition involves teaching and demonstrating tools related to both maladaptive cognitions and behaviors (Sorocco and Lauderdale 2011). For example, maladaptive cognitions are altered through the use of cognitive techniques like cognitive restructuring (e.g., replacing maladaptive automatic thoughts with more realistic thoughts) and the downward arrow technique (e.g., asking the individual to describe the meaning of their thoughts until the individual uncovers a core belief about themselves). In the CBT model, an individual's thoughts or interpretation of a situation is theorized as the mediating factor between the situation itself and the individual's subsequent emotional response. The alteration of one's automatic thoughts to the situation allows the person to alter their emotional response as well, thus decreasing distress. The relationship between thoughts, behaviors, and situations is typically monitored through the use of "ABC" worksheets, where "A" represents the "activating event," "B" is the "belief" or automatic thought held by the patient, and "C" represents the "consequence" or emotional reaction to the situation as the result of the automatic thought (Sorocco and Lauderdale 2011). The worksheets used to monitor thoughts may vary based on the patient's symptoms and cognitive ability. Different types of thoughts are captured within the worksheet.

Automatic thoughts are themselves the result of an individual's underlying schemas, or their way of viewing the world. These kinds of thoughts are reflected in the belief portion of the worksheet. Deeper thoughts or themes, known as schemas, develop over the course of an individual's life as the result of an interaction between genetic predispositions and learned responses over time. The therapist and patient can look for common themes in the worksheets to identify schemas.

Maladaptive behavior patterns also develop over time and can exacerbate psychological distress by decreasing the opportunities for individuals to receive positive reinforcement from their environment (Sorocco and Lauderdale 2011). Behavioral problems related to psychological distress are altered through the use of behavioral activation, in the case of depression, and exposure exercises, in the case of obsessive-compulsive spectrum, trauma, and anxiety disorders. Modification of maladaptive behaviors typically starts with activity monitoring worksheets, where the patient monitors his or her activities and mood over the course of a week. This allows the patient and the clinician to assess for patterns related to the patient's behaviors and subsequent mood. Next, the clinician and the patient work together to incorporate pleasurable activities throughout the patient's week. Problem solving and social skills training are also often incorporated into behaviorally based interventions in order to decrease the obstacles faced by patients during this process (Sorocco and Lauderdale 2011). With respect to exposure exercises, patients must face the stimulus that they are repeatedly avoiding. This can be done through imagery or actually engaging with the fear-provoking stimulus. Finally, clinicians and patients work together to create maintenance plans for the patients to decrease the likelihood of their symptoms returning. Relapse prevention in the treatment of older adults is typically done over multiple sessions and possible includes planning for follow-up sessions either in person or over the phone (Sorocco and Lauderdale 2011).

A case conceptualization process is typically utilized as a necessary component of a CBT model (Sorocco and Lauderdale 2011). The case conceptualization process starts at intake but is modified repeatedly throughout as new information develops. The conceptualization allows for clinicians to hypothesize about the cognitive, behavioral, and situational factors that may be contributing to an individual's current psychological distress (Sorocco and Lauderdale 2011). Clinicians are able to consider the effect of possible age-related factors, such as cognitive decline and social situation, when creating a treatment plan for geriatric patients.

Anxiety and Obsessive-Compulsive Spectrum Disorders

Up to 27% of older adults may suffer from anxiety-related symptoms and up to 10% of community-dwelling older adults may meet criteria for an anxiety disorder (Petkus et al. 2014). The prevalence of anxiety disorders in late life may be even higher in medical settings (Goncalves and Byrne 2012). Generalized anxiety disorder (GAD) and specific phobia are the two most common anxiety disorders found in late life (Petkus et al. 2014). Older adults suffering from anxiety disorders are likely to prefer psychotherapy to either medication or a combined psychotherapy-medication approach (Goncalves and Byrne 2012). Further, older adults report being more satisfied with a CBT-based protocol than a discussion group intervention (Ayers et al. 2014a).

There is currently a debate in the literature about the most effective treatment for anxiety disorders in older adults, which may be due to a dearth of large treatment trials studying late-life anxiety (Goncalves and Byrne 2012; Gould et al. 2012). While some studies suggest that CBT does not surpass other active treatments of geriatric anxiety, including relaxation training (Hofmann et al. 2012; Petkus et al. 2014), there is also evidence that CBT is equal to or surpasses other treatment modalities, including relaxation therapy, supportive therapy, or psychodynamic therapy (Hofmann et al. 2012). Further, some literature suggests that although CBT may be an effective treatment for late-life GAD, the effect may be less significant than what has been

observed in younger samples (Petkus et al. 2014; Ayers et al. 2014a; Gould et al. 2012). There are multiple reasons why CBT may be less effective in older adults than it is in younger adults. Most notably, older adults with GAD are likely to have maladaptive schemas and behaviors that have been reinforced over several decades, resulting in a psychopathology that is more highly ingrained than in younger adults (Petkus et al. 2014). Further, age-related difficulties with cognitive restructuring may result from increased levels of cognitive dysfunction and reality-based worries (e.g., worries about health and finances) (Petkus et al. 2014). Because CBT requires relatively intact executive functioning in order to be fully engaged in traditional CBT exercises, cognitive dysfunction may serve as a moderator for CBT treatment response in older adults (Ayers et al. 2014a). There may also be additional confounding factors which could have affected the generalizability of the results of many of the major investigation of CBT for late-life anxiety, including self-referral, concurrent unregulated pharmacotherapy, and a lack of control of nonspecific therapeutic effects (e.g., social support) (Gould et al. 2012).

Obsessive-compulsive disorder (OCD) is less frequent in older adults than anxiety-related disorders, only effecting 1.5% of older adults (Ayers and Najmi 2014). The first line of treatment for OCD is Exposure and Response Prevention (ERP), a form of CBT; however, there has been little systematic investigation of the efficacy of ERP in older adults with OCD beyond assorted case studies (Ayers and Najmi 2014). Hoarding disorder, an obsessive-compulsive spectrum disorder with strong ties to anxiety disorders, may be as prevalent as 15% in geriatric samples (Ayers and Najmi 2014). Hoarding disorder has also received poor results when treated with CBT in geriatric samples, with few individuals responding to treatment and no evidence of long-term effects of treatment (Ayers et al. 2014b). Treatment of late-life hoarding is further complicated by low insight, executive functioning problems, and decreased levels of social engagement (Ayers et al. 2014b).

Modified CBT protocols may show more promise than traditional CBT-based interventions for late-life anxiety. Interventions involving increased problem solving skills and teaching strategies may help to increase long-term outcomes for anxiety disorders (Ayers et al. 2014a). Similar results have been found for hoarding disorder when using a CBT-adapted protocol that focused on compensatory cognitive training and exposure and response prevention (Ayers et al. 2014b). Compensatory cognitive training focuses on skills related to prospective memory and planning, attention and vigilance, learning and memory, and cognitive flexibility, and problem solving. This enables patients with executive functioning problems to work around their deficits when engaging in treatment (Ayers et al. 2014b).

Mood Disorders

The prevalence of mood disorders in late life rivals that of anxiety disorders: as many as 25% of community-dwelling older adults have reported experiencing symptoms related to depression (Shah et al. 2012). Older adults with a late onset of depression symptoms are more likely to have a poor prognosis and greater disability associated with their symptoms that are individuals with early-onset depression (Sorocco and Lauderdale 2011). The CBT model of depression postulates that depressed mood is a combination of maladaptive cognitions, social isolation, and decreased performance of pleasurable activities (Shah et al. 2012). In the treatment of mood disorders, CBT has been found to be equally effective as other treatment modalities, such as interpersonal therapy and behavioral therapy (Sorocco and Lauderdale 2011; Shah et al. 2012), and may even surpass other treatment models in the maintenance of long-term results (Hofmann et al. 2012). Research suggests that a combined CBT and medication approach in late-life samples does not increase the effectiveness of either approach alone (Hofmann et al. 2012). CBT-based protocols for older adults with depression are often modified to take into consideration age-related changes in cognition and memory, as well as physical limitations (Sorocco and Lauderdale 2011; Shah et al. 2012). Typical modifications include using telephone or

home-based therapy, incorporating breaks within sessions, the simplification of thought records, increased use of handouts, and booster sessions (Sorocco and Lauderdale 2011). The majority of sessions in a typical CBT intervention for geriatric depression are focused on both the identification of maladaptive cognitions and the generation of more helpful alternative thoughts as well as behavioral activation and the introduction of pleasurable or positively reinforcing activities (Sorocco and Lauderdale 2011). Problem solving skills may be introduced in later sessions and can help to increase the mastery felt by geriatric individuals (Sorocco and Lauderdale 2011).

Bipolar disorder, a mood disorder characterized by alternating manic and depressive states, is estimated to be prevalent in 0.1–0.5% of community-dwelling older adults (Sorocco and Lauderdale 2011). CBT is considered the treatment of choice for bipolar disorder, especially in light of the high rates observed for patient noncompliance (40–50%) for pharmacological treatments (Sorocco and Lauderdale 2011). Unfortunately, there is little research on the efficacy of CBT for bipolar disorder in geriatric patients (Sorocco and Lauderdale 2011).

Adaptations for Geriatric Samples

Older adults may be more likely to seek therapy due to external pressures from their medical doctors or children and may be less likely to attend treatment for self-motivating reasons (Sorocco and Lauderdale 2011). Consequently, it is especially important for geriatric mental health professionals to assess motivation for treatment and to engage in motivational interviewing when necessary (Shah et al. 2012). This may be especially important for older adults exhibiting low levels of insight into their symptoms, as is often witnessed in geriatric hoarding disorder (Ayers et al. 2014b). Older adults may also have increased obstacles to treatment, including transportation or financial issues (Sorocco and Lauderdale 2011; Ayers et al. 2014b). Because geriatric patients may be unfamiliar with psychological services, extra time may need to be spent to socialize late-life patients to the CBT framework (Sorocco and Lauderdale 2011). This includes explaining the purpose and benefits of homework, the organization of treatment sessions, and an overview of the CBT model (Sorocco and Lauderdale 2011). Finally, clinicians working with older adults should be especially mindful of suicide risk and assess for suicidal ideation throughout the therapeutic process, as older adults are more likely to have increased risk factors, such as social isolation (Sorocco and Lauderdale 2011).

As individuals age, their opportunities for positive reinforcement, such as interacting with friends or exercising, may decrease due to changes in available resources and their own physical health (Sorocco and Lauderdale 2011). Cognitive impairment may also decrease the ability of older adults to fully engage in some of the core facets of CBT, such as cognitive restructuring or behavioral activation. When constructing lists of pleasurable activities for geriatric patients to incorporate into their daily lives, clinicians should consider how activities that individuals used to enjoy could be altered to be appropriate for their current levels of functioning (Sorocco and Lauderdale 2011). For example, if an older adult enjoyed kayaking but is no longer able to perform due to a medical illness, they might consider walking in the park to be a suitable alternative to incorporate into their daily routine. Clinicians may want to consult with patients' primary care providers before suggesting any new physical activities be added to patients' daily routines.

Older adults who have difficulty with cognitive restructuring due to possible cognitive impairment may benefit from the use of coping cards, which rely on recognition rather than recall memory (Sorocco and Lauderdale 2011). Patients write down common maladaptive cognitions and alternative thoughts on coping cards and then refer to them as needed, rather than having to generate alternative thoughts spontaneously. Other alterations that may increase the efficacy of CBT for geriatric patients include a lengthened course of therapy, increased structure, and an increased use of examples (Sorocco and Lauderdale 2011). Clinicians should also consider the incorporation of booster sessions every 3–6 months to decrease the

occurrence of re-emerging symptoms (Sorocco and Lauderdale 2011) or reminder calls in between sessions to help increase homework compliance (Ayers et al. 2014a). Because older adults may report feelings of guilt at homework noncompliance (Ayers et al. 2014b), booster calls may also increase the therapeutic alliance between the patient and the clinician. Emphasizing the behavioral aspects of CBT over the cognitive skills may also lead to increased outcomes for older adults (Ayers et al. 2014a). For instance, more time is spent doing behavioral activation and in vivo exposures as opposed to cognitive therapy techniques. In summary, accommodations can be made to address cognitive and physical issues.

Future Directions

Although depression and anxiety disorders are often comorbid in older adults, little research has been done on the effectiveness of CBT for comorbid late-life anxiety and depression (Ayers et al. 2014a). Some evidence suggests that CBT for anxiety may also decrease depression symptoms (Gould et al. 2012). Depression may also be more effectively treated by CBT than are anxiety disorders, further suggesting the need for increased research into alternative therapies (Gould et al. 2012).

Cross-References

- ▶ Anxiety Disorders in Later Life
- ▶ Behavioral Analysis
- ▶ Clinical Issues in Working with Older Adults
- ▶ Depression in Later Life
- ▶ Interpersonal Psychotherapy
- ▶ Problem-Solving Therapy
- ▶ Suicide in Late Life

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Cognitive Compensation

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Synonyms

Cognitive plasticity

Definition

The ability to maintain everyday functioning despite quantifiable age-related decline in

cognitive ability (i.e., memory, attention, executive functioning, speed of processing information). Compensation can be achieved in a number of ways, including reliance on pragmatics or experience, strategy use, task modification, cognitive plasticity or growth, and cognitive reserve (i.e., education, activity engagement).

Overview

It is well established that as adults age, they experience decline in various cognitive capacities, including certain types of memory, executive functioning, attention, and processing speed (Schaie 1996; Hultsch et al. 1998). Given the size of these deficits, one might expect that older adults must substantially revise how they complete day-to-day tasks, or require considerable assistance carrying out chores such as managing finances, meal preparation, and taking care of grandchildren. However, the changes in cognitive ability do not tend to translate over to noticeable declines in the ability to complete everyday tasks. Rather, older adults continue to go about their daily lives with the same levels of vigor and proficiency as when they were younger. They may even make achievements that they were not capable of when they were younger. For example, the majority of CEOs for Fortune 500 companies are between their late 40s and early 60s (Salthouse 2012). There are no parallel declines in everyday functioning because older adults can compensate for cognitive decline in a number of ways, including reliance on pragmatics or experience, strategy use, task modification, cognitive plasticity or growth, and cognitive reserve (i.e., education, activity engagement).

Reliance on Pragmatics

There are two general categories of cognition: fluid intelligence and crystallized intelligence (Horn and Cattell 1966). Fluid intelligence uses cognitive abilities that rely on biology and are termed the "mechanics" of cognition. Fluid intelligence involves all of the basic processes needed to complete higher-order cognitive tasks or solve novel problems. It includes domains such as processing speed, spatial skills, working memory, and reasoning. A person is completing a task based on fluid intelligence when the task requires "adaptation to new situations for which prior education or learning provide little advantage" (Berg and Sternberg 2003, p. 105). On the other hand, crystallized intelligence involves experience, expertise, or "pragmatics" (i.e., practical knowledge). This includes abilities such as general and procedural knowledge, skills, strategies, verbal knowledge, occupational expertise, and the ability to solve real-life problems such as counting change.

To further illustrate this distinction, imagine a bicycle. The mechanical or basic entities of the bicycle would be the wheels, chain, pedals, handlebars, and frame. If there is deterioration in the mechanics of the bicycle, such as if the air in a tire is low, the bike can still function, but it becomes harder to pedal. Similarly, a decline in the basic mechanics of cognition, such as processing speed, would make completing a task that relies on fluid intelligence more challenging. In contrast, if a person is cycling down a hill, their practical knowledge or experience would let them know that they do not have to continue pedaling down the hill but can use their momentum and coast to reach the bottom of the hill. The mechanics of their bicycle, deflated tire or not, would not be at play in this scenario, and the person can rely on their experience in riding the bicycle to efficiently manage the hill.

The distinction between fluid and crystallized intelligence is relevant to cognitive compensation because the two types change differently across the lifespan. Fluid intelligence begins to decline soon after age 30, while crystallized intelligence increases until the mid-40s and remains stable until the 70s (Li et al. 2004). Therefore, even though an individual experiences decline in fluid intelligence with age, they can compensate for this deficit by relying more on their crystalized intelligence (i.e., acquired knowledge, pragmatics, expertise, and experience) to complete tasks.

Everyday Life is Different from Cognitive Tests

Another key factor related to cognitive compensation is that the tests used in the laboratory to

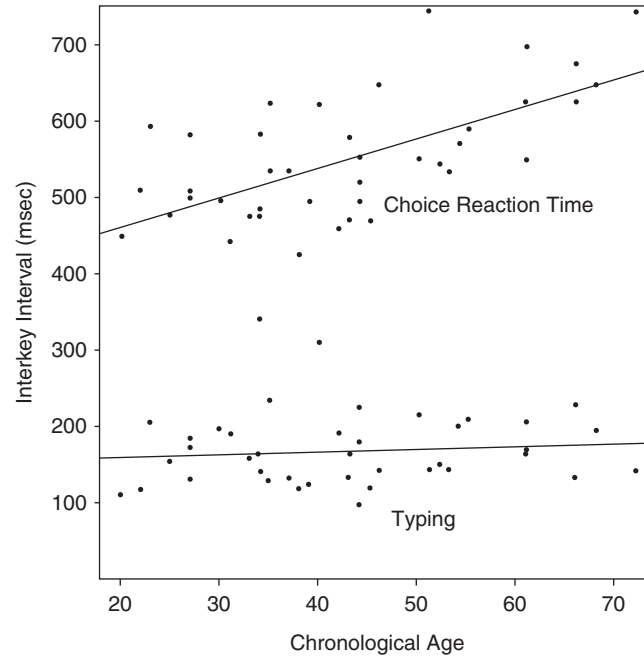
assess cognitive change are very different from the tasks essential to everyday life. Hess (2005) described laboratory-administered memory tasks as "relatively stripped down in terms of familiarity or meaningfulness" (p. 383), as a person rarely has to memorize a list of unrelated words or discover the pattern among sets of letters in the real world. Because of this, tests have been developed that attempt to assess a person's proficiency in completing tasks required in their daily life. These measures provide participants with real-life stimuli like nutrition labels, medication labels, or appliance instructions and ask them to complete tasks designed to assess everyday problem solving or cognition (i.e., balancing a checkbook, reading a bus schedule). Tests of everyday ability show moderate correlation with standard cognitive test scores (Allaire and Marsiske 1999), indicating that while there is overlap between successful completion of both types of tasks, the ability to solve everyday problems is distinct from typical cognitive tasks. However, tests of everyday ability still do not provide a precise measure of how well an adult can actually function in the real world.

Salthouse (2012) discussed facets of our everyday lives that may help to explain why there are not greater consequences in real life as a result of age-related cognitive decline. First, successful fulfillment of daily activities only require one's typical level of functioning, whereas academic cognitive tests assess maximum effort and ability. It may be that cognitive decline with older age is only noticeable when attempting to achieve the upper echelons of human cognitive ability (i.e., on cognitive tests), and the level of cognitive exertion required in our daily lives is not sensitive to detect age-related cognitive deficits. Second, day-to-day tasks are likely only slightly different over time, limiting the amount of novel tasks and situations encountered in daily life and allowing the majority of one's daily function to be solved by relying on past solutions. Consequently, everyday tasks that rely purely on fluid intelligence, which declines with age, would be an exception rather than the rule and experienced only rarely in daily life.

In addition, Park and Gutchess (2000) described that everyday tasks become automatized and require little cognitive effort to fulfill. While the effortful component of memory declines with age, the processes that rely on automatic cognitive processing that occur without conscious awareness or effort do not (Jacoby et al. 1996). Therefore, age-related declines in processing abilities will only be apparent in situations that need mental effort. It is important to note that the automation of tasks is very specific to an individual, and the same situation that requires little cognitive demand for one older adult may involve effortful processing for another (e.g., driving into a large city can be effortful for a tourist versus being rather automatic for a local) (Park and Gutchess 2000). Overall, although it may appear that older adults are engaging in substantial compensation for cognitive decline, an alternative explanation is that the tasks they complete everyday are fundamentally different than the tasks used in the lab that repeatedly demonstrate age-associated cognitive decline.

Strategy Use and Task Modification

If necessary, cognitive compensation can also be achieved through explicit strategy use or modification of the task to accommodate cognitive decline. Possible internal strategies include rote rehearsal (e.g., repeating a name or word multiple times), mental imagery (e.g., recalling ingredients by picturing the finished dish one plans to make), method of loci (i.e., mentally placing items to be recalled in familiar locations, then "walking" through the location to assist in recalling the items), or mental retracing of past steps or events. However, older adults tend to be less likely to spontaneously use such strategies and continue to perform worse than younger adults even when instructed on how to use them (Cavanaugh and Blanchard-Fields 2011). Rather, it is common to rely on external aids such as lists, address books, calendars, notes, or smartphones to aid memory in everyday contexts. A well-known strategy is to use medication organizers or pillboxes to assist with medication adherence, although the efficacy of this aid is inconsistent (Bosworth and Ayotte 2009). Collaborative cognition, where two or



Cognitive Compensation, Fig. 1 Interkey interval for choice reaction time and typing tasks across adulthood (Salthouse, TA. Effects of age and skill in typing. *Journal of Experimental Psychology: General*, 113(3), 345–371, 1984. American Psychological Association. Reprinted with permission)

more people work together to complete a cognitive task, can also be an aid in everyday life. This method can be particularly effective when the other person is one's family or friend as they can have a shared past and familiarity with one another that allows them to tailor their reminder cues to their partner (Rauers et al. 2011).

Extensive practice with the task at hand can also benefit older adults. For example, older adults who are given very large numbers of practice trials (i.e., at least 500) on attention-based tasks can perform just as well as younger adults (Cavanaugh and Blanchard-Fields 2011). Older adults may also simply need more time to complete a task, or perform their best when no time limits are imposed.

Individuals may also begin to approach the same cognitive task differently with age, allowing them to compensate for any possible declines in basic processing resources. Salthouse (1984) completed a seminal study demonstrating this phenomenon. Experienced typists between 17 and 72 years of age completed a range of typing-related tasks. As can be seen in Fig. 1, choice reaction time, a test of basic processing speed, was slower with age. However, even though typing presumably involves similar skill, there was no correlation between age and typing speed. Rather, Salthouse determined that older typists had increased their anticipation span, or were looking farther ahead in the text to be transcribed, and this allowed them to compensate for their slower processing speed.

Similarly, having greater domain-specific knowledge (i.e., crystallized intelligence) for a task or being an expert appears to positively impact performance. Studies have evaluated expertise in a wide range of abilities, including flying, music, chess, bridge, graphic design, and the game of Go. In general, being an expert in a task appears to attenuate but not eliminate age effects on performance and only for tasks specific to the area of expertise (Hess 2005).

Cognitive Plasticity and Training

Improving our cognitive performance despite age-related cognitive changes is another way cognitive compensation is possible. Cognitive plasticity refers to the idea that cognition can be trained or improved. In other words, our cognitive ability is not set in stone and can be changed or show growth over the lifespan.

Numerous studies have attempted to improve older adult's cognitive performance via intense

training or practice of various cognitive skills. One seminal investigation was the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) trial, a multisite intervention that involved 2832 adults aged 65–94 years (Ball et al. 2002). Participants were randomized to receive training in either processing speed, reasoning, or memory ability over ten 60–75 min sessions over 5–6 weeks or were assigned to a control group. All training conditions involved strategy instruction and extensive practice, with tasks becoming more challenging over time. The training conditions involved the following: processing speed training focused on visual search skills, particularly when attention was divided; reasoning training focused on identifying the pattern in various real-life (e.g., travel schedules) and laboratory sequences (e.g., the next letter to appear in a series); and memory training involved recall for word lists, text, and stories, in terms of both real-life (e.g., shopping lists) and laboratory-like (e.g., recall a paragraph) tests. Immediately after the training period, participants who received the training sessions performed better on cognitive tests than the control group, but only in the same domain as the training they received (e.g., the memory training group performed better on memory tasks only). This demonstrated that cognitive ability can be improved in older age, but the training gains were task specific and did not generalize to other types of cognition. Impressively, the training gains were maintained even 10 years later for the speed of processing and reasoning groups (Rebok et al. 2014). Moreover, after 10 years participants in each training group reported less difficulty in completing tasks of everyday living. Therefore cognitive training not only resulted in immediate cognitive compensation but also extended to helping participants be more effective in their daily lives.

Despite the remarkable cognitive gains shown from the ACTIVE trial, the success of interventions that involve extensive practice of tasks or training of particular strategies is not entirely clear. In some studies, improvements are limited to the cognitive domains that were targeted (Ackerman et al. 2010; Owen et al. 2010), whereas other interventions do find generalized improvement to untrained tasks (Schmiedek et al. 2010; Smith et al. 2009). Few studies evaluate intervention effects on everyday function, and the follow-up time of training studies is relatively short (i.e., mostly immediate posttest or months later), putting the durability of effects into question.

Another way to enhance cognitive performance is with interventions that involve increased activity rather than specific practice in cognitive tasks. For these interventions, stimulation is achieved via an intellectually and socially complex environment or particular activity (Park et al. 2007). Older adults who have been assigned to learn theater performance (Noice et al. 2004), competed in team problem-solving tournaments (Stine-Morrow et al. 2014), or participated in an intense elementary school volunteering program have shown significant gains on various cognitive tests (Carlson et al. 2008). Although the novelty of the activity may be relevant to instituting cognitive growth, it may be critically important as to whether the activity requires the acquisition of new skills or involves productive engagement (Park et al. 2007). This is in contrast to activities that rely only on existing knowledge or receptive engagement. Park and colleagues (2014) demonstrated the importance of this distinction by finding that older adults who learned to design and sew quilts, practice digital photography, or a combination of the two over a 3-month period improved on episodic memory tasks compared to those who were assigned to the two receptive engagement conditions. One condition provided only novelty but not skill acquisition (e.g., field trips), and the other involved traditional mental activities (e.g., completing puzzles).

The longevity of the cognitive changes resulting from engagement-based interventions is unclear, but these interventions have the potential of being more easily integrated into everyday life compared to those assigning cognitive training. However, given the documented cognitive growth from both methods, each method holds potential benefit. It remains to be seen if the two intervention techniques are only additive or if cognitive improvement can be maximized by introducing both techniques.

Finally, it is important to note that there also appear to be limits to the cognitive plasticity available to older adults. Although older adults do show cognitive gains from training and activity engagement, the magnitude of possible improvement is smaller than that for younger individuals (Nyberg 2005) even if this varies by cognitive domain (Schmiedek et al. 2010). Therefore, although one method of cognitive compensation may be to increase cognitive capacity via intensive training or engagement, it is unlikely that this method can completely rescind age-related cognitive declines.

Cognitive Reserve

Another way cognitive compensation can occur is via cognitive reserve. The concept of cognitive reserve was created because there is not a direct relationship between the severity of neurological insult or disease and a person's level of cognitive functioning. Rather, individuals may continue to perform at a level higher than expected or show no obvious signs of neurological disease despite diagnosed pathology such as Alzheimer's disease. In other words, older adults appear to be compensating for neurological decline. Stern (2002) described cognitive reserve as the ability of the brain to maximize performance by either using neural networks more efficiently or recruiting alternate neural pathways or cognitive strategies. Cognitive reserve is also known as active reserve, in that the brain actively compensates for pathology, compared to passive brain reserve which is determined by brain volume or the number of synapses. Cognitive reserve is believed to be acquired by engagement in lifestyle activities and educational and occupational attainment. Individuals with more of these resources or reserve are consequently better able to tolerate higher levels of brain pathology before showing signs of clinical impairment (Stern 2002). Each of these potential sources of reserve and their link to cognition is briefly described.

It is well established that older adults who engage in more physical, social, and cognitive activities such as jogging, talking with friends, or playing board games perform better on cognitive tests than less active individuals (Hertzog et al. 2009). Active older adults also have a reduced risk of developing dementia (Wang et al. 2006; Wilson et al. 2002). It is unclear whether lifestyle engagement slows the rate of age-associated cognitive change per se or simply increases cognitive ability level to a higher starting point and that advantage is maintained with age (Salthouse 2006; Bielak et al. 2014). The precise mechanisms for the association with cognitive performance are unclear and vary by activity domain (Bielak 2010).

It is hypothesized that physical exercise may increase blood flow to the brain, positively impact hormone levels, or increase synaptic connections. Moreover, those who frequently exercise are more likely to have other healthy lifestyle behaviors (e.g., adequate sleep and nutrition) and health status (e.g., healthy weight) that can have repercussions for their cognitive health. Social engagement can enhance emotional well-being through decreasing stress and providing opportunities for instrumental and emotional support which can decrease the physical toll on the body and brain. Finally, stimulating cognitive activity may be neurologically beneficial by increasing cerebral blood flow, increasing the number of synapses, or allowing optimal neurochemical compositions. Exposure to cognitive activity may also produce a feedback loop that encourages further engagement in similarly challenging environments and activities. The environmental complexity hypothesis also proposes that exposure to complex environments offer opportunities for intellectual flexibility and practice that in turn enhance cognitive performance (Schooler and Mulatu 2001).

Greater years of formal schooling are also associated with less cognitive decline compared to those who receive fewer years of education, but the relation appears to vary by cognitive domain (Kramer et al. 2004). Low levels of education are a well-established risk factor for Alzheimer's disease, but higher levels do not appear to attenuate the rate of cognitive change (Zahodne et al. 2011; Wilson et al. 2009). Greater exposure to formal education settings would provide high levels of cognitive stimulation, and highly educated individuals are likely more confident completing tasks that challenge their cognitive skills and may seek

out similar environments. Educational attainment is also highly correlated with socioeconomic status, and individuals with greater education are more likely to partake and experience other activities known to be beneficial for cognitive health including good nutrition, holidays to relieve stress, and knowledge of healthy lifestyle behaviors. Consequently, it is unclear to what extent education per se is influencing cognitive reserve versus other related factors.

The complexity of the tasks one completes in their occupation has been linked to cognitive performance. Those who worked in occupations that had greater environmental complexity, or an environment that involved diverse stimuli, having to make many decisions and having to make decisions that had many factors and contingencies showed greater intellectual functioning in older adulthood than those whose paid work was not substantively complex (Schooler et al. 1999). Specifically, it may be greater complexity with people (e.g., mentoring compared to taking instructions or serving) and data (e.g., synthesizing compared to copying or comparing) at work that is associated with better cognitive performance (Andel et al. 2015) and reduced risk of dementia (Andel et al. 2005). Similar to the effects associated with educational attainment, occupation is associated with many other factors that may also indirectly affect cognition (e.g., nutrition, exercise).

Cognitive reserve acts to boost cognitive ability by allowing the brain to be better able to compensate for impending or already existing declines in functioning. However, the various sources of cognitive reserve may not be purely additive. Rather, the potential gains may be modest when multiple other sources of reserve have already been acquired. For example, the benefit of completing complex work was no longer significant to late-life cognition when participation in social activities was also high (Andel et al. 2015).

Conclusion

Compensation for age-associated cognitive decline is possible in various ways. Some of the methods involve explicit compensatory techniques or training, while others are achieved indirectly through participation in other activities or passive reliance on other skills. Despite these various sources, older adults do not appear to be able to achieve the same level of performance on cognitive tests as younger adults. However, the relevance of this limitation is negligible given that age-associated cognitive decline does not have a significant negative impact on everyday life for older adults.

Cross-References

- ▶ Aging and Strategy Use
- ▶ Behavior Modification
- ▶ Cognitive and Brain Plasticity in Old Age
- ▶ Everyday Cognition
- ▶ Expertise and Ageing
- ▶ Memory Training Methods and Benefits
- ▶ Plasticity of Aging

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Cognitive Control and Self-Regulation

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Synonyms

Executive control; Self-control

Cognitive control and self-regulation are key determinants of goal-related behavior and known to be highly susceptible to increasing age. This entry provides an overview about new insights into the geropsychology of cognitive control and self-regulation. In two sections, each concept is briefly defined in combination with existing knowledge about their neuronal underpinnings. Then, empirical evidence on age differences in cognitive control and self-regulatory abilities as well as on how these can be improved by cognitive interventions will be summarized.

Definition of Cognitive Control

The term *cognitive control* refers to a set of higher-order processes that regulate basic sensory, motor, and cognitive operations for planning, guiding, and coordinating goal-directed behavior in everyday life (Miller and Wallis 2009). As these higher-order cognitive processes are assumed to allow pursuing internal goals and flexibly adapting to external changes, cognitive control is regarded as being critical to intelligent behavior.

Evidence from cognitive neuroscientific studies suggests that the mechanism of cognitive control can be attributed to a distributed brain network with the prefrontal cortex (PFC) taking a critical role. Due to its extensive connectivity, the PFC seems to be strongly activated whenever multimodal information from sensory and motor systems and subcortical structures needs to be integrated and maintained in a highly accessible state (Miller and Wallis 2009). Specifically, this PFC activation ensures the maintenance of goal-related information against distraction and serves the top-down guidance of neuronal activation in other brain areas required for the execution of controlled behavior. Advancing age is characterized by a marked neuronal deterioration particularly affecting the integrity of the PFC (Raz 2005). This neuronal alteration in the healthy aging brain has been linked to a pronounced decline of performance in tasks assessing cognitive control processes.

Age Differences in Components of Cognitive Control

Researchers suggested three key components of cognitive control that are assumed to be interrelated but separable abilities: (1) the updating and monitoring of working memory (WM) representations, (2) the inhibition of predominant response tendencies, and (3) the flexible switching between cognitive tasks (Buitenweg et al. 2012). At the theoretical level, aging researchers investigating cognitive control aimed at determining whether age differences in these abilities reflect process-specific limitations or whether they can be explained by age differences in one single general factor reflecting age-related changes in speed of cognitive processing (Kray and Eppinger 2010). At the applied level, aging researchers become more and more interested in assessing the extent to which these abilities can be improved by cognitive interventions (Kray and Ferdinand 2014).

In the following, evidence on both levels will be reviewed for each of the three key components of cognitive control.

Working Memory. There is now ample empirical evidence that WM is a crucial determinant of age differences in cognitive control. In its traditional conceptualization, WM includes domain-specific buffers for short-term storage of visuospatial and verbal information along with central executive processes that monitor and manipulate the storage contents in the service of controlled, goal-directed operations (Hale et al. 2007). The large number of existing WM tasks distinguishes tasks that measure storage capacity, generally termed simple-span tasks (Reuter-Lorenz and Jonides 2007), from tasks that assess both storage capacity and central executive processing, generally termed complex-span tasks. For instance, digit-span tasks can be classified as simple-span tasks. They are assumed to assess the individuals' ability to actively store a number of visually or auditorily presented items and to recall them in the correct order. In contrast, complex-span tasks assess not only storage processing but also the manipulation of the stored information or the processing of a secondary task (Reuter-Lorenz and Jonides 2007). For instance, reading-span tasks require the processing of a sequence of sentences and deciding for each sentence whether it is meaningful or not. At the same time, individuals have to encode the final word of each sentence and to remember these until the end of the task (Reuter-Lorenz and Jonides 2007).

Researchers investigating age differences in simple-span tasks found a differential decline in the performance on visuospatial and verbal WM tasks in older relative to younger adults, indicating larger deficits in visuospatial relative to verbal WM tasks (Hale et al. 2007). Other studies show that age differences are even more pronounced in complex-span tasks, tapping both storage and executive processes, than age differences in storage measures per se. While some researchers tried to separately investigate storage and executive processes of WM in order to identify process-specific limitations in old age, others argued that this separation is artificial, as even storage tasks might require executive control processes, particularly in older adults (Reuter-Lorenz and Jonides 2007). Evidence for this view comes from studies using functional magnetic brain imaging (fMRI) data. Older adults recruit regions of the PFC associated with cognitive control even in simple storage tasks, while these brain regions are not significantly activated in younger adults. These findings suggest that the recruitment of the PFC serves as a compensatory mechanism to maintain good performance in older adults, as assumed by the *Compensation-Related Utilization of Neural Circuits Hypothesis* (CRUNCH) (Reuter-Lorenz and Jonides 2007). However, as task complexity increases, and thereby the demands on executive control, older adults perform poor on WM tasks because their control processes are already taken up by lower storage demands (Reuter-Lorenz and Jonides 2007).

It is now well known that age differences in WM tasks are particularly pronounced with increased cognitive control demands. A critical question from an applied perspective is whether WM can be improved by cognitive interventions even in elderly individuals. In the last decade, a variety of training studies aimed at improving WM performance by means of computerized training programs (Klingberg 2010). These programs often used adaptive training schedules to optimally adjust training demands to individuals' performance levels. Results of these studies indicate that a variable amount of training on visuospatial and verbal WM tasks results in considerable training gains not only in the trained task but also in closely related but untrained WM tasks (Buitenweg et al. 2012; Klingberg 2010). Less consistent evidence is reported on the extent to which these training gains can be maintained over a longer period of time and can be generalized to other cognitive tasks (Buitenweg et al. 2012; Klingberg 2010). These inconsistencies might be due to differences in the duration of the training interventions as well as in the type of training. For instance, it has been shown that practice of explicit memory strategies leads to WM improvements in older adults, but these strategies are not easily transferred to other memory tasks. In contrast, adaptive, process-oriented WM training sometimes also leads

to performance gains in other cognitive tasks (Buitenweg et al. 2012).

Inhibition. Pronounced age differences have also been demonstrated in cognitive control tasks requiring the ability to inhibit irrelevant responses and predominant actions (Buitenweg et al. 2012). One frequently used task to measure the efficiency of inhibition processes is the Stroop task (Kray and Eppinger 2010). This task consists of color words either printed in a compatible color (i.e., "red" printed in red ink) or in an incompatible color (i.e., "red" printed in blue ink) (Kray and Eppinger 2010). Subjects are usually instructed to perform the less-practiced color naming and to inhibit the more-automatized reading of the word meaning. Results typically show longer reaction times and larger error rates in cases in which the word reading interferes with the color naming, that is, on incompatible stimuli relative to compatible ones. This so-called Stroop interference effect is usually larger in elderly adults than in younger adults. Results from a meta-analysis suggest that the larger Stroop interference effect in older adults can be fully explained by age differences in general speed of processing as a general underlying factor (Kray and Eppinger 2010) and not by specific limitation in inhibitory processing. However, when the demands on controlled processing are increased, for instance, by manipulating the frequency of trials on which subjects have to inhibit automatic responses, older adults tend to show larger deficits in inhibitory control than younger adults. The greater need to flexibly recruit cognitive control on less frequent conflict trials, inducing higher demands on cognitive control, lead to pronounced impairments in inhibition tasks in the elderly, similar to the reported findings on age differences in WM tasks (Kray and Eppinger 2010).

Despite the existing age-related decline in measures of inhibition, studies that aim to enhance inhibitory control in old age are lacking (Buitenweg et al. 2012), although there is some evidence for practice-related improvement in the Stroop tasks in older adults. Whether these training gains also transfer to other inhibitory control tasks or even to improvements in other measures of cognitive control remains to be examined (Buitenweg et al. 2012). It has also been suggested that older adults show better inhibitory control in the morning than in the evening, based on circadian arousal patterns for inhibitory processes that predominantly peak in the morning in the elderly (Hasher et al. 2007). In addition, there are some first results indicating that physical fitness is linked to better inhibitory control that is explained by increased prefrontal oxygenation. In this regard, it has been shown that 8 weeks of moderate aerobic training can improve performance on an inhibition task in older adults (Berryman et al. 2014).

Task Switching. Age differences in cognitive control are also obtainable in tasks assessing the flexible switching between task rule representations. In these types of tasks, subjects are required to alternate between two or more simple categorization tasks such as deciding whether a stimulus belongs to the category of fruits or vegetables (picture task) or whether it is gray or colored (color task). Results of a meta-analysis on age differences in task switching show larger general (or global) switching costs in older than younger adults when two tasks are performed in an alternating order on a task-switching block relative to performance on a single task block (also termed mixing costs) (Kray and Ferdinand 2014). These age-related deficits seem to map on age differences in WM as a key determinant of cognitive control, as age differences in the implementation of a task switch within a task-switching block, termed specific (or local) switching costs, are less pronounced than age differences in general switching costs (Kray and Ferdinand 2014). Importantly, age effects in these costs remain reliable after controlling for age differences in processing speed, suggesting process-specific limitations in the ability to maintain and select task sets.

Further evidence for this view comes from aging studies measuring the neuronal activity during task preparation and response selection by means of fMRI and event-related potential (ERP) data. For instance, if the upcoming task in a task-switching paradigm is announced by a preceding task cue, changes in neuronal activity suggest that older relative to younger adults tend to update the appropriate task representations in

WM after task-cue presentation all the time, even if not required, i.e., when the response rules are exactly repeated compared to the previous task. Moreover, older adults seem to recruit a larger proportion of the PFC than younger adults even in single task blocks in which no task switching is required. Similar to age differences in WM, this finding may reflect that older adults tend to compensate for difficulties in maintaining task rule representations by activating a larger network of prefrontal brain areas (Kray and Ferdinand 2014). Together, the results of task-switching studies favor process-specific limitations, as behavioral and psychophysiological measures suggest age differences in the representation and selection of task goals in WM that cannot be attributed to processing speed as a single underlying factor. In contrast, the switching process itself seems to be relatively preserved in old age (Kray and Ferdinand 2014).

Despite these age-related limitations, recent intervention studies revealed substantial plasticity in task-switching abilities among older adults (Buitenweg et al. 2012; Kray and Ferdinand 2014). Strategy-based interventions, for instance, employed labeling strategies such as verbalizing the next task to promote the planning and preparation of the upcoming task switch and thus to facilitate goal-directed behavior. Results on these kinds of interventions show a substantial benefit of verbal self-instructions on switching costs particularly in older adults, indicating language processes to offer a promising approach to support action control in old age (Kray and Ferdinand 2014). Process-based interventions aim to enhance cognitive control by the practice of the underlying cognitive control processes involved in task switching. Recent studies reported a considerable reduction in switching costs for younger as well as older adults, indicating substantial potentials to improve switching ability (Buitenweg et al. 2012). Both age groups also showed larger performance gains in an untrained but structurally similar switching task, and these gains were even more pronounced in the older than in the younger age group. Importantly, training gains also generalized to untrained cognitive control task (e.g., inhibition, WM (Kray and Ferdinand 2014)), suggesting the training of cognitive control processes, and in particular, the training of maintaining and selecting (biasing) of tasks as required in dual-task-like situations is a promising approach to induce broader transfer to other cognitive domains (Buitenweg et al. 2012; Kray and Ferdinand 2014).

A Theoretical Framework for Explaining Age Differences in Cognitive Control

In sum, age-related differences in cognitive control have been shown in WM, inhibition, and switching tasks. Recently, the dual mechanisms of control (DMC; Braver et al. 2007) theory proposes that age differences in all of these tasks can be explained by age differences in one common mechanism, namely, the ability to process context information. Context information is described as the internal representation of task-relevant information such as rules, goals, or instructions within WM that is maintained and updated to serve controlled, goal-related behavior. Within this framework, context processing relies on the interaction between the dorsolateral PFC (DL-PFC) and the midbrain dopamine (DA) system. More precisely, sustained neuronal activity of the DL-PFC provides the online maintenance of context information in order to bias the activity in posterior and subcortical brain regions responsible for goal-related behavior in accordance with the current context representation. At the same time, phasic DA projections toward the DL-PFC in response to new, salient, or reward-predicting context cues are proposed to act as a gating mechanism, i.e., ensuring the appropriate updating of context information in the DL-PFC (Braver et al. 2007). Hence, sustained activity within the DL-PFC ensures the stability of goal-directed behavior against distraction, whereas the DA-guided gating mechanism simultaneously allows for the flexible adaptation to changing task demands. Given the well-known age-related neurobiological changes observed in the PFC and the midbrain DA system, deficits are expected in both the active maintenance and the

gating of new context information that in turn impairs performance on a variety of cognitive control tasks. For instance, the active maintenance of task-relevant context information serves to protect information against interference, and disturbances therein particularly affect WM capacity. In a similar vein, deficits in actively maintaining context representations may also impair the ability to inhibit predominant response tendencies, as the maintenance of a contemporary task rule is thought to enable the activation of a weaker, task-relevant against a stronger but task-irrelevant response. Finally, phasic DA responses to the DL-PFC indicating the need for updating context representations are particularly important in task switching. Therein, context information represents the currently relevant task rule, and deficits in the gating mechanism might impair the updating and flexible attention shifting between cognitive tasks. These examples outline that instead of separating age differences in cognitive control into a decline of subprocesses such as WM, inhibition, and attention shifting, the DMC theory considers age differences in the neurobiological basis of context processing to be fundamental to account for age deficits in subcomponents of cognitive control (Braver et al. 2007).

Recent behavioral and neuroscientific studies on testing the assumptions of the DMC theory show that changes in the interplay between the PFC and the DA system inherent to healthy aging predominantly affect the time course of updating context information. Younger adults exhibit an early, proactive manner of context updating by the time context information is presented and hence update context information to prepare for an upcoming task in advance. In contrast, older adults show a late, reactive manner of context updating, only when needed such as when interference is detected in a reactive fashion (Braver 2012). While the temporal shift of context updating in a pro- versus reactive manner with increasing age has been supported on the basis of fMRI and ERP data (Braver 2012; Schmitt et al. 2014), age differences in maintaining context information have revealed mixed results and seem to occur only under specific task conditions. However, the DMC theory is promising as temporal differences in context updating seem to account for age differences in inhibition, WM, and task shifting that are often regarded as separable components of cognitive control (Braver et al. 2007).

Age-related differences in context updating have been shown to be susceptible to different training regimes. In two training studies, the AX continuous performance task (AX-CPT, Braver 2012) was applied in order to measure an individual's ability to process context cue information required for correct responding to a subsequent probe stimulus. It has been demonstrated that both extended practice and directed strategy training toward the use of cue-based, proactive control in the AX-CPT reduced context processing deficits in older adults, indicating process- and strategy-based interventions to benefit context updating in old age. Moreover, the behavioral improvements in the AX-CPT in older adults were accompanied by increased PFC activation to the presentation of contextual information (Braver 2012). These results correspond to a recent training study showing training-related alterations in PFC activity to underlie the transfer of training gains to untrained cognitive control tasks (Bamidis et al. 2014). In this study, older adults performed an adaptive multitasking video game training offering a large stimulus variability and continuous feedback. The multitasking approach in particular encompassed the need for resolving task interference in the dual-task situation. Training gains were larger after multitask training than after training both tasks in isolation, transferred to other untrained cognitive control tasks such as WM and attention, and remained stable at a follow-up measurement 6 months after the training. Moreover, robust correlations between multitasking ability and changes in activation patterns of the PFC predicted the transfer gains to the untrained cognitive control tasks. Hence, process-based training interventions, such as multitasking training, that aim at improving cognitive control can result in alterations of the neuronal recruitment of the PFC in elderly individuals that may also generalize to other cognitive tasks relying on cognitive control networks (Bamidis et al. 2014).

Definition of Self-Regulation

The concept of *self-regulation* refers to the individual control of own actions, thoughts, and emotions toward the achievement of desired outcomes and intentions (Bauer and Baumeister 2011). It is very loosely defined and considered as a conglomeration of abilities, consisting among others the capability to override automatic habits, basic affects, and impulses, to control and monitor performance, to achieve distal aims, and to resist short-term temptations to the benefit of long-time goals. Accordingly, failures of self-regulatory ability affect both flexible behavior and social adaptation that can be observed in a broad range of psychological phenomena such as gambling, addiction, eating disorders, underachievement, prejudice, aggression, and so on (Bauer and Baumeister 2011).

In general, self-regulatory processing is considered as a system of feedback loops in which individuals concurrently monitor the discrepancy between the actual behavioral outcomes and feedback and the individuals' goal and intentions (Bauer and Baumeister 2011). Whenever there is a discrepancy, individuals automatically or consciously engage in self-regulatory abilities to minimize the discrepancy until the goal is achieved. Hence, similar to the concept of cognitive control, self-regulation is highly important to adaptive, goal-directed behavior (Bauer and Baumeister 2011). For instance, it has been shown that individuals with better cognitive control ability, such as higher WM capacity, also tend to show better self-regulatory skills, such as less mind-wandering or more resistance toward the temptation of eating candy (Hofmann et al. 2011).

Neuronal Underpinnings

Recent research has also identified subprocesses of cognitive control to play an important role in the mechanisms of self-regulation (Wagner and Heatherton 2011), in particular the self-control aspects of self-regulation. This view is supported by evidence that akin to the mechanisms of cognitive control, a broader range of self-regulatory abilities depend on a network of specialized prefrontal brain regions, including the lateral PFC (L-PFC), the ventromedial PFC (VM-PFC), and the anterior cingulate cortex (ACC) (Wagner and Heatherton 2011). The L-PFC is highly related to other prefrontal regions, especially to motor cortices, the VM-PFC, and the ACC, and is assumed to contribute to the mere self-control processes involved in self-regulation, such as inhibiting inappropriate behaviors, maintaining multiple goals in WM and flexibly selecting between them, dealing with distraction, and carefully planning the sequence of goal-directed actions (Wagner and Heatherton 2011). In contrast, the VM-PFC is highly connected to subcortical structures involved in affective processing (e.g., the amygdala, the hypothalamus, the insula, and the ventral striatum). Therefore, the VM-PFC is seen to be particularly important for regulating affective and appetitive processes and adapting to social norms (Wagner and Heatherton 2011). This assumption has been supported by case reports showing patients with damage to the VM-PFC to exhibit drastic personality changes such as aggressive, socially inhibited behavior and a particular inability to respect social norms (Wagner and Heatherton 2011). Despite their functional differences, both the L-PFC and the VM-PFC are interconnected with the ACC that shares many connections with subcortical (e.g., the ventral striatum) and motor regions. Patient studies show that due to its close connection to motor cortices and subcortical structures involved in reward processing, damage to the ACC may result in general apathy, loss of motivation or interest, and an inability to generate behavior (Wagner and Heatherton 2011). Moreover, given its anatomically strategic position, neuroscientific research regards the ACC as a neuronal correlate of a conflict detection mechanism, signaling the need for increased control toward the L-PFC whenever performance errors are detected. This role closely reflects the conceptualization of self-regulation as a system of feedback loops (Wagner and Heatherton 2011).

The strong anatomical and functional overlap between control processes (e.g., inhibition of temptations and automatic behaviors) attributable

to both the concepts of cognitive control and self-regulation has led to systematic investigations of their interaction. In the *Strength Model of Control and Depletion* (Bauer and Baumeister 2011), it has been argued that these control processes depend on a limited, domain-general physiological resource that – once depleted – results in impaired performance on task relying on this resource. Dieters, for example, whose resource for self-regulatory control on eating behavior was stressed by inhibiting temptation from nearby food, showed impaired performance not only in a subsequent task on self-regulation (i.e., eating ice cream) but also on a cognitive control task (i.e., WM) relative to non-dieters and dieters whose self-regulation was not additionally depleted by tempting foods (Bauer and Baumeister 2011). Likewise, participants who were required to take part in a difficult cognitive control task (i.e., attentional control) showed impaired self-regulatory control (i.e., emotion regulation) compared to control participants who did not complete the cognitive control task (Wagner and Heatherton 2011).

Age Differences in Self-Regulation

Age-related deficits in self-regulation have been strongly associated with impairments in cognitive control and in particular with impairments in inhibitory control (Von Hippel and Henry 2011). On the one hand, due to a failure to inhibit and control automatically activated thoughts and temptations, older adults seem to express more social stereotypes (i.e., race-related prejudices), exhibit more socially inappropriate behavior (i.e., talking about private issues in public and generating gratuitous comments), and engage more in risky gambling (i.e., larger perseverance in the absence of reward) than younger adults (Von Hippel and Henry 2011). Interestingly, individual differences in inhibitory deficits (as measured with standard cognitive control tasks) seem to directly mediate the extent of self-regulatory failure in older adults (Von Hippel and Henry 2011). Moreover, these inhibitory deficits have been shown to be sensitive to circadian rhythms, with smaller deficits obtained in the morning than afternoon based on biological changes in the underlying neuronal resource. Therefore, older adults showed more risky gambling and socially inappropriate behavior when they were tested in the afternoon relative to when the experiment took place in the morning (Von Hippel and Henry 2011). On the other hand, evidence exists that older adults are able to manage self-regulatory deficits and inhibit expressing stereotypes or inappropriate behaviors when they are aware of it. For instance, if older adults are forewarned about an upcoming, irrelevant stereotypic situation or if they know beforehand that they have to suppress a socially inappropriate action later on (Von Hippel and Henry 2011), they do not differ in the appropriateness of their behavior relative to younger adults. This suggests that older adults may prepare for potential inhibitory control deficits, and hence, can exert conscious control over their self-regulatory abilities.

Furthermore, there are also findings suggesting *increased* self-regulatory skills in older adults than in younger adults (Von Hippel and Henry 2011). For instance, in the domain of emotion regulation, it has been shown that older adults focus more on positive than negative or neutral information in order to voluntarily enhance their emotional well-being. This phenomenon, known as the *age-related positivity effect* (Mather 2006), has been explained in the framework of the *socio-emotional selectivity theory* (Mather 2006). This theory posits that personal goals have to be regarded within future time constraints. In the case that individuals value future time horizons as enduring, they will focus on goals related to the future, such as gaining knowledge. In contrast, if individuals recognize future time as restricted, just as it occurs in older age, they will focus on immediate, meaningful goals, such as emotional regulation and gratification (Mather 2006). Accordingly, relative to younger adults, older adults expressed higher emotional stability and skills of emotion regulation, showed more effective social problem-solving, focused more strongly on positive relationships with others, and reported less self-conscious negative emotions (Mather 2006). Similar to the controlled

compensation of inhibitory deficits, the age-related positivity effect seems to be more pronounced when older adults are forewarned and for older adults with better cognitive control ability. In contrast, when cognitive load is increased or cognitive control abilities are impaired as in pathological aging, older adults are less able to invest in controlled processing of emotional information and the positivity effect vanishes (Mather 2006).

Apart from the stable or even improved ability of emotion regulation in the elderly, there are only a few studies that have investigated whether self-regulatory skills can be improved by cognitive interventions. These studies show that already a limited amount of practice in self-regulatory control, for instance, by controlling eaten food or engaging in regular physical exercises, is able to translate into improvements in key aspects of self-control in laboratory tasks and also transfers to self-regulatory skills in everyday life (e.g., decreased consumption of cigarettes, alcohol, and unhealthy food) (Bauer and Baumeister 2011). So far these studies have mainly been conducted in younger or middle-aged individuals and largely neglected the effect of self-regulatory practice in older adults (Hofman et al. 2012). However, given existing evidence for self-regulatory failures in old age (e.g., problematic gambling), it might be especially important to create successful self-control trainings and to investigate any potential transfer to measures of self-regulation in this age group. In this respect, it is also interesting to note that improvements in self-control have been demonstrated via training of cognitive control functions. In a study on middle-aged problem drinkers, WM training transferred to self-regulatory improvements, i.e., reduced alcohol consumption for more than 1 month after training (Hofman et al. 2012). Given the functional relationship between cognitive control and self-regulation, these improvements may draw back on the underlying neuronal process resource common to cognitive control and self-regulation. Thus, as cognitive interventions have already demonstrated significant potential to improve different facets of cognitive control in old age (see previous section on cognitive control), future research studies in older adults might investigate whether and to what extent these interventions are able to transfer to self-regulatory skills. Finally, these studies might also turn to training-related changes in the underlying brain network of self-regulation and cognitive control.

Summary

There is now accumulated evidence for age-related limitations in cognitive and self-regulatory control that are associated with alterations in different underlying neuronal networks. Age differences in cognitive control occur in tasks requiring high demands on WM, inhibitory control, and task switching that can be explained by a recent neurobiological theory on context processing. Age differences in self-regulation primarily concern self-control, while emotion regulation is relatively preserved. Intervention studies have revealed considerable plasticity in cognitive control in elderly individuals, while the potential benefit of training in self-regulation is not known yet. Given that cognitive control and self-regulation partly rely on similar neuronal networks, it will be an important challenge for future research to determine whether training in either of these abilities will lead to improvements in the corresponding other one.

Cross-References

- ▶ Age-Related Positivity Effect and Its Implications for Social and Health Gerontology
- ▶ Executive Functions

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Cognitive Dissonance and Aging

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Synonyms

Inconsistency; Inconsistency resolution

Definition

In its original definition, cognitive dissonance is a state of arousal caused by having co-occurring cognitions such that one follows from the obverse of the other. Dissonance is experienced as an unpleasant tension-like state and needs to be reduced. A cognition is an individual piece of knowledge about the world or about one's internal states.

Cognitive Dissonance

Cognitive dissonance is a ubiquitous aspect of human social life. Introduced into the scientific literature by Leon Festinger (1957), the concept was defined as a state of arousal caused by inconsistency among a person's cognitions. In Festinger's view, people abhor inconsistency. When faced with discrepancy among cognitions, people experience a motivation akin to hunger or thirst. It is an uncomfortable drive-like state that we are motivated to reduce. We resolve our inconsistencies in myriad possible ways that are designed to alleviate the tension state and restore equanimity.

Festinger (1957) offered a set of hypothetical examples that helped to describe some of the circumstances that might lead to the arousal of dissonance. Among those circumstances are choosing to smoke when you know that smoking is damaging to your health, making a statement contrary to your true opinions, choosing one commodity or action from a set of attractive alternatives, holding an opinion that is inconsistent with more general values or opinions, or observing events that are inconsistent with past experience.

Despite our preference for consistency, there are numerous times in our daily lives in which we are confronted with a set of inconsistent cognitions. Because the perception of inconsistency leads to an uncomfortable state of arousal, we have developed ways to reduce the inconsistency. We may respond to inconsistency by changing a cognition to make it fit with other cognitions we hold. We can also change the importance of a cognition or act to avoid noticing the inconsistency altogether.

Aging may affect the dissonance process. At the very least, the cognitions that people find to be important change with age. Young children may be invested in the toy they are allowed to choose; young adults may be profoundly affected by the cost of attending university; older adults may be most interested in the types of leisure activities they can choose or the age of retirement from their careers. More profoundly, changes in memory and emotional processes may also affect the quality and magnitude of dissonance arousal, and changes in mental and physical health status may also affect the way that dissonance is experienced in people's lives.

The plan of this entry is to describe the basic tenets of cognitive dissonance theory and the focal areas that have received the preponderance of research attention. Alternative formulations of dissonance will be examined as will the accompanying evidence for those alternatives. Changes in mental processes and brain activities that characterize passage into older age will be presented along with a discussion of the ways that such changes affect the arousal and reduction of cognitive dissonance.

Cognitive Dissonance as Function of Choice

Our lives are replete with choices. We choose a breakfast cereal to begin the morning, we choose the clothes we put on, and, possibly, we choose the means of transportation we use to shop or go to work. If we have been fortunate in our lives, we have chosen the job we currently have or the school that we attended. What is little noted in all of these choices is the fact that choices create the conditions for the arousal of cognitive dissonance. Imagine a couple that has recently retired and decided to change their living accommodations from a private home to a retirement community. They have narrowed their choice to two facilities that they view as highly attractive. One community offers excellent recreational activities but comes at a steep cost. Another may have a dearth of recreational facilities but has excellent food and costs appreciably less. The choice is an important one for it has implications for future lifestyle and happiness.

Cognitive dissonance theory predicts that these retirees will experience cognitive dissonance as soon as they decide which facility to join. Prior to the choice, the many facets of the decision were examined carefully and objectively. In the pre-decision period, people try to make the very best decision possible and consider their options without bias. However, once the decision is made, then every attractive feature of the unchosen alternative stands in contradiction to the choice that was made. So, too, does every unattractive feature of the chosen alternative. For example, if the

retirees decide to join the facility that had the best recreational activities, they will be comforted by the fact that recreation – as well as all other positive features of this choice – fit with their decision. They can envision hours on the treadmill, or the golf course. On the other hand, the cost of the facility will make it less feasible for them to travel for holidays or family visits. Moreover, by choosing the facility with the better recreational activities, the couple will not be able to savor the excellent meals at the second facility.

Cognitive dissonance theory predicts that, once having made a choice, all of the consequences of that choice that are inconsistent with the selected alternative become grist for the dissonance process. The perception of inconsistency – for example, foregoing the excellent food at the rejected community and paying the steep price at the chosen community – creates the aversive feeling state of cognitive dissonance. In order to reduce the aversive state of dissonance, the couple is motivated to reevaluate the components of their decision in order to support the conclusion they came to. They can decide that they did not really want to be saddled with the burden of having to go to the rejected community's elaborate dinners and that traveling is not a highly prized activity after all. They might also engage in selective memory by recalling all of the consequences consistent with their choice while forgetting those that are inconsistent. In the end, dissonance theory predicts that the couple will become more satisfied with their choice than they were when they made their selection. In brief, the inconsistency created by making a difficult choice between alternatives arouses the uncomfortable tension state of dissonance. In order to reduce dissonance, the chosen alternative is seen as more attractive and the rejected alternative becomes less attractive. This is known as the "spreading of alternatives," one of the signature predictions of cognitive dissonance theory.

Numerous laboratory studies have supported this prediction (Cooper 2007). In the first empirical investigation of the consequences of free choice, Brehm (1956) asked adult consumers to rank a number appliances in terms of how attractive they would be to own. The consumers were then given an opportunity to select one of two highly attractive items. The choice was a difficult one because the items had been ranked similarly in attractiveness. Brehm found that, following the choice, the participants came to feel that the item they had chosen was even more attractive than it had been prior to the choice and the item they had rejected was rated as less attractive. The spreading of alternatives following a choice has been replicated with children and adult participants and is robust across cultures (Cooper 2007).

Cognitive Dissonance and Induced Compliance

Induced compliance is the name given to the social situation in which someone is induced to argue for a position that is contrary to the person's own beliefs. In the first experiment of its type, Festinger and Carlsmith (1959) asked participants to engage in a performance task in the laboratory that was designed to engender a negative attitude. It was tedious, boring, and apparently without purpose. Participants were then induced to lie to a person who was waiting to take part in the experiment. They were asked to convince the alleged next person that the performance task was fun, engaging, and enjoyable. Because the statement was clearly contradictory to the participants' attitudes, it aroused cognitive dissonance. In order to reduce the arousal of the unpleasant tension state, participants changed their attitudes to make them more consistent with their behavior – that is, they came to agree that the task was interesting.

Dissonance has a magnitude (Festinger 1957). People who hold cognitions that are incompatible can experience dissonance to different degrees. Some of the variance is due to individual differences in tolerance for inconsistency (Cialdini et al. 1995). Most of the research on the magnitude of dissonance, however, has focused on situational differences in the inducement for counterattitudinal behavior. For example, asking people to make a counterattitudinal statement for a small, or no, incentive creates more dissonance than making the same request for a substantial incentive. Festinger and Carlsmith predicted and found that making attitude-discrepant speeches in

return for a small incentive ($1) created more attitude change than making attitude-discrepant speeches for a large incentive ($20).

The situation that Festinger and Carlsmith employed in their research was well controlled but somewhat artificial. Enjoyment of a specific laboratory task is not a concern in most people's lives. Nonetheless, there are instances in people's lives in which they may find themselves advocating positions that they do not fully endorse and these may lead to the arousal of cognitive dissonance. Imagine that a special interest group hires a retiree to advocate for privatization of a pension or retirement system. Although the retiree does not endorse privatization, he consents to advocate on behalf of this plan. Consistent with dissonance theory predictions, the retiree is likely to change his attitude in favor of privatization. The less he is paid for his advocacy, the greater the dissonance and the greater the attitude change in favor of the privatization plan.

Empirical research has supported the prediction that people change their attitudes toward important issues that affect their lives. People have been induced to change their attitudes about banning controversial speakers, students have changed their attitudes toward raising tuition, and taxpayers have changed their attitudes about raising taxes after being induced to make statements contrary to their attitudes. And, as in the laboratory, the less the incentive, the greater the dissonance and the more the attitude change (Cooper 2007).

An additional feature of the induced compliance situation critical for the maximization of dissonance is that the attitude-discrepant behavior must lead to an unwanted consequence. If a retiree makes a statement advocating privatization of pension plans, the statement will lead to dissonance if there is a consequence to his behavior. The likelihood that someone will be convinced by the counterattitudinal statement facilitates maximal cognitive dissonance and will lead to attitude change.

Effort Justification

People often engage in effortful activities in order to achieve a goal. In the literature on effort justification (Aronson and Mills 1959), effort is considered to be any activity that is difficult and unpleasant or would otherwise not be engaged in. Imagine that a person hopes to join a book discussion club at a neighborhood senior citizen center. Imagine, too, that the group has requirements that could be considered onerous. In order to join, members have to pay a deposit as a precaution against damages, must read and write reports on several books so that their reading and intellectual abilities can be assessed, and agree to lead more than their share of group discussions. Assuming that the deposit, the extra reading, and reports are unpleasant or effortful, then engaging in them arouses cognitive dissonance. If they were engaged in for the purpose of joining the club, then the club ought to be a very good one in order to justify the amount of effort expended. Suppose that objectively it is only mediocre. In that case, the effort expended to join the group is inconsistent with the group's quality. This increases the amount of dissonance. The unpleasant arousal state can be reduced by distorting the perception of the quality of the group. Rather than viewing the book club as mediocre, people can alter their attitude to believe that the group is wonderful, thereby justifying the effort and expense they paid to join.

Alternative Models of Dissonance

The New Look Model. Cooper and Fazio (1984) proposed an alternate model for the basis of cognitive dissonance. They outlined a theory in which dissonance is caused by assuming responsibility for a behavior that results in a potentially unwanted consequence. In the New Look model, dissonance is not aroused by inconsistent cognitions per se but is rather a coping strategy to deal with one's responsibility for bringing about aversive events.

The New Look model raises an important issue that affects many people as they age. Any number of unwanted consequences may occur as a function of growing older. People may need to retire because of failing health or because of arbitrary age restrictions. Home environments may need to be modified or people may need to move to special care facilities. These consequences of aging

are often unwanted and aversive, which seem suited to evoking the arousal of dissonance. Dissonance often works to the advantage of people who must make difficult decisions about retirement or health because it typically serves to make them feel more positively about the decisions they have made. The critical factor that determines whether the unwanted consequences of aging lead to dissonance is whether people feel personally responsible for the occurrence of the aversive events. In principle, if dissonance is aroused, it will lead to cognitive activity designed to reduce the dissonance. If moving to a senior facility leads to something objectively unwanted, people will experience dissonance and take action to reduce it. It would be reasonable to predict that people will be motivated to like their new living facilities as a way to reduce dissonance – but only to the extent that they feel personal responsibility for their choices. If they feel retirement has been forced on them or they had no role in a decision to move to a new facility, then dissonance will not occur and there will be no motivation to raise their evaluations.

The Action-Based Model. Harmon-Jones (1999) proposed a functional approach to the motivation for cognitive dissonance. The action-based model suggests that people are motivated to reduce inconsistency because the negative arousal interferes with people's distal motivation to prepare for unequivocal action. Because inconsistent cognitions imply inconsistent actions, the discrepancy needs to be resolved.

Self-Esteem Approaches. Aronson's self-esteem model (Aronson 1968) and Steele's self-affirmation theory (Steele 1988) suggest that the central motivation for dissonance arousal and reduction is to maintain a high sense of self-esteem. Acting inconsistently threatens people's self-worth. Therefore, restoring consistency is at the service of reestablishing a self-worth and global self-esteem.

Self-Standards Model and the Role of Self-Esteem in Aging. Stone and Cooper (2001) proposed a resolution of the role of self-esteem in dissonance. They showed that the effect of the self in the arousal of dissonance is moderated by the standards that are used to evaluate the consequences of behavior. When people behave, they assess the valence of the consequences by comparing them to a particular standard of judgment. Stone and Cooper's self-standards model proposes that the choice of standards of judgment moderates the role of the self in the dissonance process. When people are motivated by situational or dispositional factors to assess their behavior against normative standards of judgment, such as "How would most people assess this behavior?", then self-esteem does not factor into the dissonance process. However, when people evaluate their behavior by using a personal standard of judgment, then self-esteem is very much a part of the dissonance process. As a general rule, the higher the self-esteem, the greater is the dissonance.

What can we expect about the role of self-esteem in the aging process? To the extent that dissonance is based on personal standards of judgment, an aging population will experience more or less dissonance depending on changes in their self-esteem over the life span. Research concerning the self-esteem of the elderly leans toward the conclusion that older adults have a lower sense of self-esteem than younger adults (Robins et al. 2002), which would suggest that dissonance may be less acute with an aging population. On the other hand, self-esteem of older adults tends to be related not only to chronological age but also with their ability to assimilate into their social environment and to manage difficult life events (Alaphilippe 2008). Self-esteem of the elderly also shows fewer fluctuations than the self-esteem of younger adults. Empirical research has not yet addressed the role of aging as a moderator of the role of self-esteem in the dissonance process but it is likely that self-esteem is a complex factor of chronological age and social circumstances.

Neuropsychology of Dissonance. Dissonance is accompanied by the psychological experience of discomfort (Elliot and Devine 1994) and by autonomic physiological arousal as assessed by elevated skin conductance responses (SCR) (Croyle and Cooper 1983; Losch and Cacioppo 1990). In the brain, research has associated cognitive dissonance with increased neural activity in

the right inferior frontal gyrus, the medial frontoparietal regions, and the ventral striatum and decreased activity in the anterior insula (Jarcho et al. 2011). Such processes are found to engage quickly at the moment of decision without extensive deliberation. Van Veen et al. (2009) found that attitude change associated with cognitive dissonance engages the dorsal anterior cingulate cortex and the anterior insula. More broadly, greater left frontal activity appears to be activated in the dissonance process, linking it to other negative, approach-oriented motivations such as anger (Harmon-Jones 2004).

Dissonance in the Aging Process

Numerous changes occur during aging that affect dissonance. The magnitude of dissonance is influenced by factors that undergo change during the life span. For example, when making a choice between alternatives, a person's age may determine the importance of the choice and therefore the magnitude of dissonance. More fundamentally, increased age brings with it changes in psychological functioning and neurological integrity. These changes are likely to affect cognitive dissonance in fundamental ways.

Older adults experience deteriorations in neural areas important for executive functioning. The prefrontal cortex is one of the areas most affected by aging. With increasing age, the prefrontal cortex responds more slowly than, for example, the limbic system, when processing emotional stimuli (Gross 2013). The vmPFC shows marked structural decline after the age of 60 (Asp et al. 2012). Neuronal density in the frontal gyrus is measurably different when people enter their 70's. Yet, despite the atrophy in structure, activation in areas associated with dissonance and decision making remain strong in older age. Activations in the dorsolateral prefrontal cortex and the ventral medial frontal cortex remain strong, as do the parietal areas.

There are decreases in explicit memory with age, but the decreases are not associated with diminished ability to process or respond to dissonant information. Explicit memory does not appear to be necessary for dissonance reduction. Lieberman and colleagues (2001) tested amnesiacs whose explicit memory was impaired and compared them to normal adults in a free-choice dissonance situation. In the experiment, amnesiacs and normals were asked to make a selection between attractive alternatives. Lieberman et al. found that amnesiacs engaged in choice-supportive reevaluation of the alternatives despite their having no explicit recollection of the initial choice. Consistent with dissonance theory, and similar to the responses of normal participants, amnesiacs spread the attractiveness of the choice alternatives to support the initial decision they had made.

Older adults are more averse to negative affect than are younger adults. For example, they are more likely to rate highly arousing negative stimuli as more negative than do younger adults and are vigilant to minimize the occurrence of negative experiences. Older adults concentrate on avoiding regret and boosting contentment (Carstensen and Hartel 2006). When asked to report their emotional experiences, older adults report as many positive emotional experiences as younger adults but report fewer negative experiences (Carstensen et al. 2000). In general, older adults spend more time and resources regulating emotional experiences, both in laboratory research tasks and in daily life tasks, and do so with a bias that leads to emotional satisfaction (Scheibe and Carstensen 2010).

As people age, they become more proficient at knowing the emotional effects of future events and have the enhanced ability of tailoring their emotion-regulatory strategies to meet contextual demands (Scheibe and Carstensen 2010). Thus, the future emotional implications of decisions may be weighted heavily by older adults, suggesting that because the elderly are concerned with their view of self, decisions and actions that go against their attitudes and views may intensify their experience of dissonance. This effect in the elderly can be further understood through the life-span theory of control (Heckhausen & Schulz 1995), which suggests that people's capability to regulate their environments and attain their growth-related goals declines in older adulthood. Therefore, older

adults increasingly use secondary control tools, such as emotion regulation, which is aimed at changing the self to be able to adjust to a given situation, instead of relying on primary control strategies that change the situation itself.

The increase need for emotion regulation combined with diminished structural integrity of frontal brain activity suggest that older adults devote more of their cognitive resources to regulating emotion, with particular emphasis on avoidance of negative states. Because cognitive dissonance is experienced as a specifically negative emotional state, older adults are motivated to engage in dissonance reduction, consistent with their orientation to avoid negative emotional states. Mather and Johnson (2000) examined people's recollections of the positive and negative features of choice alternatives in a free-choice (Brehm 1956) situation. Older adults (64–83) and younger adults (18–26) were given the option to choose an alternative in a set of two-choice options. Choices included selections of which of two houses they would prefer or about which of two candidates they would select for a job. Several positive and negative attributes of each alternative were described. Following their choice, participants were asked to recall as many of the attributes as they could remember. The older participants showed more choice-supportive memory than the younger adults. Older adults remembered more positive attributes and fewer negative attributes of the alternatives they selected. They also recalled more negative and fewer positive aspects of the alternatives they rejected. Older participants also misattributed attributes of the alternatives in a choice-supportive manner. When given the opportunity to attribute positive and negative features to the alternatives that had not been mentioned in the original list, they made errors of memory in the same choice-supportive fashion.

In order to assess the crucial role played by emotion regulation, participants were either asked to remember the facts or remember how they felt when making their decisions. Younger adults did not show choice-supportive memory when asked for a factual review. They manifested the choice-supportive memory effect only when asked how they felt. Older adults showed the choice-supportive memory effect regardless of condition, indicating that they used selective and distorted memory as ways to adjust negative feelings that were aroused by dissonance.

In Mather and Johnson's research, participants were also administered a neuropsychological test battery to measure frontal brain region pathology. The results showed poorer overall memory among people identified with neuropathological disorders but found even greater ratios of choice-supportive memory in this subpopulation. This is consistent with the notion that the weakening of cognitive executive function causes people to put more of their available resources toward the goal of regulating emotion by becoming more emotionally satisfied with the choices they made (Mather and Johnson 2000).

Further research (Mather and Johnson 2000) confirmed that the distortions of memory are consistent with dissonance theory predictions. Participants either chose one of the alternatives or were assigned one of them. Results confirmed that choice-supportive memory distortions occurred only in the free-choice conditions known to produce cognitive dissonance (Brehm 1956) but not in conditions in which the alternatives were merely assigned.

Conclusion

Cognitive dissonance is a state of aversive arousal that occurs when people perceive inconsistency among their cognitions. Although dissonance was not theorized to be age related, empirical work on dissonance had been primarily focused on convenience samples of young adults. Recent research suggests that, to the extent that gerontological factors influence the course of cognitive dissonance, older adults may be particularly sensitive to dissonance effects. With increasing age, changes in psychological functioning imply different needs, goals, and abilities. Although regions of the brain associated with memory and executive function show structural and functional decline with age, regions associated with cognitive dissonance show no consistent pattern of decline. Instead, research in emotion regulation suggests that the need to achieve positive emotional states increases with age along

with the concomitant sensitivity to potential negative threats. Cognitive dissonance is a potential threat. Reducing it in a choice-supportive manner appears to be an increasing priority of the aging process.

Cross-References

- ▶ Positive Emotion Processing, Theoretical Perspectives
- ▶ Social Cognition and Aging
- ▶ Strength and Vulnerability Integration

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Cognitive Neuroscience of Aging

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Synonyms

Aging; Cognition; Neural differences; Structural changes

Definition

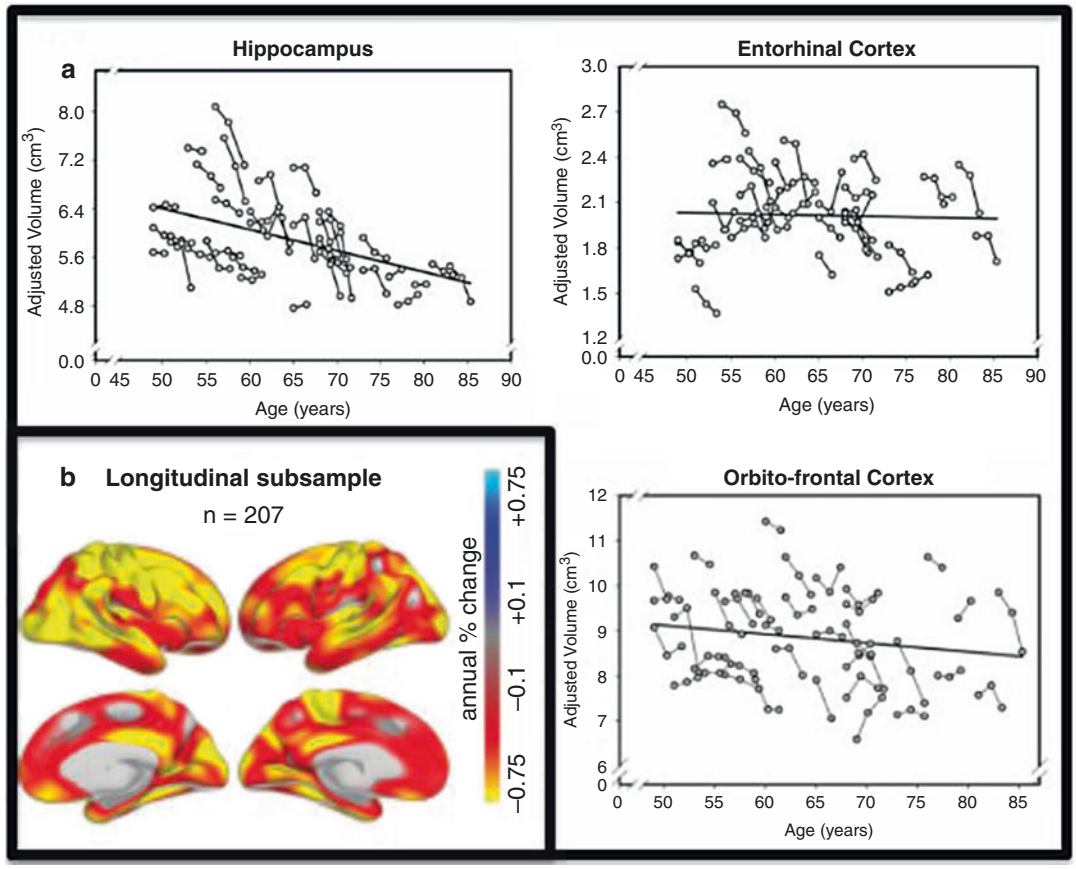
While physical changes are obvious with age, cognitive neuroscience sheds light on the structural and functional changes that occur in the brain throughout the lifespan. Using behavioral and neural measures, cognitive neuroscience suggests that with increasing age, there are not only cognitive deficits, but also the potential for reorganization and stability of these underlying cognitive processes.

Introduction

Much of the previous behavioral research has focused on losses with age – the senses become less sharp, performance worsens on tasks, and it is easier to become distracted and forgetful. While aging brings readily apparent changes to areas such as physical appearance, health, and stamina, it also brings significant changes to the brain. Cognitive neuroscience has greatly impacted the way in which aging is understood by probing these internal changes. New methods have shown that aging leads to alterations in multiple aspects of the brain, including structure, integrity, and active engagement of neural regions. The physical anatomy of the brain changes in terms of both gray matter (as assessed with methods such as magnetic resonance imaging, MRI) and white matter (as assessed with method such as diffusion tensor imaging, DTI). Determining *functional* activation in the brain, such as how different regions are engaged during demanding cognitive tasks, is accomplished via methods such as functional magnetic resonance imaging (fMRI). These are just some of the many methods used in cognitive neuroscience research, but these are the methods that will be predominantly discussed in this entry. Studies employing these methods begin to uncover how age-related changes to the brain impact behavior, including not only how neural regions support cognitive function with age but also the overall efficiency in engaging processes. Importantly, the application of cognitive neuroscience methods has shown that aging is not simply deterioration of the brain, but it also reveals evidence for reorganization and compensation underlying cognitive processes. For example, some research illustrates how an older brain is able to adapt to physiological changes to perform a task comparably well as a younger brain, albeit not as efficiently. Much of the literature argues that older adults recruit additional activation in brain areas that were not activated in younger adults performing the same task. While the function of these activation changes is still greatly debated in the field, it indicates, at the very least, flexibility in the brain recruitment of older adults. Cognitive neuroscience has helped progress the field by seeking to understand the behavioral impairments on a neural level and how brain plasticity attempts to compensate for these changes.

Structural Changes in Aging

With aging, the brain typically undergoes widespread cortical thinning. The gaps (sulci) between the cortex widen, while the volume of the folds of the cortex (gyri) decreases, as evidenced with methods such as MRI. However, certain regions are more prone to atrophy than others, and individuals vary widely in their extent of change. For example, the hippocampus, orbitofrontal cortex, and entorhinal cortex have all been shown to decrease in volume over time, whereas regions like the primary visual cortex, putamen, and pons remain relatively intact (see Fig. 1a; Raz et al. 2010). Longitudinal studies of cortical thickness have also shown that regions such as the

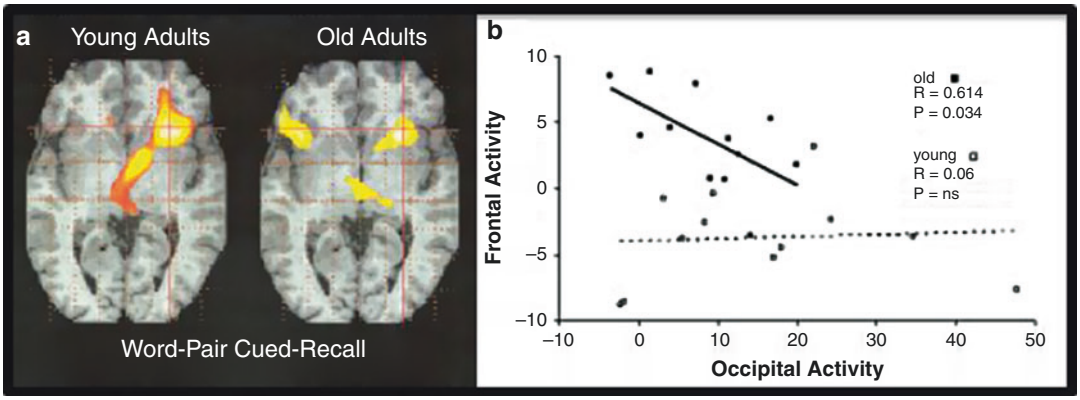


Cognitive Neuroscience of Aging, Fig. 1 Atrophy in the aging brain is exhibited by overall cortical thinning of the cortex. (**a**) Volume was measured twice, 15 months apart, in individuals aged 49 and older. This is depicted by two measurements, connected by a line for each individual. Most individuals show decreases in volume, even in this short time frame, with the vast majority of lines connecting the two points showing a downward trend. The overall trend line reflects that the volume of the region tends to decline after age 49. (**b**) Annual percentage change in cortical thickness was measured in a longitudinal sample aged 60–93. This is represented by a color-coded brain map where percent decrease in cortical thickness is represented by *yellow* and *red*, appearing as lighter and darker *gray* in the grayscale version. The longitudinal sample showed a mean annual change of −0.59% across the cortical surface. This reduction was especially seen in regions such as the lateral frontal, temporoparietal, and lateral occipital cortices (Source: (**a**) adapted from Raz et al. (2010) with permission; (**b**) adapted from Fjell et al. (2014) with permission)

lateral frontal, temporoparietal, and lateral occipital cortices all exhibit an increased mean annual percent change with age (see Fig. 1b; (Fjell et al. 2014)).

Although there is much interest in linking structural measures of the brain with performance on cognitive tasks, there is not always a straightforward link between these measures. However, relationships have emerged for some regions, such as the entorhinal cortex. The cortical thickness of this region is associated with memory performance and shows substantial atrophy both in Alzheimer's disease and in normal aging (Fjell et al. 2014). A role for entorhinal cortex in memory is consistent with its location in the medial temporal lobes near the hippocampus, an important structure for memory.

Classically, atrophy in the brain has been studied by examining gray matter, which is the tissue that contains the cell bodies and dendrites of neurons. However, cognitive neuroscience has revealed that it is also important to study the



Cognitive Neuroscience of Aging, Fig. 2 Changing brain activation patterns with aging. (**a**) Support for the HAROLD model reveals that prefrontal cortex activation during a cued-recall task (e.g., studied *parents-piano,* presented with *parents*-??? at test) was right lateralized in younger adults but bilateral in older adults. Activation appears as a *yellow*/*orange* blob, *gray* in the grayscale version. Concurrent with HAROLD and reductions in hemisphere asymmetry, older adults recruited two hemispheres to complete a task that only required recruitment of one hemisphere for younger adults. (**b**) Correlations between occipital and frontal activations in younger (depicted as *circles*) and older (depicted as *squares*) adults. Consistent with the PASA model, older adults (relative to younger adults) showed less occipital activity concomitantly with increased frontal activity. This suggests age-related deficits in sensory processing that require recruitment of regions involved in organization and reconstruction of information (Source: (**a**) adapted from Cabeza (2002) with permission; (**b**) adapted from Davis et al. (Davis et al. 2008) with permission)

connections between regions of the brain formed by white matter, the tissue that contains the axons of neurons and that is necessary for communication and coordination between regions (Gunning-Dixon et al. 2009). One metric used in DTI is fractional anisotropy (FA), which characterizes the presence of white matter fiber tracts by studying how much water diffuses in one direction. Intact fibers restrict the flow of water, increasing the measure of FA. Research using this method has shown that aging causes deterioration of tissue microstructure, decreasing FA (Gunning-Dixon et al. 2009). As a result, there is no longer an exclusive focus on just gray matter. White matter changes with aging can be profound and may explain much of age-related cognitive decline (Gunning-Dixon et al. 2009).

Age-Related Differences in Neural Activity

While structural measures of gray and white matter largely reveal a pattern of decline, research with functional measures can reveal different patterns. For many tasks, older adults can activate more brain regions than younger adults (Park and Reuter-Lorenz 2009). This includes patterns of bilaterally recruiting the same region in both the left and right hemispheres and shifting from activating regions largely in the back of the brain to those in the front (Cabeza 2002; Davis et al. 2008). Several models have sought to understand the causes and functions of these age-related changes in activation.

The *Hemispheric Asymmetry Reduction in Older Adults (HAROLD)* model looks at how younger adults activate a region in one hemisphere when performing a task, whereas older adults have a tendency to activate the same region in both hemispheres (see Fig. 2a; Cabeza 2002). This pattern of bilateral activity, or reducing the asymmetry of hemispheric activations, can sometimes be linked to better cognitive performance, suggesting that additional bilateral recruitment may support older adults' performance to be on par with that of younger adults.

While HAROLD considers patterns of activation across hemispheres, the *posterior-anterior shift in aging (PASA)* model studies a different

pattern with aging – changes in activation from the back of the brain to front. Specifically, decreases in occipital lobe activation occur concomitantly with increases in frontal lobe activity (see Fig. 2b; Davis et al. 2008). The occipital lobe is involved in sensory-related processes that become deficient with age (e.g., difficulty organizing sensory input of a previously seen image). PASA suggests that older adults try to offset sensory deficits and underrecruitment in these areas by overrecruiting in frontal regions. This change may reflect greater reliance on high-order cognitive processes responsible for directing sensory input or reconstructing poor signals coming from sensory cortices, also known as top-down processing (Davis et al. 2008).

Like HAROLD, another pattern of activity known as *dedifferentiation* illustrates a decrease in the specialization of regions with age (Park et al. 2004). In contrast to HAROLD or PASA, which emphasize the location of the brain areas recruited differently with age, dedifferentiation usually emphasizes the specialization of the process. For example, parts of the brain that respond specifically to seeing faces in younger adults may respond less distinctly to faces but also respond to other images, such as places or words, for older adults (Park et al. 2004). This loss of specialization in activity can occur even in brain regions that do not show atrophy with aging, such as the ventral visual cortex (Park et al. 2004).

Within the literature, there is much debate over whether these increased patterns of activation are actually compensatory, helping to improve older adults' performance. If this is the case, older adults could be bringing "online" additional cognitive resources in response to task demands. One theory has focused on how changing task demands (e.g., increasing or decreasing difficulty of task) can alter activation in older adults. The *compensation-related utilization of neural circuits (CRUNCH)* hypothesis suggests that making a task more difficult should proportionally increase neural activity for older adults at levels of difficulty that would not be considered strenuous for younger adults (Cappell et al. 2010). Building off of that theory, the *scaffolding theory of aging and cognition (STAC)* shows older adults compensate with task difficulty by recruiting additional regions, creating new connections, and enhancing neural systems to improve cognitive performance (Park and Reuter-Lorenz 2009). Cognitive neuroscience methods have helped develop important theories like STAC to advance our understanding of aging. Unlike other theories, STAC actually accounts for both cognitive decline as well as the ability to utilize additional resources to improve performance with age. STAC incorporates the possibility that while cognitive declines may be inevitable with age, interventions such as cognitive training or physical exercise could help subside some of the age-related challenges to cognition.

Theories of Cognitive Aging

Thus far, this chapter has reviewed ways in which cognitive neuroscience has led to new ways of thinking about aging. However, data using these methods have also substantiated or enriched classical theories of cognitive aging originally based on behavioral data.

Speed of processing. Slowing in **o**lder adults is true both physically and mentally, as our ability to process information slows with age. Known as speed of processing, this ability is assessed by how many judgments can be made in a short period of time (Salthouse 1991). Performance declines with age because older adults are slow to complete initial cognitive tasks and processes within a trial, and this prevents them from completing later stages of tasks (Salthouse 1991). Underlying neural regions involved in executive function, such as the prefrontal cortex, have been shown to decrease with age leading to increased response time and inaccuracy in tasks specifically measuring speed and efficiency (Rypma et al. 1999). As previously mentioned, cognitive neuroscience helped establish the importance of studying white matter pathways. It has now been shown that damage to connections between the prefrontal cortex and other regions formed by white matter tracts can largely account for such cognitive slowing (Gunning-Dixon et al. 2009).

Memory. There are two major subtypes of memory, both of which are affected by aging. Working memory manipulates and stores information "online," such that it can be stored, retrieved, or transformed at the same time (Craik and Byrd 1982). Looking up a phone number, keeping it active in mind, and dialing it a few minutes later would be an example of this. The ability to manipulate information decreases with age. Research suggests older adults require additional cognitive resources to maintain information in mind as task demands increase (e.g., remembering a string that is three numbers vs. nine numbers long). In line with the PASA model, older adults try to counteract deficits in underrecruited sensory regions by recruiting higher-order cognitive processes mediated by frontal regions (Cabeza and Dennis 2012). This leads to a pattern of prefrontal overactivation in older adults as additional resources are needed. Interestingly, a similar pattern of activation happens for younger adults too, but not until they reach seemingly higher memory loads (Cappell et al. 2010). This suggests that older adults are using compensatory processes but require them at lower levels of task difficulty than younger adults.

Aging also affects long-term memory or lasting storage of information. As previously mentioned, structural deficits to regions involved in memory processes have been shown to occur with age and accelerate in Alzheimer's disease (Fjell et al. 2014). One consideration within this type of memory is true versus false recollection of items. True recollection, or correctly remembering an event in enough detail to feel as if it were being reexperienced (rather than feeling only generally familiar), is associated with age-related decreases in occipital activation and increases in prefrontal cortex activation (Dennis et al. 2014). Despite recruitment of different neural regions, older and younger adults have similar behavioral rates of true recollection. This pattern of activation therefore suggests an age-related inability to retrieve perceptual details and a greater reliance on familiarity and gist (e.g., general meaning that lacks distinct features) for older adults to complete the task (Dennis et al. 2014). On the other hand, false recollection is associated with age-related decreases in prefrontal cortex activity, parahippocampal gyrus, and occipitoparietal cortex (Dennis et al. 2014). Unlike the comparable memory performance for true recollection, older adults have higher rates of false recollection. The resulting activation then suggests a reduced ability to reconstruct perceptual details leading to increased false memories (Dennis et al. 2014).

Inhibition. Older adults' difficulty with speed of processing and memory could be largely connected to breakdowns in inhibition with age. Inhibition, or the ability to focus on important target information and inhibit attention to irrelevant information, becomes increasingly difficult with age (Hasher et al. 1991). Successful versus unsuccessful "ignore" trials have revealed differences in brain activation. When told to ignore certain words, younger adults activated rostral prefrontal cortex and inferior parietal cortex more than older adults, and activity in these regions was negatively correlated with priming for distracting words (Campbell et al. 2012). Younger adults remembered fewer of the "ignore" words than older adults. Besides activating the rostral prefrontal cortex less during to-be-ignored trials, older adults also had reduced functional connectivity within the frontoparietal network. These results suggested that increased distractibility could be due to decreased engagement of this cognitive control network and impairment in how this network works together with other networks involved in ignoring information (Campbell et al. 2012).

Socioemotional Information and Aging

This chapter has shown that aging brings changes to structural integrity of the brain and the cognitive processes necessary to carry out various tasks. Aging can also impact the ways in which one interacts with the environment. The application of cognitive neuroscience methods to social psychology has allowed researchers to understand the neural changes involved in social domains and emotional responses. Importantly, the inclusion of aging into social and affective neuroscience

research highlights how age-related differences in social cognition, similar to cognitive function, are not just about loss.

Changes in social cognition. Social neuroscience research has revealed a variety of activation patterns. Some patterns are consistent with the cognitive literature, showing that age-related declines in cognitive processes may also contribute to social domains. Other patterns, however, suggest that social domains may be more preserved with age. One ability that seems to be largely preserved with aging is self-referencing. In these tasks, participants must reference words or items to oneself or to another person, and this process can enhance the memorability of information. When comparing activation between younger and older adults, it was found that both groups engage the medial prefrontal cortex similarly (Gutchess et al. 2007). This finding was interpreted as evidence for preserved social functioning, and corresponding neural activity, with age.

Other research, however, suggests that patterns of activation in social cognition are consistent with the functional deteriorations seen in the cognitive literature. Processes like inhibition and speed of processing which decline in age may contribute to changes in social cognition by way of their contribution to executive function. For example, executive functions are necessary for regulation of bias, specifically toward stigmatized individuals (e.g., individuals with facial deformities, homeless people). It has been shown that high-functioning older adults, who had relatively preserved levels of executive function, activated areas of lateral prefrontal cortex more than younger adults and low-functioning older adults (Krendl et al. 2009). On the other hand, younger adults had greater activity in medial prefrontal cortex than older adults in response to stigmatized individuals that were considered less negative (Krendl et al. 2009). Because high-functioning older adults and younger adults showed similar attitudes toward stigmatized targets, the differences in the groups' neural activity suggest high-functioning older adults and younger adults rely on different underlying processes (Krendl et al. 2009). High-functioning older adults may have exerted greater cognitive effort, relying on executive function, to achieve the same behavioral results.

Changes in emotion. In contrast to the other abilities reviewed thus far, emotion regulation, or the ability to control reactivity to valenced stimuli, seems to improve with age. Unlike other areas of the brain that undergo large amounts of atrophy, the amygdala is relatively preserved with age (Nashiro et al. 2012). Further, aging seems to affect the is processed way in which valenced information. Older adults show a positivity effect, whereby they spend more time viewing positive items and less time viewing negative items. As a result, older adults remember relatively less negative information and more positive information (Mather and Carstensen 2005). Behavioral theories suggest that the positivity effect seen with aging is due to a greater focus on regulating emotions and required cognitive processes (Mather and Carstensen 2005). This cognitive control theory predicts that prefrontal emotion regulation processes diminish amygdala responses to negative but not positive stimuli (Nashiro et al. 2012).

Using cognitive neuroscience methods, one can examine the ways in which different regions in a network operate together to contribute to this shift in emotional processing with age. Research suggests that emotional processing differences are the result of age-related changes in encoding processes when viewing positive stimuli only. In these instances, the connectivity between the ventromedial prefrontal cortex, amygdala, and hippocampus was stronger during encoding of positive trials only (Addis et al. 2010). There were no changes in connectivity between regions during encoding of negative trials (Addis et al. 2010). This suggests that aging may not weaken emotional network connections (as in the negative stimuli) but rather strengthen them (in relation to the positive stimuli), allowing for increased attention and memory for positive information.

Conclusion

The growth of cognitive neuroscience has changed the way aging is studied and understood. Brain volume and cortical thickness decrease, and

important connections between regions lose integrity as white matter tracts deteriorate. In aging there are also general brain activation patterns that change, such as reduced hemispheric asymmetry and overrecruitment of frontal regions. Importantly, cognitive neuroscience has shown that aging is not just a downward spiral of loss but can include compensation by bringing additional regions "online" and reorganizing neural circuits. Despite the increased appreciation for malleability in neural circuits with age, changes in the brain do affect cognition, causing older adults to process information slower, demonstrate short- and long-term memory problems, and experience difficulty attending to important information while ignoring irrelevant information. In regard to social cognition, research is split on whether social domains may be preserved in aging. Some aspects appear to be affected by underlying cognitive processes that are known to deteriorate, whereas other abilities seem to be unaffected. Age-related differences are also seen in emotional processing, with older adults exhibiting a positive bias when viewing and remembering information. Research has shown this change could be the result of a greater focus on emotion regulation with aging or altered connections between neural regions, allowing for the emphasis on positive information over negative. Ultimately, developments in cognitive neuroscience have shown that aging is not as clear-cut as previously thought – there are both age-related deficits and alterations that reveal the ability of the aging brain to adapt to change through compensation. Advances in cognitive neuroscience methods seek to better understand the physiological changes that occur through aging and how these neural changes ultimately influence behavior.

Cross-References

- ▶ Aging and Attention
- ▶ Aging and Inhibition
- ▶ Cognition
- ▶ Cognitive and Brain Plasticity in Old Age
- ▶ Cognitive Compensation
- ▶ Cognitive Control and Self-Regulation
- ▶ Emotion–Cognition Interactions
- ▶ Executive Functioning
- ▶ History of Cognitive Aging Research
- ▶ Positive Emotion Processing, Theoretical Perspectives
- ▶ Psychological Theories of Successful Aging
- ▶ Social Cognition and Aging

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Cognitive Rehabilitation

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Synonyms

Adaptation; Cognitive strategies; Cognitive training; Compensation

Definition

Cognitive rehabilitation refers to therapy designed to restore, substitute, or compensate for cognitive abilities lost due to injury or illness. Cognitive rehabilitation typically refers to training targeting improvement of skill by regaining (reestablishing or strengthening) abilities that were intact prior to the loss. The other focus of cognitive rehabilitation is developing compensatory strategies for lost abilities when they cannot be regained. In contrast, the term cognitive intervention refers to targeted training of a particular cognitive skill or domain for the purpose of enhancement regardless of the baseline state of cognitive abilities. As such, many cognitive interventions target healthy functioning individuals. Distinct from rehabilitation and intervention, cognitive stimulation therapy refers to a brief psychological intervention used to provide general stimulation of cognitive abilities in individuals with mild to moderate dementia.

The techniques used in cognitive rehabilitation can be applied to any individual who experiences cognitive loss due to an injury or illness. Most commonly, cognitive rehabilitation is used with stroke victims and traumatic brain injury patients. Additionally, while less common, cognitive rehabilitation techniques and programs have been designed for elders with cognitive decline due to normal aging, mild cognitive impairment (MCI), or neurodegenerative disease (Attix and Welsh-Bohmer 2006; Camp 2010).

History of Cognitive Rehabilitation in Old Age

As the name suggests, cognitive rehabilitation represents a diverse set of therapeutic interventions aimed at restoring, substituting, or compensating for cognitive abilities impacted by injury or illness through the use of specific strategies or adaptations. These interventions are nonpharmacological and nonsurgical and are aimed at remediating the cognitive capacities (Prigatano 2005). Historically, cognitive rehabilitation has focused on specific kinds of acquired brain injury

such as traumatic brain injury (TBI) and stroke (Parente and Stapleton 1996). While injury severity necessarily limits the extent to which cognitive rehabilitation can be effectively utilized, age is also a significant factor contributing to the efficiency (e.g., time, cost) of cognitive rehabilitation for acquired brain injury (Flanagan et al. 2005) as well as later-life cognitive impairment and dementia.

To combat the effects of cognitive decline in older adults, cognitive rehabilitation was born out of plasticity research in the 1970s, which conceptualized the cognitive aging process as both multidimensional and multidirectional (Verhaeghen 2000). At that time, the "performance-potential" divide associated with cognitive aging spurred the search for modifiability, which would later be described as plasticity. Baltes and Willis (1982) defined plasticity as "the range of intellectual aging under conditions not normally existent in either the living ecology of older persons or in the standard assessment situation provided by classical test of psychometric intelligence." While early experiments focused on the enhancement of performance on tests of intelligence, plasticity research with elders quickly branched out into the domain of episodic memory function and has since expanded to include nonspecific cognitive stimulation targeting a variety of cognitive domains (Smith et al. 2009). As the construct of brain plasticity has matured, it has come to stand alongside, if not over shadow, cognitive rehabilitation training programs focused on strategy use. This is in part due to the lack of generalized gains from direct strategy instruction outside of the specific cognitive tasks related to the training. Additionally, it can be difficult for older adults to continue learning new approaches to cognitive processing, as use of specific strategies require.

One of the dominant theories underlying current understanding of neuroplasticity in cognitive aging is known as the scaffolding theory of aging and cognition (STAC; Goh and Park 2009). STAC posits that the aging brain responds to neural insults (e.g., volume reduction, white matter degradation) through the recruitment of additional brain regions to achieve adequate function. Barulli and Stern (2013) identify STAC as a more generalized theory of neural compensation within which the concept of cognitive reserve remains an important factor associated with better neural compensation. Such additional brain recruitment has been observed in both structural and functional imaging studies. For example, Ilg and colleagues (2010) investigated practice-induced neural activation associated with mirror reading and found that short-term gray matter signal increase was associated with task-specific processing. Similarly, Steffener and colleagues (2009) investigated age-related changes in working memory using an fMRI paradigm. They found that while decreased regional volume in the primary neural network was associated with increased secondary network utilization independent of age, only older adults demonstrated increased activation in the secondary neural network as working memory load increased. Whether this recruitment represents neural compensation in the facilitation of task completion remains debated (Park and Reuter-Lorenz 2009).

Preventative Cognitive Training

Increasingly, however, targeting healthy older adults before symptoms of impairment develop has been a focus of research. Shatenstein and Berberger-Gateau (2015) have recently posited four categories of modifiable cognitive risk or protective factors for older adults: (1) collective societal factors, (2) individual psychosocial factors, (3) lifestyle factors, and (4) cardiometabolic factors. Within these four categories, seven individual modifiable factors account for 28% of the risk of developing Alzheimer's disease: diabetes, obesity or hypertension in middle age, low physical activity, depression, smoking, and low educational level. Within this model, Shatenstein and Berberger-Gateau identify primary prevention as reduction of the occurrence of specific risk factors, with secondary prevention aimed at early prevention of disease by identification of clinical or biological markers that could lead to early detection and treatment of at-risk individuals.

Historically, cognitive interventions have been used to remediate intellectual decline in normal

older adults. In a longitudinal study conducted by Schaie and Willis (1986), their findings suggest that decline is associated with the disuse of cognitive abilities overtime. With the implementation of cognitive training, two thirds of the participants were able to improve their intellectual functioning. Specifically, 40% of the participants that had shown significant decline over a 14-year period were able to return to their pre-decline performance (Schaie and Willis 1986). Furthermore, the outcomes of this cognitive training were shown to be long-lasting, with the benefits persisting 7 years after training in comparison to controls (Schaie et al. 1994).

The potential benefits of targeting healthy older adults have been rigorously demonstrated in the recent Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) study. The ACTIVE study was a randomized, controlled single-blind trial (n = 2832) with three intervention groups and a no-contact control group to determine the effects of cognitive training on cognitive abilities and everyday function over a 10-year period. Each of the three intervention groups targeted a specific cognitive domain: memory, reasoning, and speed-of-processing. The intervention consisted of an initial ten-session training (60–70 min per session) for one of the three cognitive domains, with some participants receiving a four-session booster training at 11 and at 35 months after training. Outcome measures included both objective measures of memory, reasoning, and processing speed and functional measures of IADLs.

At the conclusion of the study, all groups showed declines from their baseline tests across cognitive domains. Interestingly, individuals who received training in reasoning and processing speed evidenced fewer declines than those in the memory and control groups. Results of the cognitive tests after 10 years reported by Rebok and colleagues (2014) demonstrated that nearly three quarters of those individuals that received reasoning training were still performing reasoning tasks above their pretrial baseline level. In contrast, only 62% percent of control participants showed above pretrial performance. Similarly, 71% of those receiving the processing speed intervention were performing comparable or better than their baseline level compared to 49% of controls. Memory performance was comparable between the intervention and control groups after 10 years. With respect to IADLs, individuals across all three intervention groups endorsed less subjective difficulty with IADLs than control participants; however, performance on objective measures of functional abilities was comparable across intervention and control groups.

In summary, ACTIVE was the first multisite clinical trial to test the effects of cognitive training interventions on cognitive abilities and daily function in healthy functioning older adults. The relative success of the ACTIVE trial provides support for preventative cognitive interventions in this population and has significant economic implications given the aging of the US population. Interventions that reliably extend healthy cognitive aging trajectories could significantly reduce the economic burden associated with cognitive impairment and dementia.

Cognitive Rehabilitation for Mild Cognitive Impairment

MCI is often described an intermediate stage between cognitive decline due to normal aging and dementia (Huckans et al. 2013). Criteria for MCI diagnosis are (a) evidence of modest cognitive decline from a previous level of performance in one or more cognitive domains including memory, language, attention, visuospatial functioning, and executive functioning, or as documented by standardized neuropsychological testing, (b) cognitive deficits do not interfere with capacity for independence in everyday activity, (c) cognitive deficits do not occur exclusively in the context of a delirium, and (d) it is not better explained by another mental disorder and does not meet criteria for dementia (American Psychiatric Association 2013). Although many people with MCI live independently, declines in subjective and objective memory and cognition impact quality and degree of independence in daily life. Deficits may impact scheduling, transportation, or financial management. Functional impact may be

greater for those struggling with multiple domain MCI rather than in a single domain (Huckans et al. 2013). Within the older adult population, the prevalence rate of MCI is estimated to range from 3% to 42% (Ward et al. 2012). However, it is estimated that 14–40% of people with MCI return to normal cognitive functioning (Ganguli et al. 2004) and others maintain MCI functioning without progressing to dementia (Manly et al. 2008). The use of cognitive rehabilitation in this population may have particularly beneficial outcomes (Huckans et al. 2013), as gains will not be obscured by progressive decline.

A large proportion of patients (35–85%) with MCI have additional psychiatric comorbidities, such depression, anxiety, irritability, apathy, disinhibition, and sleep disorder (Monastero et al. 2009). Therefore, effective management of MCI will not only focus on cognitive decline but also incorporate strategies to address neuropsychiatric symptoms and lifestyle.

Although many cognitive rehabilitation programs exist to treat MCI, there are several strategies and interventions that are consistent across programs. The first and most directive approach to address cognitive impairment is restorative cognitive training. The aim of this technique is to enhance or restore cognitive abilities through neuroplasticity mechanisms. This is most commonly done through the utilization of structured and repeated practice of specific cognitive tasks and mental exercises (Huckans et al. 2013). These tasks are tailored to the individual's ability level and in the domain that is impaired, such as memory or attention. The exercises have the potential to improve or maintain functioning in these cognitive domains with the goal to improve performance that will generalize beyond the immediate training task. However, the impact and the duration of task repetition remain unclear (O'Sullivan et al. 2015). Belleville and colleagues (2006) demonstrated that instruction in episodic memory strategies is effective in improving memory performance in individuals with MCI. More recently, Gagnon and Belleville (2012) reported that individuals with a single-domain executive function deficit benefit from an attentional control cognitive intervention.

A different approach is to train cognition through the development of new processing approaches. Here, cognitive training draws on internal strategies to work around the deficit when the impairment cannot be improved through repetition. Examples of such cognitive training strategies include visual imagery, chunking information, storytelling, and creating acronyms to remediate memory difficulties. Other strategies such as structured problem solving and planning methods can be used to address specific executive deficits (Huckans et al. 2013). Teaching mindfulness to double check and develop habits and routines may also be helpful for some individuals (O'Sullivan et al. 2015). Compensatory techniques can also involve external aids such as day planners, calendars, and personal notebooks (Kurz et al. 2009). Navigation devices can be helpful for those with visuospatial compromises. Additionally, environmental strategies may be used, such as setting up a quiet workspace in order to avoid distracting visual and auditory stimuli (Huckans et al. 2013). Quinn and colleagues (2015) recently reviewed three self-management interventions for individuals with MCI that focused on information, communication, social support, and skills training. They concluded that continued study of this intervention is necessary to test the efficacy of self-management techniques in an MCI population.

Treatment benefit will likely be maximized if additional treatment modifiers, such as mood and lifestyle factors, are also addressed (Attix and and Welsch-Bohmer 2006). Education about MCI as a risk state, rather than prognostic indicator, can be quite helpful. Information about lifestyle practices that involve protective factors (e.g., diet, exercise, and cognitively stimulating activities) and risk factors (e.g., smoking, heavy substance use) is also relevant. This can be done through direct behavioral engagement or through the use of motivational interviewing with patients (Huckans et al. 2013; Kurz et al. 2009). Lastly, psychotherapeutic interventions are utilized to treat the neuropsychiatric symptoms that frequently accompany MCI. For example, relaxation exercises and deep breathing can be taught to reduce anxiety, and cognitive-behavioral

interventions can be utilized to address negative thoughts and feelings related to MCI (Kurz et al. 2009; O'Sullivan et al. 2015; Huckans et al. 2013). While not every patient will need cognitive retraining, compensatory strategies, modification of lifestyle interventions, and psychotherapy, these interventions are each part of a comprehensive treatment model to improve overall quality of life in patients with MCI.

Cognitive Rehabilitation in Dementia

Due to the progressive nature of neurodegenerative diseases, many do not believe that cognitive rehabilitation is a suitable treatment for people with progressive dementias such as Alzheimer's disease, progressive vascular disease, and Lewy body disease. However, when the goal is to improve quality of life rather than return to premorbid cognitive ability, cognitive intervention can be a proactive approach to improve overall functioning (Marshall 2005). Dementia is a relatively common condition in older adults aged 65 and older, affecting approximately 5% of the population (Jolley 2005). Alzheimer's dementia (AD) has an insidious onset and progressive cognitive decline, predominately in the domain of episodic memory, and is most evident in the ability to register and retain new information. However, people with AD tend to maintain the ability to recall stories from early in their lives, as well as habits and skills performed over decades (Jolley 2005) until late stages of the disease. Cognitive intervention is primarily used in individuals with dementia to help them utilize their remaining memory functioning most effectively, learn how to compensate for difficulties, and create environmental adjustments to reduce the need for memory (Mountain 2005). In other words, cognitive intervention aims to assist patients and families discover new ways to handle problems that arise due to cognitive decline and help the individual maintain the ability to engage in pleasurable activities and interact with loved ones for as long as possible (Clare 2005). The treatment should be client-centered, recognize the changing role identities of the patient, and facilitate coping and effectiveness. Attix and Welsh-Bohmer (2006) detail the importance of the initial clinical evaluation in maximizing the effectiveness of cognitive interventions through careful incorporation of relevant patient data. These variables include goals, motivation, neuropsychological evaluation, insight, affective status, unique patient and environmental factors, and current compensatory methods and activities.

Cognitive rehabilitation techniques for people with more significant deficits in dementia include reminiscence therapy, reality orientation, and validation therapy, among others. Reminiscence therapy encourages individuals to recall past events and life experiences through stimuli that evoke memories, such as photos, objects, music, and videos. These sessions typically take place in a group setting in order to stimulate conversation about common subjects (Mountain 2005). Reality orientation is a technique that presents orientation information such as time, place, and person-related. The goal of providing information about the surroundings is to improve the quality of life in confused individuals by increasing their sense of control. Bianchetti and Trabucchi (2001) found that this therapy was able to delay entry into extended-care facilities and slow cognitive decline when administered over an extended period of time to people in early- to middle-stage dementia. In contrast, validation therapy provides a way to communicate with older individuals with dementia in a way that is opposite to reality orientation. Instead of helping the individual understand the truth of their surroundings, this communication style validates rather than corrects the individual's erroneous sense of reality (Neal and Briggs 2003). The purpose of these three therapeutic orientations aims to compensate for decline rather than attempt to reverse it. This approach can ultimately lead to greater acceptance and increased quality of life for people with dementia (Mountain 2005). Importantly, however, this therapeutic approach has received criticism with respect to its underlying evidence base. Moreover, in their 2003 review of the effects of validation therapy, Neal and Barton concluded that there is insufficient evidence from rigorous studies (e.g., randomized control trials) to

substantiate claims of efficacy for people with dementia or cognitive impairment.

Alternatives to compensatory orientations include self-management interventions, which equip people to manage the symptoms and lifestyle changes present over the course of chronic health conditions. Self-management interventions for individuals with dementia focus on psychoeducation, social support, and specific skills training. Quinn and colleagues (2016) recently reported modest effects of a randomized controlled trial of a self-management intervention for individuals with early-stage dementia and their caregivers.

Adaptations to existing methods of developmental learning have also been successfully employed in individuals with dementia. For example, Camp and colleagues developed Montessori Programming for Dementia (MPD), which provides a framework for the translation of Montessori principles into meaningful activities for individuals with dementia (Camp 2010). MPD has been used effectively within long-term care settings as well as in intergenerational care programs where programming is administered to older adults and preschool-aged children in a shared location (Camp and Lee 2011; Camp et al. 2002).

Future Directions

While interventions on individual modifiable risk factors associated with cognitive decline will continue to be investigated, multidomain approaches for the prevention of cognitive decline are strategic. This is, in part, due to the multifactorial nature of late-life dementia (Richard et al. 2012). Additionally, the majority of preventative studies to date have focused on the prevention of dementia, rather than less severe forms of cognitive impairment. The recent results of the Finnish FINGER study (Ngandu et al. 2015) provide proof-of-concept for the efficacy of multidomain interventions targeting modifiable vascular and lifestyle-related risk factors associated with mild cognitive deficits. Several other randomized clinical trials are employing multidomain approaches, including the US ENLIGHTEN trial, the Prevention of Dementia by Intensive Vascular Care (preDIVA) study, and the Healthy Aging through Internet Counseling in Elderly (HATICE) program, which focuses on the management of modifiable risk factors in older people using an Internet-based platform (Shatenstein et al. 2015).

Conclusions

While cognitive rehabilitation interventions will continue to be developed and used in older adult populations with acquired brain injury (e.g., TBI, MCI), MCI, and dementia, preventative interventions to extend healthy aging cognitive trajectories are well positioned to be more widely disseminated. Efforts to build cognitive reserve and thereby extend the course of healthy cognitive aging trajectories have significant economic implications. For example, total annual per-person payments for Medicare beneficiaries with dementia are more than three times greater than payments for those without dementia (Unpublished tabulations based on data from the Medicare Current Beneficiary Survey for 2008. Prepared under contract by Julie Bynum, November 2011). Total payments in health care, long-term care, and hospice for individuals with neurodegenerative disease are currently estimated at $214 billion, and over the next 25 years, the cumulative cost of care for individuals suffering from neurodegenerative diseases such as Alzheimer's disease has been estimated at over $1 trillion (Alzheimer's 2014). These cost underscore the economic benefits associated with the prolongation of healthy cognitive aging trajectories even over relatively short amounts of time.

Cross-References

- ▶ Cognitive and Brain Plasticity in Old Age
- ▶ Cognitive Compensation
- ▶ Frailty and Cognition
- ▶ Healthy Aging
- ▶ Mild Cognitive Impairment
- ▶ Neurocognitive Markers of Aging

▶ Psychological Theories of Successful Aging
▶ Resilience and Aging

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Cohort Effects

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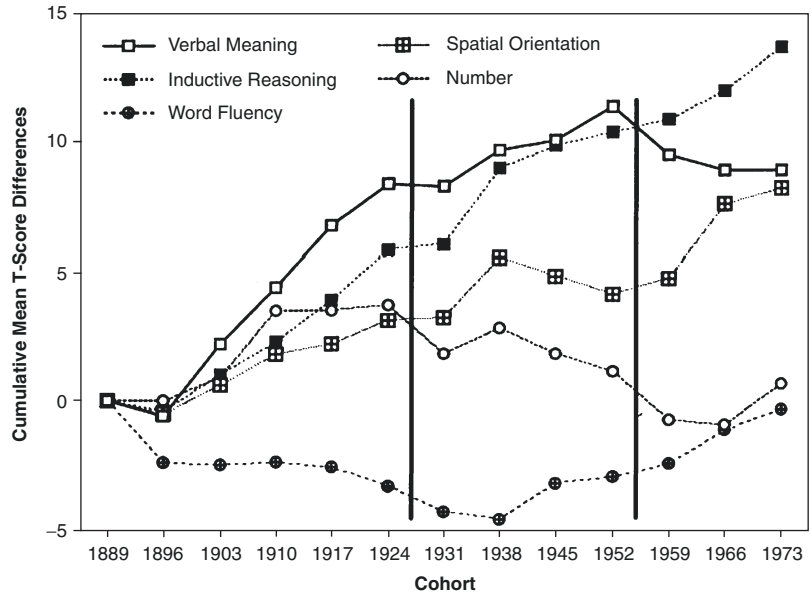
Synonyms

Birth cohort; Cohort effect; Generation (e.g., Baby boomers); Generational shift

Definition

The term *cohort* refers to a group of people born at about the same time.

In geropsychology, the term *cohort* refers to a group of people born at about the same time. While it has long been considered a nuisance variable for age-based developmental studies, cohort is an important variable for many researchers in the social and health sciences because it provides evidence of secular changes. Studies of cohort effects on intelligence, reasoning, memory, and other cognitive abilities have garnered recent attention in both the academic and lay communities (Schaie et al. 2005; Williams 2013). A cogent example is the *Flynn effect* (Flynn 1987), which is the observation that generation by generation, people are becoming smarter with respect to intelligence test scores.



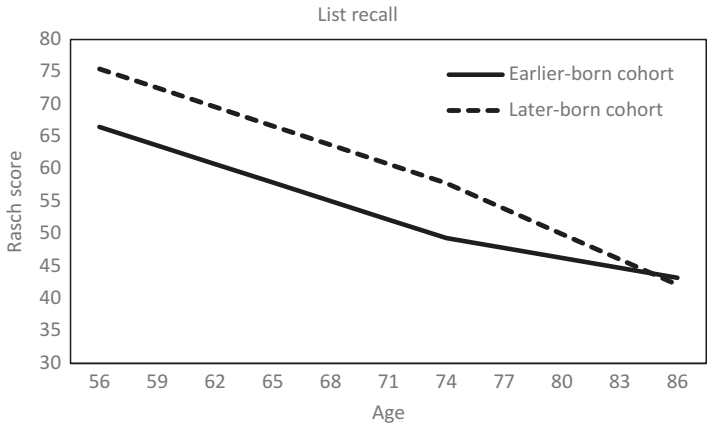
Cohort Effects, Fig. 1 Cumulative cohort differences for the primary mental abilities in the Seattle Longitudinal Study. Excerpted from Schaie (2005) (Reprinted with permission from Oxford University Press.)

This entry will focus on cohort effects on cognitive performance primarily in adulthood and older age. After reviewing some of the methodological issues that affect the measurement of cohort and age effects, several important findings on cohort differences in cognitive performance including the Flynn effect will be reviewed. Finally, the issue of whether cohort differences continue into later life will be discussed.

Methodological Issues

Cohort is often contextualized in the metric of years, decades, or generations. Decisions about defining an appropriate time metric to assess cohort effects are important because the gap between cohorts needs to be large enough to detect statistical differences, yet not too large as to miss meaningful changes or turning points. Decisions about the range of birth years to be included in a sample are best made before initiating a study but are often constrained to the parameters of previously collected data in studies that were not specifically designed with the measurement of cohort in mind (Schaie et al. 2005).

Cohort-sequential longitudinal studies and time-lag studies have been used to assess the effects of cohort for a variety of measures and for a variety of research questions (Schaie and Hofer 2001). *Cohort-sequential studies* (AKA panel studies), which include two or more longitudinal panels of participants derived from different birth cohorts, are able to assess cohort effects in two important ways. First, they can be used to measure changes in cognitive performance over birth cohort. As shown in Fig. 1, Schaie and collaborators (Schaie et al. 2005) have often used this approach to examine cohort changes in performance for psychometric measures of cognition. The figure shows that psychometric performance can be mapped over birth cohorts yielding evidence of cohort trends. For example, one can see from Fig. 1 that there have been marked increases in inductive reasoning performance in more recent birth cohorts. Second, cohort-sequential studies can be used to assess cohort differences in time-based or age-based analyses of measures of cognitive performance. As shown in Fig. 2, Zelinski and Kennison (2007) demonstrated this approach when they assessed cohort differences in mean level functioning and in age-related changes of performance in a list recall task. The cohort difference observed from ages 56 to 74 weakens from ages 74 to 86.



Cohort Effects, Fig. 2 Estimated longitudinal changes for list recall for earlier-born (*solid line*) and later-born (*dashed line*) cohorts. The chart was created from the parameters reported in Table 5 of Zelinski and Kennison (2007)

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A classic example of a cohort-sequential study is the Seattle Longitudinal Study (SLS), which includes multiple longitudinal sequences (panels) initiated approximately 7 years apart currently providing the potential for 7, 14, 21, 28, 35, 42, and 49 year cohort comparisons (Schaie et al. 2005). Some of the other studies that have used this approach are the Victoria Longitudinal Study (Dixon and de Frias 2004) and the Long Beach Longitudinal Study (Zelinski and Kennison 2007).

An alternative method used to assess cohort effects in longitudinal studies is the practice of replacing lost subjects with new ones who are matched on baseline age but born to a later cohort. An example of this approach can be found in the Health and Retirement Study (2015), which replaces participants lost to attrition. In addition, as the HRS has progressed, it has included panels that represent different cohort groups.

The other approach that is often used to study cohort effects is the *time-lag design* (Twenge 2010). In time-lag studies, groups of participants are tested at about the same age but at different points in time. The participants used in the different data collections are not the same, so the approach is not longitudinal. Like cross-sectional studies, time-lag studies are less expensive and easier to conduct than longitudinal studies. However, time effects are confounded with cohort effects making it difficult to uniquely attribute causality; possible causes are either specific historical events or the accumulation of life experiences nested within a broader historical period (Twenge 2010; Salthouse 2015).

The important design features of a valid cohort study have been debated. Jensen in a personal communication sent to and reported by Flynn (1987) identified four elements needed to conduct a reasonably valid cohort study. He stated:

> (a) The possibility of sample bias should be eliminated by comprehensive samples, such as mass testing of draft registrants; (b) tests should remain unaltered from one generation to another and estimates of trends should be based on raw score differences; (c) particular emphasis should be placed on culturally reduced tests like the Ravens Progressive Matrices Test, as distinct from tests with items that might easily be learned from one generation to another; and (d) particular emphasis should be placed on using mature subjects, subjects who have reached the peak of their raw score performance.

While these criteria are generally desirable, aspects of each have been challenged. On the first criterion (a), the best methods for selecting subjects such as random sampling from a well-defined population are difficult and costly to achieve. Many of the most consequential longitudinal studies that have reported on cohort effects have used convenience samples including the Victoria Longitudinal Study, Seattle Longitudinal Study, and Long Beach Longitudinal Study (1, 5, and 7, respectively). Even the use of representative sampling is flawed because samples are likely to become less representative as subject

attrition occurs over time and testings (Schaie et al. 2005). Criterion (b), while it was originally one of the central tenants of longitudinal methods, has become somewhat less important with the development of item response theory methods (Embretson 1996), which allow tests and measures to be equated. Criterion (d) states that subjects should have reached maturity before inclusion into the study, however, this does not allow for the assessment of cohort differences in the age at which maturity is reached (Schaie et al. 2005).

In recent years, many of the existing and retired longitudinal studies have archived their data for use by other investigators. According to the Maelstrom Research webpage (Fortier and Ferretti 2015) there are currently 115 active or completed cohort-based studies worldwide and most of those studies include one or more measures of cognitive performance. Many of the databases can be found on the Maelstrom website (www.maelstrom-research.org) or on other websites such as the National Archive of Computerized Data on Aging (NACDA) in the USA.

Cohort as a Nuisance Variable

In the developmental sciences, research studies are not able to achieve pure measures of age, cohort, or time-of-measurement (AKA period effects), which are likely to be the primary measures of interest. That is, the experimental designs that are currently available are problematic such that two of three time-varying measures, age, cohort, and time, are always confounded with one another, and the so-called "ACT problem" is intractable (Horn and Donaldson 1976). However, as statistical modeling methods continue to advance, there is the likelihood that the magnitude of the three effects can be estimated and that these estimates can be confirmed within and across studies. If reliable estimates can be determined then they can be statistically controlled for.

In *cross-sectional studies*, which are the most popular type of study used to examine cognitive performance (Salthouse 2015), age is the variable of interest but cohort confounds its measurement (Horn and Donaldson 1976). In such studies, the performance of different age groups is compared to determine whether age differences exist among those groups. However, compared to a younger age group, an older age group's participants are not only older but they are also born into an earlier birth cohort, and thus any conclusions about observed age differences are potentially confounded by cohort differences. Depending on the nature of the cohort effect, age group differences in performance can either be inflated, which is the norm, or reduced (Schaie et al. 2005; Zelinski and Kennison 2007). Yet, even when the direction of a cohort effect is not clear or is inconsequential, additional cohort-related noise is likely to be introduced into cross-sectional data, which may affect estimates of variability.

While many cross-sectional studies are performed in the highly controlled environment of a research laboratory, the potential for birth cohort contamination is not directly knowable from the data collected. The implicit assumption of many researchers has been that cohort effects are small and that they have only trivial effects on conclusions about age differences (Salthouse 2015). However, such assumptions are not always well founded and are contradicted by findings from the cohort-based results of cohort-sequential longitudinal studies, which have shown that many of the most studied measures of cognitive performance are indeed affected by birth cohort differences (Schaie et al. 2005; Zelinski and Kennison 2007). Matched sampling, in which the younger and older aged participants are matched on variables such as education or health can be used to reduce potential cohort effects, but such matching strategies are not likely to be entirely effective because such variables do not fully account for observed cohort effects (Williams 2013; Flynn 1987). While it is the case that cohort contamination is usually acknowledged as a limitation of cross-sectional study designs, cohort effects are scarcely considered in discussion sections.

As shown in Figure 1, positive cohort trends, whereby later-born cohorts outperform earlier-born cohorts, have been observed for measures of inductive reasoning, episodic memory, spatial

reasoning, and vocabulary (Schaie et al. 2005). Such findings suggest the likely existence of cohort contamination in cross-sectional studies of age-related cognitive performance, and they indicate that conclusions about age differences are likely to be overstated. Findings of cohort differences have been mixed for some measures such as verbal fluency and numerical ability, and so the potential for cohort contamination is less clear but not necessarily inconsequential (Schaie et al. 2005).

Salthouse (2015) in an intriguing study investigated the validity of longitudinal and cross-sectional results in light of the Flynn effect. The Flynn effect, the observation that more recently born cohorts score higher on IQ measures compared to earlier-born cohorts, has largely been confirmed with time-lag studies, in which both time-of-measurement and cohort effects are measured together and therefore confounded. If the Flynn effect is at least partially a product of historical changes, then longitudinal results may be contaminated by the Flynn effect. Salthouse studied Flynn effect biases in both cross-sectional and longitudinal comparisons and concluded that "...there were similar time-of-measurement increases in cognitive scores at different ages, which were accompanied by nearly constant cross-sectional age differences, but positively inflated estimates of longitudinal age differences." Thus, he showed that longitudinal studies are not immune to secular changes in performance and in some cases may be more biased in the measurement of age effects than cross-sectional studies. Others have shown that cohort effects can alter both cross-sectional and longitudinal results (Zelinski et al. 2009).

Research Findings on Birth Cohort and Cognitive Function

Gains in intelligence. The so-called *Flynn effect* is the observation that there has been a strong, positive trend of increasing intelligence scores from one generation to the next for nearly a century (Flynn 1987). Rundquist in 1936 (Rundquist 1936) and Tuddenham in 1948 (Tuddenham 1948) were among the first researchers to document the phenomenon in the early to mid-twentieth century in American samples. Tuddenham (1948), for example, observed gains over an 11 year gap from 1932 to 1943 in an American sample, and he attributed the gains to advances in health, nutrition, education, and test-taking abilities. It was not until the 1980s, however, that the phenomenon gained its current traction and a name, when it was reported by Richard Lynn in 1982 and James R. Flynn in 1984 (Lynn 2013). It was Flynn's detailed investigation and description that led to the phenomenon being labeled the "Flynn effect" (Lynn 2013). Although this is the term popularly used, some refer to it as the Flynn-Lynn effect to recognize Lynn's 1982 contribution, whose publication preceded Flynn's and who like Flynn has published extensively on the topic (Lynn 2013).

In the United States, intelligence scores have risen by about three IQ points per decade from 1932 to 2002 on various versions of the Stanford-Binet and Wechsler IQ tests (Flynn and Weiss 2007). Similar strong gains have been recorded in countries all across the globe, including developed (Flynn 1987; Flynn and Weiss 2007) and developing nations (Williams 2013). These gains have been observed in both verbally based IQ measures as well as for Raven's Matrices and other matrix reasoning tests, which are believed to be less affected by cultural and educational influences (Flynn 1987).

A recent meta-analysis evaluated average IQ gains from 1909 to 2013 for a combined sample created from 271 individual samples representing 31 countries of over four million participants. They reported IQ gains of 4.1 points per decade for measures of fluid abilities (Pietschnig and Voracek 2015). Somewhat more modest gains were observed for spatial abilities (IQ gain = 3.0 points/decade), full scale IQ (IQ gain = 2.8 points/decade), and crystallized abilities (IQ gain = 2.2 points/decade). While IQ gains have been observed across most of the twentieth century, there is a growing body of evidence that these gains have slowed or even reversed around the turn of the twenty-first century for some countries. Teasdale and Owen (2008), for example,

found losses of 1.5 IQ points over a 5 year period from 1998 to 2003 in a Danish sample.

The magnitude of gains has been observed to be larger in people with lower IQ scores, but this finding is not universal (Williams 2013). Observed gains have also been larger for urbanites than for rural samples (Williams 2013).

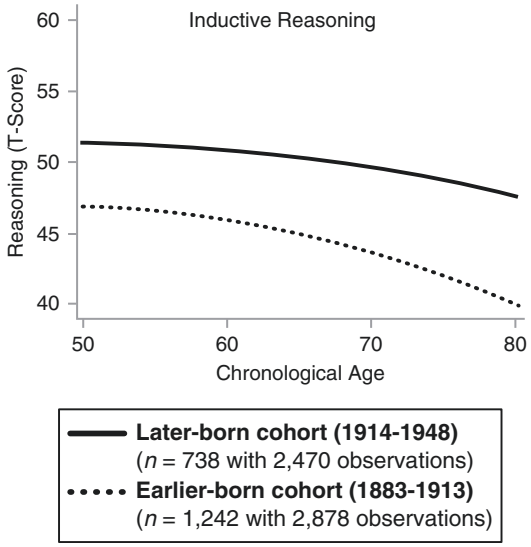
The largest gains have usually been found for fluid ability measures such as inductive reasoning, word recall, and spatial reasoning (Schaie et al. 2005; Zelinski and Kennison 2007). Somewhat smaller gains have been observed for crystallized abilities such as vocabulary (Schaie et al. 2005; Zelinski and Kennison 2007), and in some cases no gains have been observed (Lynn 2013). The observed increases in fluid abilities have sometimes been taken as evidence that the gains represent real gains in intelligence as opposed to gains in knowledge. Yet, the inconsistent correlation in the rise of IQ scores around the globe and the small fluctuations in reports of gifted individuals have led Flynn (1987) to conclude that IQ tests have a weak but not inconsequential relationship to the construct of intelligence.

So what explains the rather extraordinary gains in IQ performance observed over the past century? Several non-mutually exclusive explanations have been proposed and at least partially supported, including increases in educational quality and attainment (Alwin and McCammon 2001), exposure to technology and media (Williams 2013), the benefits of better health and healthcare (Williams 2013; Gerstorf et al. 2011), and reductions in poverty and malnutrition (Flynn, 2008), among others (Lynn 2013). However, none of these explanations individually or in combination fully explain the observed gains. In addition, Lynn (2013) has demonstrated that cohort-based IQ gains have been found in infants, which brings into question explanations that are likely to occur in later development, including education-based explanations. Thus, the question of cause remains open and the search for a comprehensive explanation continues to remain elusive.

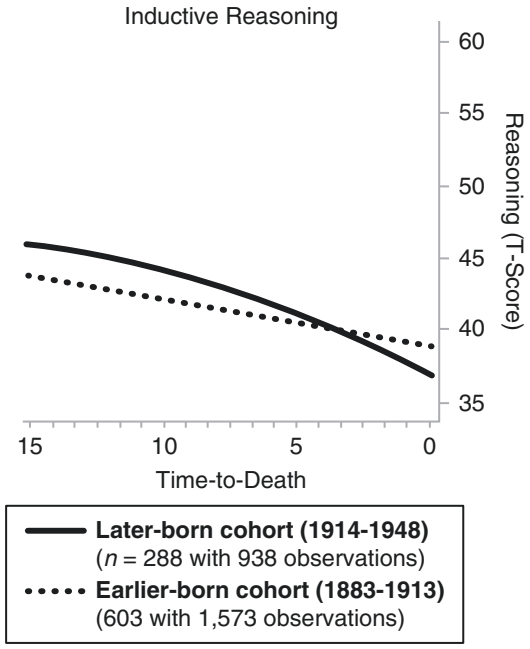
Cohort effects in older adult samples. It is well established that there are large age-related declines in many aspects of cognitive performance. For example, declines in fluid intelligence abilities (e.g., inductive reasoning, memory, and word fluency) have been observed to begin soon after human maturity is reached, around age 30, with increasingly large age-related declines thereafter as confirmed in both cross-sectional and longitudinal analyses (Schaie and Hofer 2001). Given these persistent declines and the expanding size of the older adult population relative to other age groups, questions about whether cohort-based positive gains in intellectual abilities will offset or partially mitigate anticipated declines in present and future generations are well worth considering (Zelinski and Kennison 2007).

Most studies that have examined cohort effects in psychometric measures have done so by examining mean level differences in cognitive performance, whereby participants from different cohorts are matched on age and their average performance is compared to determine whether cohort differences exist (Schaie et al. 2005). Such comparisons have usually indicated that a later-born cohort outperforms an earlier-born cohort (Schaie et al. 2005; Williams 2013). Fewer studies have examined cohort differences in the rate of age-related changes (Schaie et al. 2005; Zelinski and Kennison 2007; Gerstorf et al. 2011). Such studies typically employ growth modeling, whereby a model is "fit" to the data. At least two results are typically reported: (1) cohort differences in mean level performance (intercept) and (2) cohort differences in the rate of change (slope).

Zelinski and Kennison (2007) examined cohort differences in the Long Beach Longitudinal Study from ages 56 to 86 for two cohorts born 16 years apart on five measures of cognition including inductive reasoning, list recall, text recall, spatial reasoning, and vocabulary. Piecewise growth models consisting of two linear slopes – one for young-old age (ages 56–74) and the other for old-old age (ages 74–86) – were fit to each measure of cognition. The results indicated that mean level cohort differences favoring the later-born cohort were found for all measures except vocabulary. No differences in the rates of decline were found for inductive reasoning or spatial reasoning. However, for the two memory measures, list and text recall, the rate of decline for



Cohort Effects, Fig. 3 Cohort differences in inductive reasoning from age 50 to age 80. Later-born cohorts (*solid lines*) outperformed earlier-born cohorts (*dashed lines*) at age 70 and also showed shallower rates of cognitive decline. Excerpted from Gerstorf et al. (2011) (Reprinted with permission from the American Psychological Association)



Cohort Effects, Fig. 4 Cohort differences in terminal decline for inductive reasoning. Mortality-related models suggest no evidence for positive secular trends in inductive reasoning. Later-born cohorts (*solid lines*) showed steeper mortality-related declines than earlier-born cohorts (*dashed lines*). Excerpted from Gerstorf et al. (2011) (Reprinted with permission from the American Psychological Association)

the old-old age slope (age 74–86) interacted with cohort such that the advantage of the later-born cohort disintegrated with advancing age. This result can be seen in Fig. 2 for list recall.

Similar findings have been reported by Gerstorf et al. (2011), who examined age-related performance on five cognitive measures from the Seattle Longitudinal Study including inductive reasoning, spatial reasoning, word fluency, numerical ability, and vocabulary. Separate growth models were fit for age-related changes and for time-to-death changes. The five age-related change models each showed that a later-born cohort outperformed an earlier-born cohort and that the gap increased from 50 to 80 years of age. Figure 3 demonstrates this finding for inductive reasoning. Yet, the time-to-death models showed that the cohort advantage enjoyed by the earlier-born cohort receded as death approached. Figure 4 shows the collapse of the advantage in performance of the later-born cohort compared to the earlier-born cohort as death nears.

Possible explanations for the reduction of cohort effects in very old age include: (1) greater selectivity in the oldest segment of the sample or (2) that the protective effects of cohort recede at the upper reaches of the lifespan. While greater selectivity is a possibility in the results reported by Kennison and Zelinski (2007), the Gerstorf et al. (2011) time-to-death results reduces selectivity as a possible explanation for their results because all of their participants were followed to their deaths. They concluded that "[the] results are in line with the idea that mortality-related mechanisms and the progressive processes leading toward death (e.g., deteriorating health) are so pervasive that they override historical, cohort-related effects that were apparent earlier in life." Thus, these results suggest that cohort effects, while quite robust, may not persist across the entire lifespan, especially at the upper reaches of the lifespan.

Still there is considerable evidence that birth cohort differences favoring the later-born cohort exist in older samples, and this suggests that the

effects of early developmental experiences are likely to be long lasting, even into old age. There is also growing and compelling evidence that cognitive, social, and physical engagement among adults enhances level of cognitive functioning (Hertzog et al. 2008). These findings combined with findings that later-born cohorts are more likely to engage in such positive health behaviors (Baltes et al. 2006) suggests that the level of age-related declines that are seen in today's older adults are likely to be smaller for future generations (Skirbekk et al. 2013).

Conclusion

The cohort-based findings reviewed in this entry have far reaching societal and institutional implications as they have been linked to secular changes in education, technology, health, health care, etc. Yet, a comprehensive explanation of the observed positive cohort trends remains a work in progress. While methodological constraints persist, much progress has been made towards understanding age, cohort, and time effects and their interactions by employing a variety of different study designs, sampling frames, and statistical techniques. The cognitive performance advantages enjoyed by later-born cohorts are likely to persist into old age, however, as death approaches, these advantages may recede. Finally, the findings reviewed here give hope that the typical cognitive declines seen in older adults today are likely to be smaller and less intrusive in future generations of older adults.

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Common Cause Theory in Aging

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Synonyms

Common cause hypothesis; Common cause factor; Dedifferentiation; Shared age-related variance; Shared influence models

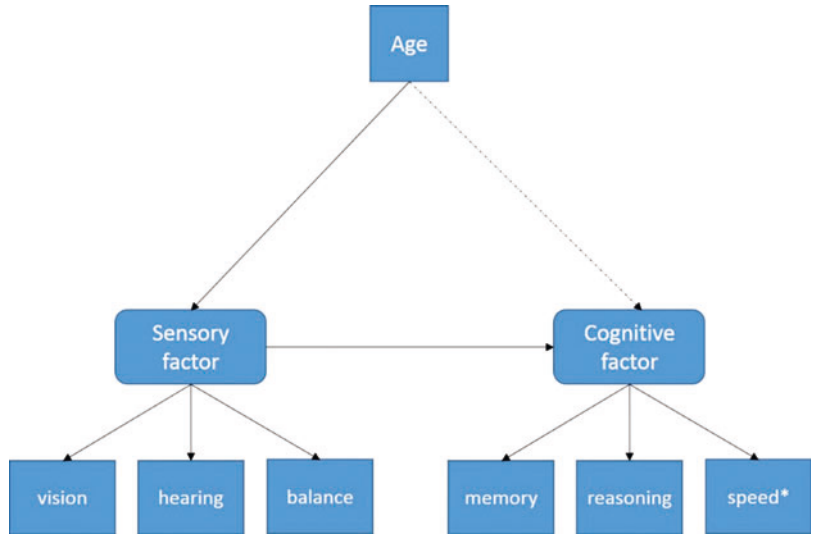
Definition

The common cause theory of cognitive aging hypothesizes that age-related declines in cognitive, sensory, and sensorimotor functioning can primarily be attributed to a domain-general neurobiological mechanism. It predicts an increasing association between cognition and sensory acuity with advancing age and was originally proposed as a broad third variable explanation to account for shared variance between age, cognitive, and noncognitive variables.

Historical Context and Background to the Common Cause Hypothesis

Since Galton's early work in the late 1800s (Galton 1883), psychologists have long attempted to draw conceptual and empirical links between sensory discrimination and intelligence, particularly those adopting an individual differences perspective (Deary 1994). For example, sensorimotor abilities have been identified as important structural components in hierarchical models of human intelligence (Carrol 1993). In more recent times cognitive scientists, guided by an information processing framework, have recognized that cognition and sensation do not operate in isolation, but constitute an integrated system in which top-down and bottom-up processes are intrinsically intertwined. Of interest to geropsychology is the way in which the coupling between these two domains changes with age. While there is no evidence to suggest that sensory functioning is strongly linked to cognitive performance in early life or mid-life, a small number of studies conducted sporadically during the latter half of the 1900s consistently demonstrated an association between cognition and sensory functioning (particularly hearing ability) in older age-groups (Schaie et al. 1964; Anstey et al. 1993; Rabbitt 1990a; Granick et al. 1976). These cross-domain interassociations were important from the viewpoint of life-span developmental psychology as they appeared to emerge during later life and therefore provided an example of discontinuity in life-span development (Lindenberger and Baltes 1994). They also indicated that dedifferentiation may extend beyond the cognitive domain (Anstey et al. 2003a) and were relevant to theoretical debates concerning the extent to which age-related changes in a variety of domains could be accounted for by a broad and general mechanism, rather than a number of unrelated domain-specific factors (Salthouse and Czaja 2000).

Despite the significance of these findings for theories of cognitive aging, it was not until the mid-1990s that there was a concerted research program seeking to understand why cognitive and noncognitive variables are increasingly

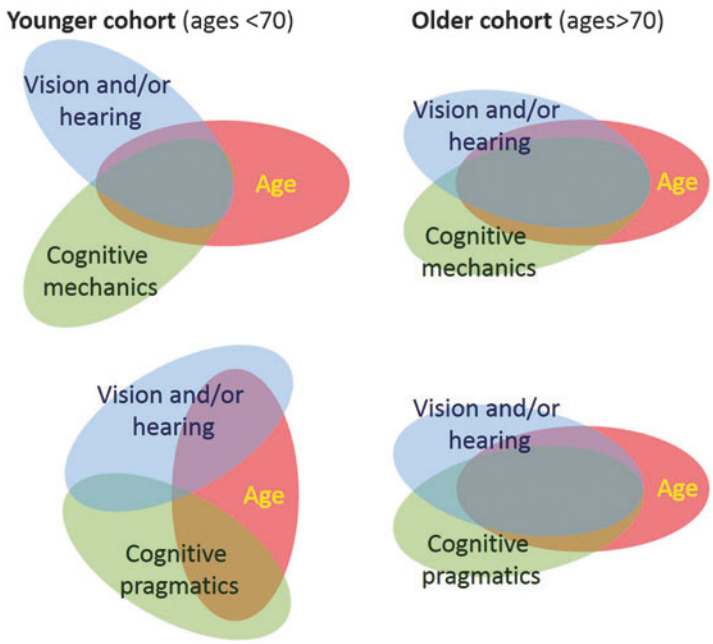


Common Cause Theory in Aging, Fig. 1 Schematic of mediation model analogous to those tested by Lindenberger and Baltes (1994) and Anstey (Anstey and Smith 1999; Anstey et al. 2001). *Sensory functioning is generally found to be a stronger predictor of age-related individual differences in cognition than processing speed

related at older ages. At the start of the decade, Rabbitt (1990b) strongly argued that cognitive scientists with an interest in late-life phenomena should indeed be interested in lower-level sensory systems. Critically, this period coincided with a greater appreciation of the underlying role that degeneration of the central nervous system plays in driving age-related declines in sensory acuity (Baltes and Lindenberger 1997). That is, age-related sensory decline could be attributed to neuronal deterioration beyond the level of the end organ. It was therefore timely for geropsychologists to consider joint contribution of "brain aging" to cognitive and sensory decline (and more broadly to motor functions), and this culminated with a proposal by Lindenberger and Baltes for a "common cause hypothesis" (Lindenberger and Baltes 1994).

Shared Age-Related Variance

Motivated by previous empirical findings and their potential implications for cognitive aging theory, Lindenberger and Baltes (Lindenberger and Baltes 1994; Baltes and Lindenberger 1997) conducted two studies using baseline data from the Berlin Aging Study to investigate the roles of vision and hearing in explaining age differences in intellectual (or cognitive) abilities. In the first study (Lindenberger and Baltes 1994), visual acuity and auditory pure-tone thresholds explained 49% of the total variance and 93% of the age-related variance in a second-order general intelligence factor comprising perceptual speed, reasoning, memory, verbal fluency, and knowledge. In addition, vision and hearing fully mediated the effects of age on intelligence – that is, after adjusting for sensory functioning, there were no direct effects of age on intelligence (see Fig. 1). Importantly, excluding participants with suspected dementia or severe sensory impairment did not alter the pattern of results. The explanatory power of sensory functioning was then compared to that of processing speed, which had been identified as a potential broad mechanism underpinning cognitive aging. These analyses indicated that vision and hearing were at least as powerful as processing speed in predicting age-related individual differences in an intelligence factor defined by reasoning, memory, verbal fluency, and knowledge (i.e., excluding speed). Moreover, while sensory functioning subsumed all the age-related variance in processing speed, processing speed was unable to account for 15% of the age-related variance in vision and 9% of the variance in hearing. This finding was later supported by comparable analyses of other datasets (Anstey



Common Cause Theory in Aging, Fig. 2 Venn diagrams depicting cohort differences in shared variance patterns among age, sensory functioning (visual acuity and pure-tone audiometry), fluid cognitive mechanics (speed, reasoning, and memory), and crystallized cognitive pragmatics (knowledge and fluency). Overlapping areas reflecting proportions of shared variance are approximated from results reported in Baltes and Lindenberger (1997) and Anstey (Anstey and Smith 1999); however, the schematic is illustrative only and not based on actual data

et al. 2001). Lindenberger and Baltes (1994) argued that of the two, sensory functioning was the more powerful predictor of general intellectual abilities. Their conclusion was significant because speed of information processing was considered an important cognitive primitive and central to resource-based accounts of cognitive aging. Such theories included the generalized slowing and processing speed hypotheses, which had been proposed in various forms by Birren, Cerella, and Salthouse (for review see Hartley 2006).

The link between intellectual abilities and sensory acuity was later reexamined in a larger composite sample that augmented the baseline sample of participants from the Berlin Aging Study with newly recruited younger participants (Baltes and Lindenberger 1997). Rather than modeling the indirect effects of age on a second-order general intelligence factor, each cognitive ability was examined individually. Vision and hearing were more strongly associated with individual differences in the five cognitive abilities within the older cohort (ages 70–103), relative to the younger cohort (ages 25–69). But there remained a significant proportion of shared age-related variance among the younger participants, thus replicating their previous findings across a broader age range. A more nuanced pattern of results emerged when the cognitive abilities were classified according to a dual-process model of intellectual functioning. (Dual process models of intellectual development across the life-span make a distinction between cognitive mechanics (also referred to as fluid intelligence) and cognitive pragmatics (referred to as crystallized intelligence). Cognitive mechanics are content poor, have a strong neurophysiological basis, and typically undergo age-related declines throughout adulthood. Cognitive pragmatics reflect knowledge acquired through experience, are culturally shaped, and increase with age.) There were no cohort differences in the proportion of age-related variance shared by vision or hearing and variables reflecting fluid cognitive mechanics (speed, reasoning, and memory). In contrast, while sensory functioning predicted age-related variance among variables reflecting crystallized cognitive pragmatics (fluency and knowledge) within the older cohort, this was not the case within the younger cohort (see Fig. 2).

The Common Cause Hypothesis and Alternative Explanations

Overall, the key findings from these studies were that (a) there was considerable shared variance between age, general intelligence (primarily in fluid abilities), and sensory acuity and (b) sensory functioning fully mediated age-cognition associations. Lindenberger and Baltes offered etiological and functional explanations to account for age-related covariation between cognitive and sensory functioning. These included the neurological *common cause* hypothesis, *sensory deprivation* hypothesis, and *cognitive load on sensory performance* hypothesis. A brief description of each of these hypotheses is provided below, but interested readers may like to refer to Schneider and Pichora-Fuller (2000) who provide a thorough overview of these hypotheses and additional explanations.

The *common cause hypothesis* maintains that a domain-general mechanism is responsible for a substantial amount of the age-related decline in cognitive, sensory, and sensorimotor functions. It was argued that the emergent association between sensory and cognitive function in late life reflected "an expression of the physiological architecture, or the mechanics, of the [aging] brain" (Lindenberger and Baltes 1994, p. 339). Clearly the original intention of the hypothesis identified the underlying etiology as being neurological in nature. Though often construed as a single determinant, it was recognized that as a third variable explanation, the common cause factor could reflect an ensemble of senescent processes affecting brain structure, physiology, and function. In addition, other third variables such as "bodily functions" were not discounted (Baltes and Lindenberger 1997). The common cause hypothesis was consistent with contemporaneous views offered by researchers interested in operationalizing functional biomarkers as an index of primary aging. For example, after reporting that a bioage factor (a latent variable reflecting biological age; Anstey 2008) comprising measures of sensory acuity and physical functioning mediated the relationship between age and fluid intelligence (Gf), Anstey and colleagues (1993) concluded that sensorimotor functioning was an important indicator of intellectual decline, and this "may be interpreted as evidence for a decline in Gf related to biological changes in the brain, central nervous system, and motor systems" (Anstey et al. 1993, p. 568). Such broad explanatory mechanisms implied by common cause factors are attractive to cognitive aging theorists because they are parsimonious and reduce the search for potential mechanisms to a single or small number of underlying causes.

Whereas the common cause theory hypothesizes an underlying etiology, other explanations propose more functional and directional causal pathways between cognitive and sensory aging. The *sensory deprivation* hypothesis identifies reduced sensory functioning as a long-term antecedent of cognitive decline, linking the two via social engagement. Specifically, declining sensory acuity creates communication and mobility difficulties, increasing the likelihood of social withdrawal and disengagement from intellectually stimulating activities, which over an extended period (spanning years to decades) will eventually result in the lowering of levels of general cognitive ability. Thus, according to this view, age-related sensory impairment initiates an upward cascade of effects that ultimately impact on central cognitive functioning. Such explanations had previously been described by Sekular and Blake who referred to the process as "protracted sensory underload" (1987; cited in Lindenberger and Baltes 1994) and Rabbitt (1990b) who noted that sensory loss in late life can inhibit "social interaction, employment, enjoyment of life, learning new skills, and cognitive engagement" (p. 231) and have secondary "knock-on" effects on everyday memory and comprehension. These accounts therefore invoke the notions of brain reserve or cognitive reserve, which posit that novel and mentally stimulating activities are important for maintaining cognitive ability levels (or at least attenuating rates of cognitive decline) by promoting neuroplasticity which creates a buffer against the impacts of accumulating neuropathology.

Alternative upward cascade models have also been proposed. The *perceptual degradation*

and *cognitive permeation* hypotheses place age-related sensory decline as a driver of poor cognitive performance, but over a more immediate time frame (Schneider and Pichora-Fuller 2000; Valentijn et al. 2005). According to the perceptual degradation explanation, encoding errors of degraded sensory inputs impinge on higher-level cognitive processing. Similarly, the cognitive permeation hypothesis maintains that greater attentional, executive, and working memory resources must be allocated to processing of low-fidelity sensory inputs, thus compromising cognitive functioning by diverting cognitive resources away from higher-order processes (Lindenberger and Ghisletta 2009). A key prediction of such explanations is that correcting for sensory loss should moderate the association between sensory and cognitive function. A popular approach to testing this hypothesis has been to examine the effect of cataract surgery on cognitive function. While some studies have been argued to demonstrate that cataract surgery is associated with lower levels of cognitive impairment after surgery, these investigations have been limited by small sample size, lack of appropriate control groups, failure to assess baseline cognitive function, or inadequate control for confounding factors (Hall et al. 2005). Studies employing more rigorous research designs have failed to show that removal of cataracts improves cognitive function (Hall et al. 2005; Anstey et al. 2006).

The *cognitive load on sensory performance* suggests that deterioration of cognitive abilities such as attention and processing speed adversely affect the control and execution of simple sensory tasks. For example, deficits in sustained attention may diminish an individual's capacity to detect auditory or visual stimuli. It is important to note that these explanations are not mutually exclusive, but are related and likely to operate interdependently in a cycle of cumulative and reciprocal effects. For example, if cognitive resources become more limited and sensory acuity declines due to "brain aging," this may increase the cognitive load for basic processing of sensory information. This increases the likelihood of social withdrawal and reduced participation in mentally stimulating activities, which limits opportunities to moderate the adverse impacts of brain aging.

As the original analyses of the Berlin Aging Study employed observational and cross-sectional research designs, it was not possible to rule out any of the proposed explanations. Baltes and Lindenberger (1997) also acknowledged that each of the hypothesized causal pathways was potentially related. Nevertheless, they argued that a common cause explanation was most consistent with their results for the following reasons. Firstly, sensory functioning had weaker associations with experientially based cognitive abilities, whose development was considered to be more reliant on an enriched social environment. Secondly, it was expected the impacts of protracted sensory underload would be more pronounced among individuals with greater levels of sensory impairment, yet there was no evidence of a curvilinear relationship between sensory and cognitive functioning. Finally, sensory measures were thought to mediate age-cognition relations because they were assumed to provide a more reliable and direct measurement of brain aging (Lindenberger and Baltes 1994). Similar arguments were made by those who adopted a biomarker mediation model of cognitive aging, whereby sensorimotor variables were conceptualized as functional biomarkers that indexed primary (normative) aging processes with greater reliability than chronological age (Anstey et al. 1993; Anstey and Smith 1999).

Evidence for Common and Domain-Specific Factors

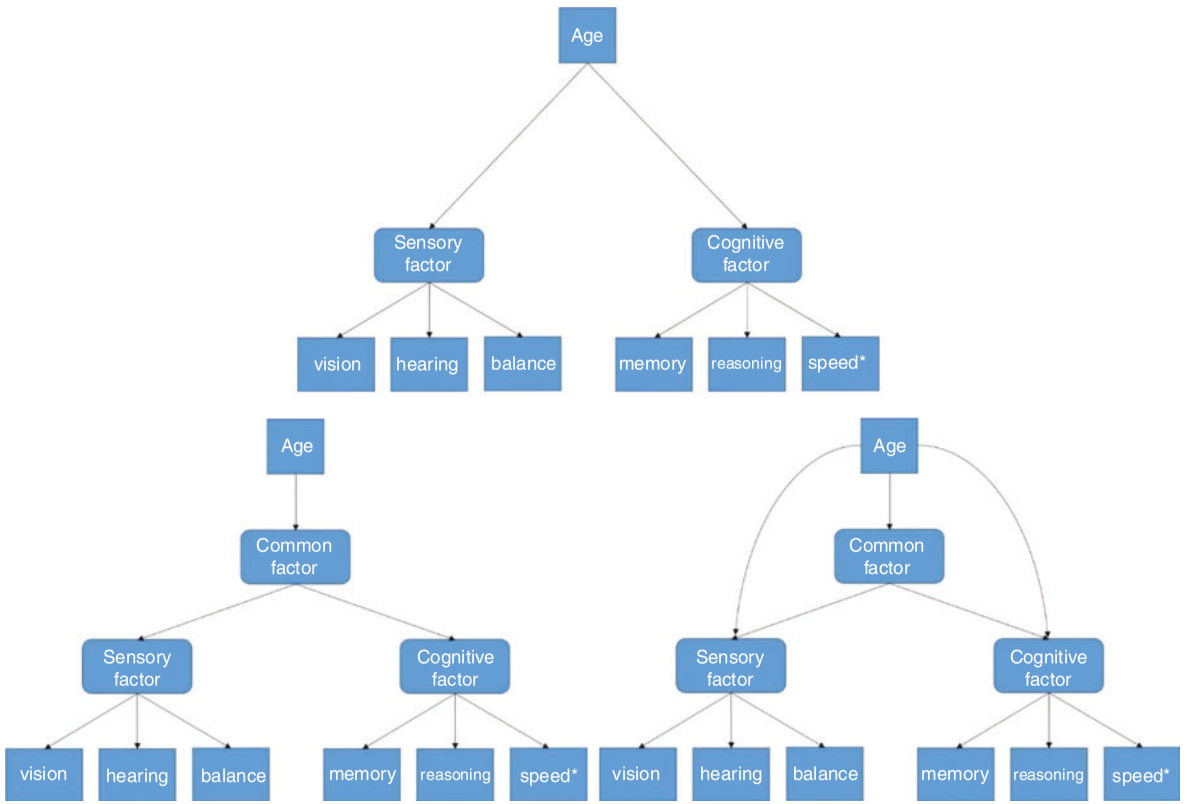
Even though these studies arose from opportune circumstance and were framed as being exploratory (Lindenberger and Baltes 1994; Baltes and Lindenberger 1997), their clear rationale and robust findings meant they quickly became a catalyst for rigorous conceptual, methodological, and empirical examination of the interassociations between age, cognition, sensory perception, and other indicators of physical ability. Because of the emphasis placed on a common cause interpretation, this theory became the main focus of subsequent

investigations. In particular, debate centered on quantifying the degree of interdependency across a variety of functional domains and whether it was reasonable to infer that a common cause was primarily responsible for age-related declines.

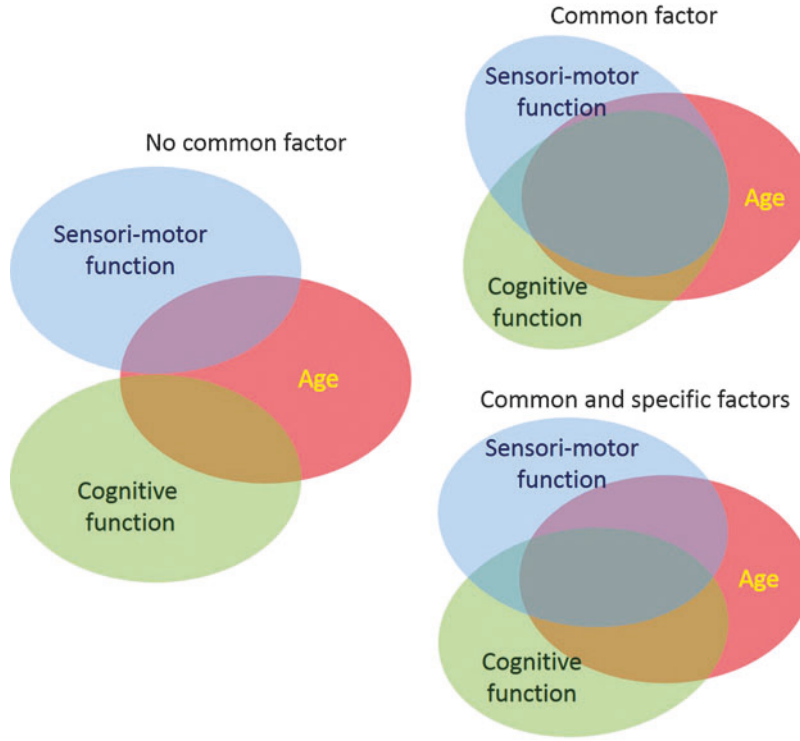
The common cause theory was originally concerned with cognitive and sensory domains, with a focus on visual acuity and pure-tone audiometry; subsequent investigations broadened the explanatory scope of the theory to include other functional domains that also exhibit declines in performance with age. Studies have examined age-related associations with cognition for a range of sensory variables such as contrast sensitivity, central auditory processing, proprioception, vibration sense, and balance. The general finding has also been extended to motor and physiological functions including grip strength, lower limb strength, walking ability and gait, lung function, and blood pressure (Schneider and Pichora-Fuller 2000; Anstey and Smith 1999; Li and Lindenberger 2002; Clouston et al. 2013; Krall et al. 2014), though blood pressure has not always been shown to load onto a common factor (Christensen et al. 2001). All such cross-sectional studies have typically reported moderate to large interassociations with age. However, it has been suggested that the magnitude of the age-related associations between different pairs of cognitive and sensorimotor variables may vary. For example, data from the Australian Longitudinal Study of Aging indicates that vision and hearing are more strongly linked to episodic memory than other general cognitive abilities (Anstey et al. 2001).

It was not unusual for cross-sectional evidence of shared age-related variance to be interpreted as suggestive of a broad explanatory mechanism (Salthouse and Czaja 2000). Early studies employing structural equation modeling or hierarchical regression analyses generally identified sensory functioning as the mediator of age-cognition associations as depicted in Fig. 1. In these cases, a common cause interpretation relied on the assumption that sensorimotor functioning was a more direct indicator of the integrity of the central nervous system. A more formal approach to assessing common cause factors is to define latent variable that reflects shared variance across cognitive and noncognitive variables and regress age onto the common factor as well as each of the individual domains or indicators. This approach, when applied to multifactorial data, is depicted in Fig. 3 and typically involves the comparison of (at least) three nested conceptual models, namely, (i) an independent factor model (no common cause factor) which only includes direct effects of age on each domain, (ii) a hierarchical common factor model with indirect age effects mediated by a common cause, and (iii) a hierarchical common factor model with both direct and indirect age effects (see Allen et al. (2001) for a detailed description of each of these conceptual models and some additional variations). An alternative depiction of these shared variance models is presented in Fig. 4.

When studies were designed to test common cause factor models following procedures outlined in Fig. 3, it quickly became apparent that there were both direct and indirect effects of age on cognitive and sensorimotor variables (Salthouse and Czaja 2000; Anstey et al. 2001; Christensen et al. 2001; Salthouse et al. 1998; Salthouse and Ferrer-Caja 2003). Thus, these analyses demonstrated that there were shared and unique portions of age-related variance among cognitive and noncognitive variables. Sensorimotor variables have also been reported to correlate with cognitive variables independent of age (particularly variables reflecting crystallized cognitive pragmatics) (Anstey and Smith 1999). Consequently by 2003, there was a broad consensus that age-related declines in cognitive and sensorimotor functioning could be attributed to both a broad common cause factor and separate domain-specific mechanisms, tempering the earlier emphasis placed on common cause interpretations. In an important appraisal of the common factor methods used to support broad mechanisms, Allen and colleagues (Allen et al. 2001) argued that many analyses failed to adequately assess the comparative fit of all competing models. They demonstrated that hierarchical common factor models did not always fit the data better than independent factor models, particularly when independent factors were allowed to have correlated disturbance terms.



Common Cause Theory in Aging, Fig. 3 *Top*: Independent factor model with direct age effects. *Bottom Left*: Second-order (hierarchical) common factor model with indirect age effects, *Bottom Right*: Second-order (hierarchical) common factor with direct and indirect age effects (Figures adapted from Salthouse and Czaja (2000) and (Allen et al. 2001))



Common Cause Theory in Aging, Fig. 4 Venn diagrams depicting three possible models of shared variance between age, cognitive, and sensorimotor functioning. *Left*: No common factor (domain-specific factors only); *Top right*: Common factor; *Bottom right*: Common and domain-specific factors. Sensorimotor variables have also been described as "functional biomarkers" (Anstey et al. 1993; Lindenberger and Ghisletta 2009)

Longitudinal Evidence for the Common Cause

Recognizing that longitudinal designs were necessary to properly examine within-person coupling of cognitive and noncognitive variables (Hofer and Sliwinski 2001), a number of research groups employed multivariate latent growth curve (and related) techniques to test covariation in levels and rates of change between cognitive and sensory measures (Anstey et al. 2003a, b; Lindenberger and Ghisletta 2009). Importantly, these studies demonstrated only modest associations between rates of sensory and cognitive decline (e.g., 9% shared variance between change in memory and vision; Lindenberger and Ghisletta 2009), as well as providing support for domain-specific factors. Again, it was argued that the evidence for a common cause factor was strongest for memory and vision and for memory and speed, which were the only inter-domain pairings to have correlated rates of change in the Australian Longitudinal Study of Ageing (Anstey et al. 2003b). Bivariate dual change score models have been used to test bidirectional time-ordered associations between cognition and sensory function (Ghisletta and Lindenberger 2005). In these analyses, levels of visual acuity were predictive of subsequent declines in processing speed, and conversely, levels of processing speed were predictive of subsequent declines in visual acuity. Consistent with other studies, large domain-independent effects were reported. Ghisletta and Lindenberger (2005) framed their discussion of this dynamic link between cognitive and sensory functioning in relation to common cause, biomarker mediation, and cascade hypotheses. Each of these longitudinal studies provides a complex picture of the interdependent nature of cognitive and sensory aging, but overall supports the notion that there are both common and independent factors driving declines in cognition and sensation. In addition, the modest interassociations suggested that initial enthusiasm for the overarching importance of a common cause factor was overstated. The divergence in findings from earlier studies

demonstrates the importance of longitudinal data for modeling time-dependent processes that are inherent to theories of psychological development and aging. Longitudinal designs enable direct examination of age changes and covariation in rates of change – which is necessary to test predictions made by the common cause hypothesis. Indeed, it has been well documented that age changes are confounded with age differences and population trends in cross-sectional data, and this can produce positively biased correlations between variables that actually share no association, or even a negative association, in their developmental trajectories over time (Hofer and Sliwinski 2001; Lindenberger et al. 2011; Lindenberger and Potter 1998).

Limitations of the Common Cause Theory

The common cause theory has both conceptual and methodological limitations that constrain its overall attractiveness as a comprehensive explanation for cognitive aging. Although common factor models often provide good fit of cross-sectional associations between cognitive and noncognitive variables and are often interpreted as reflecting broad explanatory mechanisms (Salthouse and Czaja 2000), simulation studies have shown that common factor models cannot always be rejected even when they are false (Allen et al. 2001). Many of the analytic strategies employed provide supporting evidence of a common factor rather than conduct critical hypothesis testing of the common cause theory.

One of the main challenges for the theory is that it implicates a wide range of psychological and physical functions with no obvious candidate (s) for the ensemble of common causes. A broad range of measures including peripheral hearing, visual acuity, reaction time, grip strength, lung capacity, processing speed, and episodic memory have all been shown to converge onto a common age-related factor to varying degrees, yet there is no well-defined system that is known to directly underlie performance across all of these domains (Christensen and Mackinnon 2004). Thus, at the time the common cause was attracting peak research attention, it was not possible to specify the broad mechanism (Salthouse and Czaja 2000). In the words of Ghisletta and Lindenberger (2005), the common cause theory is "empirically and theoretically under-identified" (p. 580). Indeed, when conjecturing about the common cause, proponents have cast a wide net when naming candidate mechanisms. These have ranged from general notions of "brain aging" and "integrity" of the central nervous system to more specific etiology such as structural changes or atrophy, white-matter loss or hyperintensities, gray-matter loss, impaired frontal circuitry, dopaminergic neuromodulation, inflammation, oxidative stress, telomere length, and genetic expression (Salthouse and Czaja 2000; Ghisletta and Lindenberger 2005; Christensen and Mackinnon 2004). Unfortunately, many studies examining the common cause theory have lacked direct measurement of any of these mechanisms. It is for these reasons that the latent variable reflecting a common factor should be distinguished from a putative common cause mechanism (Christensen and Mackinnon 2004).

Conclusion

Understanding relations between functional domains is an important step to developing a complete description of human life-span development. Cognition, sensation, and motor functioning are broad ability domains that are central to the study of human aging. Their age-related associations demonstrate the importance of considering cross-domain interdependencies in human development. The common cause hypothesis shone a spotlight on this important field and stimulated research into shared mechanisms underlying sensory and cognitive aging. It remains plausible that a common etiology underlies some of the age-related declines in both cognitive abilities and sensorimotor function (Li and Lindenberger 2002; Christensen and Mackinnon 2004), but it is clear that a comprehensive account of cognitive

aging must also include domain-specific factors. According to relatively recent evaluations, it is reasonable to expect that substantial portions of decline across a range of domains can be attributed to a small number of causal pathways (Lindenberger and Ghisletta 2009). Common causes are likely to draw from some of the central processes underpinning brain aging, such as systemic inflammation affecting vascular health, oxidative stress, and genetics. It is important that future research directly assesses the role(s) of candidate common causes.

Cross-References

- Australian Longitudinal Study of Aging (ALSA)
- Berlin Aging Studies (BASE and BASE-II)
- History of Biomarkers in Geropsychology
- History of Cognitive Aging Research
- History of Cognitive Slowing Theory and Research
- Individual Differences in Adult Cognition and Cognitive Development
- Physiological Effects on Cognition
- Sensory Effects on Cognition in Later Life

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Communication with Older Adults

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C

Synonyms

Aging and communication; Elderspeak; Intergenerational communication; Language and aging; Patronizing talk; Person-centered communication

Definition

Communication with older adults refers to face-to-face or mediated interactions between individuals or within groups in which at least one of the individuals meets – or is perceived to meet – the cultural standard for classification as an "older adult." The specific standard varies across cultures and is generally based on chronological age (actual or perceived) or another demographic factor such as retirement status.

Communication with others – whether in family, social, or institutional contexts – is important to the psychological well-being of older adults. Communication is the means through which older adults achieve and maintain personal control as well as the social, familial, and professional relationships that are essential to their emotional health, life satisfaction, and general well-being. From the perspective of the life span theory of control (Heckhausen and Schulz 1995; Hummert and Nussbaum 2001; Fowler et al. 2015), communication may become the sole avenue to exercising personal control for those older adults in declining health. Although normal aging is associated with changes in hearing and cognition (e.g., name recall) that can affect language and communication, the extent to which individual older adults experience these changes varies widely and most develop coping strategies that

enable them to maintain their communication skills (Kemper et al. 2015). Yet negative age stereotypes about the communication competence of older adults create challenges for them and their communication partners across contexts. This relationship between negative age stereotypes and communication carries implications for not only the psychological and social, but also the physical, well-being of older individuals.

The Communication Predicament of Aging

Age stereotypes can be positive (e.g., the wise and loving perfect grandparent) as well as negative (e.g., the bitter and demanding shrew/curmudgeon), but negative stereotypes are more accessible and numerous than positive ones (Hummert 2011). Even in East Asian cultures that traditionally have placed a strong value on filial piety, negative age stereotypes predominate and play a role in intergenerational communication (Giles and Gasiorek 2011). Negative age stereotypes include beliefs about the physical, cognitive, and psychological characteristics of older adults that have implications for their communication competence. Examples are hard-of-hearing, sick, inarticulate, slow-thinking, forgetful, sad, lonely, inflexible, and demanding (Hummert 2011). Drawing on communication accommodation theory, the *communication predicament of aging* model (CPA; Ryan et al. 1986) illustrates how these stereotypical beliefs contribute to a negative feedback cycle in communication with older adults.

According to the CPA model, when a younger person meets an older person, recognition of the physical signs of age (grey hair, wrinkles, etc.) may activate these stereotypical beliefs and result in a communication style that accommodates to the presumed needs of the older person. That is, the younger person may speak slowly and loudly, use short sentences and simple language, employ exaggerated intonation for emphasis, and/or call the older person by first name or a diminutive (e.g., honey, dearie), all in an effort to communicate effectively. This stereotype-based, age-adapted communication style, or elderspeak, constitutes *patronizing talk* because it implicitly (or in some cases, explicitly) questions the competence of the older person. In doing so, it challenges the older individual's autonomy to control his or her behavior and decisions (Savundranayagam et al. 2007).

Although control is an element in all patronizing talk, the degree of control can vary from moderate to high and the accompanying emotional tone may be warm or cold (Hummert et al. 2004). Three examples of moderate control illustrate variations in emotional tone from warm to cold: (1) "Here's the form, dear. Let me explain it to you"; (2) "Mom, don't overdo it – you're not as young as you used to be"; and (3) "Tom, as your physician, I think that I know what's best for you." Two high control forms of patronizing talk are also distinguished by emotional tone. The first form, directive talk ("I said to take your pill *NOW*"), lacks any hint of warmth that might soften the control message and indicate concern for the recipient. The second high control form is called secondary baby talk ("Now, sweetie pie, it's time to take our pill.") due to its similarity to the intonation patterns, warm emotional tone, and simple language used with infants (Caporael 1981). Older adults express their dissatisfaction with patronizing talk, and both middle-aged and younger adults evaluate it as disrespectful and controlling (Giles and Gasiorek 2011; Hummert et al. 2004).

In addition to capturing the antecedents that lead to patronizing talk, the CPA model outlines the consequences that create a feedback cycle with negative outcomes for older adults and their communication partners (Giles and Gasiorek 2011). These include unsatisfactory intergenerational relationships, avoidance of intergenerational contact, and reinforcement of negative age stereotypes in the younger and older individuals in the conversation. Ultimately, to the degree that the older person internalizes and conforms to the negative stereotypes as a result of such interactions, declines in physical functioning may follow (Hummert et al. 2004; Hummert 2012). Experimental studies and analysis of longitudinal data sets by Levy and colleagues (Levy 2009) have identified an association between negative self-stereotyping and an

increased risk of illness or death for older adults. The relationship between patronizing talk and negative stereotyping has been documented in numerous studies, but a recent study links patronizing talk to both cognitive performance and physiological stress, a risk factor for health problems. Hehman and Bugental (Hehman and Bugental 2015) randomly assigned older and younger participants to receive instructions for a cognitive task in either a patronizing or nonpatronizing style. Analysis of performance and stress responses revealed that older participants exposed to patronizing talk had poorer performance and higher stress responses in comparison to older participants in the nonpatronizing condition and young participants in both conditions.

Context and the Risk of Patronizing Talk

Communication with older adults occurs in a wide variety of contexts such as family, social, institutional, organizational, and medical. Although patronizing talk and its consequences as illustrated in the CPA model can occur in any context, it is more likely to occur in contexts which make negative age stereotypes salient than in other contexts (Giles and Gasiorek 2011; Hummert et al. 2004). Three contexts assume prominence due to their importance to the psychological and physical well-being of older persons: institutional, medical, and family.

Institutional and medical settings in particular evoke negative age stereotypes of illness, frailty, and decline (Kornadt and Rothermund 2015). In fact, the initial identification of secondary baby talk occurred in observations of nursing home staff interactions with residents (Caporael 1981). Frail older adults in such living facilities may have repeated interactions that involve the more extreme forms of patronizing talk and thus are especially susceptible to the consequences illustrated in the CPA model (Giles and Gasiorek 2011; Hummert et al. 2004; Williams et al. 2009). Community-dwelling older adults may encounter patronizing talk from physicians and other medical staff in both hospital and out-patient settings. Patronizing talk in these settings can emerge in several additional ways that disadvantage the older patient: not allowing time for the patient to describe concerns, failing to explore comments that hint at health problems, using an authoritative style that precludes the opportunity for questions, avoiding eye contact with the patient, attributing complaints to the patient's age, or directing communication to the patient's companion rather than to the patient (Fisher and Canzona 2014). Institutional and medical settings make age stereotypes salient not only for physicians and staff but also for residents and patients (Miche et al. 2014). Thus, these settings increase resident and patient vulnerability to the declines in psychological and physical well-being that can follow from exposure to patronizing talk (Giles and Gasiorek 2011; Hummert et al. 2004; Williams et al. 2009).

Age is salient within the family context because families are intergenerational by definition. In comparison to institutional and medical settings, the family context is one that is associated with positive age stereotypes about the warmth and wisdom of elders (Miche et al. 2014). At the same time, older family members report that they experience patronizing talk from their adult children (Hummert et al. 2004; Hummert 2012; Hummert in press). These problematic interactions primarily take the form of unsolicited advice and/or directives around topics of health, finances, living arrangements, and safety (e.g., driving) (Hummert et al. 2004; Hummert in press), all of which are related to negative age stereotypes of decline and incompetence. Within families, these conversations reflect a tension between paternalism (i.e., the desire to protect family members from harm) on the part of the adult child, on the one hand, and autonomy (i.e., the desire to control one's own actions) on the part of the older parent, on the other (Cicirelli 1992). Parallels can be seen in the problematic interactions between parents and adolescents, although in those interactions the expectation is that the adolescents will later achieve independence (Hummert 2012). With older parents, the expectation is that the need for paternalism will increase and the parent's ability to be independent will decline.

Older adults recognize that patronizing talk from their adult children is based on care and concern for their well-being, and so may find it difficult to discount as unwarranted even as they find it dissatisfying. Experiencing patronizing talk from valued family members therefore increases the parents' subjective experience of aging and susceptibility to negative self-stereotyping (Giles and Gasiorek 2011; Hummert et al. 2004; Diehl et al. 2014) and the related negative psychological and physical consequences of the CPA model. Communication between grandparents and grandchildren is also susceptible to the influence of negative age stereotypes and their consequences (Soliz et al. 2006), illustrating that these patterns of talk may be transmitted and reinforced across the generations.

Improving Intergenerational Interactions

Older and younger adults have the opportunity to reduce the impact of negative age stereotypes on intergenerational communication. These opportunities are addressed in the communication enhancement, the age stereotypes in interaction, and communicative ecology of successful aging models, all of which build on the communication predicament of aging model (Fowler et al. 2015; Giles and Gasiorek 2011; Hummert et al. 2004).

The communication enhancement model offers suggestions on ways that caregivers and family members can use communication to empower frail older persons, creating an alternative positive feedback cycle to the CPA model (Savundranayagam et al. 2007; Hummert et al. 2004). In the CPA model, negative stereotypes influence communication with older adults when the recognition of age cues leads to implicit activation of beliefs about the communication needs of the older adult involved and the unconscious or automatic accommodation to those needs that can result in patronizing talk. The communication enhancement model calls for disrupting this process at the outset by conscious focus on the individuality of the older person. Communication can then be modified as necessary to accommodate needs of the individual, empowering that person as a coequal partner with the provider or family member. The movement toward person-centered communication in caregiving is consistent with the individualized communication envisioned in the communication enhancement model (Savundranayagam et al. 2007; Williams et al. 2009; Storlie 2015). Empowering older adults through individualized communication increases the satisfaction of all parties and optimizes the opportunity for the older person to achieve improved well-being. It also sets in motion a positive feedback cycle by enabling the older person to maximize his or her communication skills and competence. The benefits of the communication enhancement model require conscious commitment, monitoring, and effort on the part of providers and family members. Intervention studies and assessment of training programs demonstrate that use of patronizing talk by caregivers can be decreased and person-centered communication increased to yield benefits for older individuals in residential facilities (Savundranayagam et al. 2007; Williams et al. 2009).

The age stereotypes in interaction (ASI) model considers how older adults themselves can use communication to avoid negative stereotypes at the beginning of an interaction or to redirect an interaction in a more positive direction after it has begun (Giles and Gasiorek 2011; Hummert et al. 2004). According to the ASI model, positive or negative age stereotypes may be salient at the beginning of an interaction with an older adult based not only on the context (e.g., family or medical) as discussed previously but also on the way in which the older adult communicates. Young, middle-aged, and older individuals associate several communication behaviors of older adults with negative age stereotypes (Giles and Gasiorek 2011; Hummert et al. 2004; Hummert 2012): painful self-disclosures (i.e., revealing a distressing personal experience such as the death of a spouse or child to a stranger or acquaintance), off-target verbosity (i.e., rambling and/or redirecting the conversation to a tangential or unrelated topic), self-stereotyping (e.g., referencing one's age or labeling a memory lapse as a "senior moment"), and older-to-younger

patronizing talk (e.g., disapproving/disrespectful talk, over-parenting by offering unsolicited and unwelcome advice, etc.). The ASI model predicts that the association of these communication behaviors with negative age stereotypes increases the likelihood that their use will initiate the negative feedback cycle of the CPA model. Conversely, older adults' ability to tell interesting stories, especially those that put history in context or provide an uplifting narrative to listeners, are associated with positive age stereotypes and a reduced likelihood that the negative cycle of the CPA will follow (Hummert et al. 2004).

The ASI model also considers how older adults can use their communication skills to interrupt and redirect the negative feedback cycle of the CPA through their responses to patronizing talk (Giles and Gasiorek 2011). The challenge for older adults is to respond to patronizing talk in ways that assert their autonomy and establish their competence, but to do so in a manner that builds a mutually respectful relationship with the other individual. Experiments have tested the effectiveness of passive, direct assertive, appreciative, and humorous response styles in achieving this goal. Results show that direct assertive responses, in comparison to passive responses, are better at establishing the competence of the older person but are perceived as more controlling and less respectful. Humorous and appreciative responses emerged as the most effective in establishing the competence of the older speaker in a warm and respectful way (Giles and Gasiorek 2011; Savundranayagam et al. 2007; Hummert et al. 2004).

Increasing older adults' awareness of how their own communication relates to age stereotypes can help them to avoid the consequences of the CPA model and achieve the benefits envisioned in the ASI and communication enhancement models. This awareness is at the center of the communicative ecology model of successful aging (Fowler et al. 2015). The ecology model focuses on the power of older adults to use communication to reduce their uncertainty about aging, increase their self-efficacy, take advantage of new communication technologies, and reach their own definition of successful aging (Fowler et al. 2015).

The three models may be compared on (a) their assignment of agency to older adults or others, and (b) their applicability across contexts (family, social, institutional, organizational, and medical). The communication enhancement model emphasizes the responsibility of caregivers and providers to engage in adapting their communication to the individual needs of older persons in order to support their full engagement in the communication process. Although being sensitive to one's communication partner is good advice in general, the communication enhancement model is particularly applicable in institutional, medical, or family settings in which the frailty or acute health condition of older individuals make it difficult for them to assert their agency without supportive communication partners.

In contrast, the ASI and ecology models assign agency to the older adult, but the former focuses on agency within individual interactions whereas the latter considers agency in communication holistically. In the case of the ASI model, the older adults have the ability to use their communication skills to avoid beginning the negative feedback cycle captured in the CPA model or to interrupt and redirect that cycle after it has begun. Within the ecology model, older adults have the agency to create the communication environment that supports their desired experience of aging. Both of these models apply across all contexts, but within medical and institutional contexts their applicability may be limited by the extent to which older adults' health status affects their communication agency.

Concluding Thoughts

Age-related conditions such as stroke, dementia in its various forms, and Parkinson's disease create specific communication challenges for older adults, their family members, and caregivers. End-of-life communication also has its own unique characteristics and challenges. Neither of these topics is addressed specifically in this entry. However, the communication principles outlined here – the dangers inherent in drawing on negative age stereotypes as guides, the benefits of adopting

an individualized approach, and the importance of older adults using their communication skills to achieve their version of successful aging – provide a useful framework for communication with and by older adults in these special circumstances.

Cross-References

- Age Stereotyping and Discrimination
- Age, Self, and Identity: Structure, Stability, and Adaptive Function
- Age-Related Positivity Effect and its Implications for Social and Health Gerontology
- Aging and Psychological Well-Being
- Attitudes and Self-Perceptions of Aging
- Grandparenthood and the Changing Nature of Social Relationships
- Intergenerational Relationships
- Language, Discourse Production and Communication
- Social Connectedness and Health
- Social Media and Aging

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Comorbidity

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Synonyms

Co-occurring disorders; Dual diagnosis; Multimorbidity

Definition

Comorbidity generally denotes the occurrence of two or more psychiatric or mental health disorders in one person. Two conditions that co-occur are considered to be comorbid regardless of whether the etiology of the disorders overlaps or is distinct, regardless of the chronological development of the disorders (Goodell et al. 2011).

Background

Most older Americans have at least one chronic condition (Administration on Aging: A profile of older Americans 2013) and one in four has two or more chronic conditions (U.S. Department of Health and Human Services 2010). With respect to physical conditions, approximately three-fourths of older Americans have hypertension, half have arthritis, one-third have heart disease, one-quarter have some type of cancer, and one-fifth have diabetes (Administration on Aging: A profile of older Americans 2013). Older age is associated with the presence of more chronic conditions (Bayliss 2014), which makes comorbidity an essential topic for geropsychologists. Moreover, patients with chronic medical conditions have high rates of depression and other mental illnesses (Bower et al. 2014). The prevalence of psychiatric disorders may be as high as 45% among medical inpatients and outpatients (Kaszniak 1996). Other psychiatric conditions like anxiety or substance abuse are more likely to occur when the index condition of depression is also present. In light of the ubiquity of chronic medical conditions in late life and high rates of co-occurrence of medical and psychiatric disorders, one must assess and manage comorbid conditions when working with older adults. Failure to consider medical comorbidities may dilute treatment effects and confound diagnostic accuracy. Consideration of comorbidities may also refine our psychiatric phenotypes, help us identify the genetic bases of mental health disorder, and reveal their pathophysiological mechanisms. Before considering the identification and management of comorbid disorders, one should first carefully characterize comorbidity.

Defining Comorbidity

The term "comorbidity," first used by Feinstein in 1970, refers to the coexistence of two or more disorders within one person. One important aspect of Feinstein's definition was that one of the disorders was the "index disease" being studied (Fortin et al. 2014). The term comorbidity originated in the medical literature but was soon adopted for use in psychiatry. The study of comorbidity became quite important with the 1980 publication of the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) (American Psychiatric Association 1980) because

of the use of polythetic criteria to characterize psychiatric disorders. Polythetic criteria allowed for differing clusters of symptoms to be characterized as the same disorder. Additionally, symptoms such as sleep disturbance may be included in multiple psychiatric disorders.

By the 1980s and 1990s, researchers began using the term multimorbidity (Fortin et al. 2014) to describe the burden of multiple medical conditions. Currently, multimorbidity is most often used when three or more conditions are present. Comorbidity usually has one condition of interest (i.e., index condition), whereas in multimorbidity there is no specific condition of interest. Multimorbidity encompasses the complexities resulting from the presence of multiple conditions, as is often seen in primary care settings (Fortin et al. 2014). When working with patients with multimorbidity, clinicians must sort out different recommendations resulting from the separate clinical management guidelines for each chronic condition. Reconciling different clinical management guidelines often leads to confusion on the part of the patients and polypharmacy and even results in contradictory recommendations. Multimorbidity is an important term to be aware of for clinical geropsychologists, but here, comorbidity is the term that is focused on as specialized fields such as geropsychologists often focus on one presenting problem or one index condition.

Kraemer (1995; Kraemer et al. 2006) defined several distinct types of comorbidity that are especially relevant for those studying aging: clinical comorbidity, epidemiological comorbidity, familial comorbidity, and random comorbidity. The first type, clinical comorbidity, refers to a situation in which the prognosis differs for people who have the index disorder and a second disorder when compared with those who have the index disorder and not the second disorder. The second type, epidemiological comorbidity, occurs when two disorders co-occur more often than one would expect by chance alone. Epidemiological comorbidity may occur when the two disorders share genetic risk factors or if the two disorders are different clinical manifestations of the same disorder. Epidemiological comorbidity is of interest to clinicians and researchers because the presence of one disorder (e.g., Down's syndrome) may signal that clinicians should screen for another disorder (e.g., dementia). The third type, familial comorbidity, describes comorbidity that occurs when the prevalence of one disorder differs among relatives of patients with a second disorder when compared with relatives of patients without the second disorder. For instance, the occurrence of obsessive-compulsive disorder is higher in relatives of individuals with Tourette syndrome compared with families without Tourette syndrome. Lastly, disorders that do not fit into these other three categories, that may simply co-occur at random, and that have no relevance to clinical decision-making would be called random comorbidity using Kraemer's model (Kraemer 1995). For example, the presence of social anxiety disorder and a completely unrelated condition like shingles could be considered randomly comorbid. Unrelated disorders such as these are considered an example of random comorbidity.

Prognosis and treatment recommendations can vary based on co-occurrence of conditions in clinical comorbidity (Kraemer 1995). This entry, therefore, focuses on issues relevant to clinical comorbidity because it is most relevant to geropsychologists in both clinical practice and clinical research settings.

Diagnostic, Prognostic, and Treatment Implications of Ignoring Comorbidities

Among older adults, age-related physiological and other body system changes can complicate diagnosis and treatment. One disorder may cause another (e.g., hypothyroidism can lead to depression), whereas other conditions may exacerbate one another (e.g., anxiety and chronic obstructive pulmonary disease). Hence, prognosis and treatment recommendations may vary based on the comorbid disorders present.

Sleep disturbance is one of the most frequent complaints among those with depression or anxiety in late life and as such can be thought of as a core-presenting symptom of these two mental health disorders. Nevertheless, sleep disturbance can also occur due to the presence of a

diagnosable sleep disorder, such as sleep apnea, an extraordinarily common sleep disorder in older adults. Failing to adequately assess for and diagnose sleep apnea can mean patients obtain a diagnosis of a psychiatric disorder when in fact they should be given the diagnosis of a sleep disorder. In the example of sleep apnea misdiagnosed as depression, treatment with antidepressants may have modest results at best, whereas augmenting antidepressant treatments with continuous positive airway pressure (CPAP) could alleviate the sleep-disordered breathing while also improving depressive and anxiety symptoms.

With respect to prognosis, a person with an anxiety disorder and breathing disorder may be slower to respond to behavioral treatments because of modifications needed in teaching diaphragmatic breathing or breathing retraining compared with a person with an anxiety disorder and no breathing difficulties. Indeed, it is well documented that the presence of such comorbid disorders such as pain and depression slows the response to pharmacological and psychological treatments for late-life depression. Such examples are very common in geropsychology. Given the considerable implications of many comorbid conditions for diagnosis, prognosis, and treatment, it is imperative that geropsychologists adequately assess for and address comorbid medical and psychiatric disorders in older adults.

Assessing Comorbidities

A critical issue is how best to evaluate and assess a comprehensive range of comorbid disorders. The main challenge to studying comorbidity is the inherent heterogeneity of one's sample. Consideration of this heterogeneity is essential to identifying the effectiveness of evidence-based treatments, yet characterization of comorbid samples is challenging. Frances et al. (1990) highlight several issues that influence how comorbidity is measured and classified. To start, with more disorders included in a classification system, there is more likelihood of comorbidity. Additionally, splitting disorders and using categorical classifications increase the rates of disorders and the rate of comorbidity. Often in the DSM, which relies on polythetic criteria, there is substantial symptom overlap, which can lead to increased rates of comorbidity; however, the use of a hierarchy in making diagnoses reduces rates of comorbidity.

A commonly reported issue relating to differing comorbidity rates and assessment is the halo effect, whereby an assessment geared toward detecting a particular disorder might also increase the assessor's awareness of a particular disorder. A halo effect also could be a function of the assessor's assumptions about disorders being related (Frances et al. 1990). Another reported issue regarding assessment and comorbidity includes selection of comprehensive versus narrower assessments. A comprehensive assessment, such as the Structured Clinical Interview for DSM (SCID), is more likely to detect the presence of comorbid conditions than would be the case if select measures of specific disorders were used. In the case of structured interviews (e.g., SCID), the assessor is comparing an individual's symptoms to the set list of diagnostic criteria. Assessors likely detect more conditions when using structured interviews compared with using a limited set of selected measures (e.g., depression and anxiety screens) because structured interviews force assessors to consider many different types of psychiatric conditions as the assessor reviews a set list of diagnostic criteria for each disorder. Different settings also affect the likelihood that specific pairs of comorbid conditions will co-occur, such as in an anxiety disorder clinic, where depression may be more likely to co-occur with social anxiety disorder; however in primary care clinics, depression may be more likely to co-occur with chronic medical conditions. The main challenge to characterizing comorbidity in psychiatry is the use of diagnoses based on groups of symptoms rather than etiologically defined disorders (Fyer et al. 1990). Prospective longitudinal studies will elucidate the etiology and course of psychopathology, which is needed to better understand the common pathways and courses of comorbid diseases.

In the medical literature, the burden of multiple conditions (i.e., multimorbidity) is measured using disease counts and established comorbidity

indices such as the Charlson Comorbidity Index (Charlson et al. 1987). These indices and counts do not characterize the specific relationship between an index condition and the associated conditions, as is the focus of comorbidity research. These indices are helpful in predicting negative outcomes such as mortality, but they have less relevance when trying to characterize specific comorbidities.

Personalized approaches to assessment can also be used. This would entail a multimodal assessment including reviews of medical evaluations, cognitive testing, functioning assessments, behavioral observations, and clinical interviews with the patient and an informant if possible. The thorough review of somatic symptoms can help differentiate medical disorders from psychiatric disorders. In the review of somatic symptoms, identifying the onset of symptoms and other factors in the time line is essential. Investigations of whether disparate treatment outcomes occur with different groups of comorbid patients will also help elucidate the relationships among comorbid conditions.

Common Psychiatric Comorbidities

Many aspects of psychiatric comorbidity remain true from younger to older adulthood, although some differences exist. Psychiatric disorders seldom occur in isolation from other psychiatric symptoms or disorders regardless of a person's age. The psychiatric disorders ranked from most (anxiety disorders) to least common (schizophrenia) follow the same pattern in younger, middle-aged, and older persons (Kessler et al. 2001; Zarit and Zarit 2007). The tendency for some psychiatric disorders to occur together more often than others is also somewhat age invariant. The prevalence of psychiatric disorders and subthreshold symptoms, however, differs with age. In particular, the prevalence of any psychiatric disorder decreases with age, but subthreshold anxiety and depressive symptoms are documented as common with as many as 25% of older adults reporting subthreshold depression (Zarit and Zarit 2007) and 20–29% reporting subthreshold anxiety (Gellis et al. 2014). Researchers have argued for a dimensional approach to understanding psychiatric disorders, rather than a purely categorical one, in order to capture these subthreshold psychiatric conditions (Maser and Cloninger 1990). The rationale for implementing a dimensional approach is all the more salient in older adults given the ubiquity of subthreshold symptoms. Because subthreshold psychiatric disorders are associated with substantial medical and cognitive comorbidity, especially in older adults, documenting and treating them is critical.

Anxiety and depressive disorders frequently co-occur and as such have garnered much of the attention regarding psychiatric comorbidity (Zarit and Zarit 2007). This has led some theorists to propose that anxiety and depression represent different phenotypic (i.e., expressed) manifestations of the same underlying disorder. Others have argued that the lifelong durability and trait-like nature of anxiety disorders increase the risk of developing depressive disorders, which tend to be cyclic over the life span. Older adults with any number of anxiety disorders, such as panic disorder and social anxiety disorder, often suffer from coexisting dysthymic disorder or major depressive disorder. In fact, there has been some suggestion that this overlap of depression and anxiety in older adults is greater than what is seen in younger adults, particularly when subthreshold symptoms are included. Cognitive disorders, namely, minor and major neurocognitive disorders, are much more likely to co-occur in older adults with psychiatric disorders than in older adults without any threshold or subthreshold psychiatric issues.

In addition, comorbid psychiatric issues require additional consideration in clinical situations with older patients, particularly because individuals with coexisting psychiatric problems often have more severe symptoms. The decision to treat one disorder, such as the anxiety disorder as primary versus treating the depressive disorder as primary, has implications for

treatment selection. Behavioral interventions targeting anxiety typically focus on reducing anxiety through relaxation skills training or desensitization through real or imagined exposure to feared situations or objects. Treatments for depression typically work to increase the person's social interactions, activity level, and experience of the environment as positive through a concerted effort to partake in enjoyable activities. These behavioral skills have been successfully used in older patients suffering from psychiatric disorders (Zarit and Zarit 2007). The presence of anxiety and depressive disorders could require a combined treatment approach or staged approach where the more urgent of the two disorders is first treated before treating the second disorder. With regard to pharmacological interventions, both anxiety and depression can be treated with some of the same medications (i.e., selective serotonin reuptake inhibitors or SSRIs), rendering this comorbidity issue potentially less relevant for medication management. Nevertheless, other situations, such as comorbid schizophrenia with generalized anxiety disorder, could require a more complicated medication regimen due to potential interactions and negative side effects of medications that treat the two separate disorders.

Less often discussed, but a critical issue for understanding psychiatric comorbidity in older adults, is the co-occurrence of personality disorders (Mordekar and Spence 2008). These disorders are characterized by long-standing patterns of inflexible and maladaptive behaviors that often go against society and cultural norms. This often leads to disruptions in interpersonal relationships. Again, as with other psychiatric disorders, the prevalence of personality disorders declines with age (Segal et al. 2006). The comorbidity of personality disorders with other psychiatric disorders, however, is quite high in older persons. Mood and anxiety disorders are the most commonly reported diagnoses comorbid with personality disorders. For example, it has been reported that 24% of older individuals with major depressive disorder also meet criteria for a personality disorder. Further, rates of comorbid personality disorders are notably higher (73%) in older individuals with adult-onset depression than late-life-onset depression (45%) (Mordekar and Spence 2008). With regard to anxiety disorders, comorbid DSM-5 Cluster C personality disorders (avoidant, obsessive-compulsive, or dependent) are frequently observed in individuals of all ages who experience an anxiety disorder. Treatment of an older patient becomes even more challenging, as personality disorders are often associated with poorer prognosis. They complicate treatment delivery and can require a more sophisticated intervention approach and skill level of therapist for older adults seeking help.

Common Medical Comorbidities

Older adults with psychiatric disorders often also have comorbid medical conditions. Psychiatric-medical comorbidity is likely a function of many factors including but not limited to age, poorer self-care, greater disability, and cognitive impairment. When working with older adults who have both psychiatric and medical disorders, one must determine the extent to which the medical disorder contributes to the psychiatric disorder of interest. Additionally, the manner in which the medical and psychiatric disorders are related temporally is important. For instance, chronic conditions may lead to depression, whereas depression itself may be a risk factor for chronic conditions and functional decline (Bower et al. 2014). Moreover, depression may make it more difficult for a patient to be motivated to manage their chronic conditions, leading to poorer outcomes, as may be observed in individuals with comorbid depression and diabetes (Bower et al. 2014).

There are multiple pathways through which psychiatric and medical disorders interact. To illustrate this point, take the example of late-life anxiety disorders. Chronic medical conditions, such as chronic obstructive pulmonary disease, may lead to physiological changes that predispose older adults to anxiety (Zarit and Zarit 2007). Alternatively, an acute illness or hospitalization

may lead to an exacerbation of worry and other anxiety symptoms (Zarit and Zarit 2007). It is also possible that medications such as steroids or anticholinergics prescribed to older adults could exacerbate or even cause anxiety (Zarit and Zarit 2007). The presence of an anxiety disorder prior to the development of a chronic condition may make the management of the medical condition more difficult, such as the presence of agoraphobia would likely interfere with patients' attendance at medical appointments. These are only a few examples of the multiple pathways connecting psychiatric and medical disorders.

In addition to the pathways connecting psychiatric and medical disorders, oftentimes the prevalence of psychiatric disorders may be greater and severity worse among older medical patients. For instance, depression is more prevalent among older adults with medical illness (Zarit and Zarit 2007). Functional limitations associated with medical illnesses, sensory impairments, ambulation difficulties, and pain may limit an older patient's ability to engage in pleasant activities. Behavioral theorists posit that these functional limitations reduce participation in enjoyable activities and thus cause depression.

Psychological stress, experienced by those with psychiatric disorders, may also adversely affect physical health by exacerbating chronic conditions like hypertension (Haley 1996) and preventing immune responses that are important in recovery (e.g., cancer). Individuals with severe mental illness (SMI), such as schizophrenia, die 10–15 years earlier than their counterparts without SMI. These individuals with SMI also have elevated risk of having comorbid medical conditions likely due to multiple factors. The presence of SMI requires substantial management and can result in the psychiatric disorder taking precedence over and obfuscating other problems, which is referred to as diagnostic overshadowing (Bower et al. 2014). Some antipsychotic medications contribute to weight gain, increased risk of diabetes, and metabolic syndrome, whereas other lifestyle choices (e.g., sedentary, poor diet) and comorbid conditions (e.g., substance use disorders) may contribute to the development or worsening of chronic medical conditions (Bower et al. 2014).

Treating Patients with Comorbidities

Personalized or patient-centered medicine ideally can be used to tailor treatments to patients with comorbidities. Individualized treatments can take into account the patient's medical and psychiatric comorbidities. Individualized treatments allow providers to consider the index condition being treated as well as other factors, such as cognition, which can influence outcomes. Careful assessment provides a strong foundation for tailored, personalized treatments. Additionally, interdisciplinary teams are an essential part of delivering patient-centered treatments to those with comorbidities. The team members can address medical and psychiatric conditions through the collaboration and communication across disciplines.

There is also a need to include patients with comorbidities in randomized control trials (RCTs). Patients with comorbidities are included in large and inclusive RCTs called "pragmatic" or "effectiveness" RCTs rather than the smaller efficacy studies. Effectiveness trials focus on examining the effects of treatment under the usual conditions (i.e., in community practice) rather than under the ideal conditions (i.e., controlled research setting) as is the case for efficacy studies. Moderator analysis (Kraemer et al. 2006) can be used to examine the effect of comorbidities on treatment outcomes. The resulting findings will likely yield information about what treatments work best for which groups of patients. These findings can be used to refine existing treatments, develop new treatments, and inform patient-centered medicine.

Conclusions

Psychiatric and medical comorbidities are common across the life span. Among older patients, high rates of comorbid psychiatric disorders co-occur frequently with chronic medical conditions.

Medical conditions and associated functional impairments may precede and lead to psychiatric conditions. Chronic psychiatric conditions can also affect an individual's physiology and immune responses, lifestyle, and the clinician's assessment (i.e., diagnostic overshadowing). The complex relationship between comorbid psychiatric disorders and medical and psychiatric disorders points to a need to use multimodal assessments to accurately diagnose and treat older patients with these comorbidities. Additionally, more research is needed to determine the manner in which comorbid conditions affect treatment outcomes in older patients. Prospective longitudinal studies and large-scale effectiveness trials could address this issue.

Cross-References

- ▶ Anxiety Disorders in Later Life
- ▶ Depression in Later Life
- ▶ Subsyndromal Psychiatric Disorders

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Complementary and Alternative Medicine

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Synonyms

Holistic medicine; Natural medicine; Non-conventional medicine; Unorthodox medicine

Definition

Complementary and alternative medicine (CAM) is an umbrella term used to describe a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine, that have not been part of the public healthcare system or administered by conventional medical practitioners (Adams et al. 2009). There has been a noted increase in CAM use across all populations during the past 20 years (Andrews 2002), including older adults (aged over 65). Depending on how CAM is measured, studies suggest 40–65% of older adults use either some form of CAM therapy and/or over-the-counter CAM products (Cohen et al. 2002). Older adults have been identified as being significant consumers of CAM, and the factors that influence this use are varied and have unique implications compared to other cohorts.

Population Ageing, Chronic Illness, and Health System Responsiveness

Complementary and alternative medicine (CAM) is broadly consumed by older adults and its use is on the rise. CAM, and indeed health care in general, is being influenced by the demographic shift of the ageing population (Adams et al. 2009). It is predicted that there will be 1.5 billion individuals over the age of 65 by 2050, driven by decreasing fertility rates and improved life expectancy (World Health Organization 2011). This comes at the cost of increased economic and social pressures on a range of systems and infrastructure globally. How health services are consumed and provided is changing across both traditional and nontraditional services.

The ageing population will place particular strain on the health system with disease patterns moving from acute short-term, infectious or parasitic diseases to chronic long-term, noncommunicable diseases (Hale et al. 2007). As longevity increases, frailty and chronic illness rise as physical and cognitive capacities decline at the later stages of life (World Health Organization 2011). In particular, the demand for chronic care, rehabilitation services, and palliative care all increase with the ageing of populations (Hale et al. 2007).

Criticisms have been made of the existing medical system and the difficulty it will face catering to the increased demand on services due to changing disease patterns (Holman 2004). The current health system is typically focused towards treating acute illnesses that are episodic where the health practitioner typically has the majority of control in determining treatment and management approaches, and the patient is largely a passive recipient. It has been argued the traditional medical model of health care (that focuses on biological aspects of disease and illness) is less conducive to treating chronic illnesses where treatment is ongoing and long-term management of symptoms is often the goal, rather than seeking a cure. Due to the ongoing and often personalized experience of chronic illness, it is argued that the roles in treatment need to shift from the health practitioner having full control to provide the patient with more authority over their treatment plan, allowing them more responsibility and autonomy in management of their conditions (Holman 2004). The current model of healthcare delivery offers limited flexibility.

Chronic Illness and CAM Use

The ageing population is at increased risk of chronic health complaints illness (Cherniack

et al. 2001). Older consumers are cognizant of the need to treat these health complaints, and it has been found that as health conditions deteriorate, CAM use increases (Cherniack et al. 2001). Indeed, CAM use is five times higher in the chronically ill population compared to a healthy population. In general, research completed with chronic illness populations have noted that CAM use rates are elevated and typically centered around management of health conditions (Cherniack et al. 2001).

Within the chronically ill population, the use of CAM has been linked to a belief that CAM is a "safer" option than conventional medicine with fewer side effects to conventional medicine (Vincent and Furnham 1996). Furthermore, CAM users have reported strong beliefs in the efficacy of the CAM product/service being consumed (Vincent and Furnham 1996). Practitioners who provide CAM services often have longer consultations and reportedly provide more personalized services than offered by conventional medical systems (Gammack and Morley 2004). This in itself has a therapeutic benefit that can be particularly useful in the treatment of non-life-threatening chronic illnesses.

The Active Consumer

Researchers have noted that the flexibility in services offered through CAM allows the individual to play an active role in the management of their long-term chronic disease (Bishop et al. 2007). CAM offers a different approach to the traditional biomedical model, and studies have shown it can provide a prevention-focused, flexible healthcare model for chronic and degenerative diseases (Bishop et al. 2007). While the need for conventional medicine is still undisputed, the argument that CAM offers a more versatile form of care when dealing with non-life-threatening and chronic ailments has merit and may assist in addressing the need created by the ageing population. This shift appears to be occurring as traditional health systems are not currently structured to cater for the increase in long-term chronic diseases that is occurring across the globe associated with population ageing (World Health Organization 2011).

Traditional medicine and CAM use are very much rooted in cultural contexts, and the legitimacy of both health treatment options is influenced by sociocultural perspectives (Root Wolpe 2002). The sociocultural context not only influences people's perceptions of both traditional medicine and CAM but also the illnesses that trigger their use. In the literature surrounding health service provision, there is an expanding body of research attempting to describe a shift towards consumerism and the identity of health users (Milewa 2009). The typical health consumer now interacts with health services as an active participant, picking and choosing the products best tailored and personally suited to their needs rather than being a passive consumer. The ability to make personal decisions, select from a range of options, and make choices based on a sense of personal responsibility and shared decision making are valued by many patients. Patients who adopt this viewpoint are more likely to look for broader healthcare options beyond what is offered by traditional health service providers, including services offered by CAM.

With higher uptake of CAM use, there is increasing pressure for conventional medical practitioners to have knowledge about individual patients CAM usage. Historically, many doctors have not discussed CAM usage with their patients. Research has demonstrated that up to 77% of CAM users did not disclose their CAM use to their treating practitioner (Xue et al. 2007). CAM users who discussed their CAM use with their medical practitioner were more likely to describe themes of acceptance and control whereas CAM users who did not have these conversations were more likely to describe their treating physicians as narrow minded (Vincent and Furnham 1996). To add to this, general practitioners frequently underestimate the extent to which their patients use CAM (Nahin and Straus 2001). This is concerning as studies have additionally shown that patients often have a poor understanding of the effects of CAM. Harmful interactions have been found between some CAM products and conventional medicine

approaches, e.g., herbal therapies and pharmaceutical therapies (Votova and Wister 2007).

The Third Age

Increasing longevity of life has contributed towards a period of time referred to as the Third Age, between postretirement but prior to age-imposed limitations such as illness (Weiss and Bass 2002). This growing generation in general has improved physical and mental health, greater wealth, and higher levels of education, with predicted longer life-spans than their predecessors. The Third Age provides a platform for older adults to explore personal growth, self-fulfillment, freedom, and personal engagement, with a noted increase in the desire to maintain health status and postpone the inevitable decline in health (Weiss and Bass 2002). Indeed, there is often an acute awareness of one's mortality coupled with uncertainty about future health needs (Weiss and Bass 2002). The combination of increased resources and the time to use them has placed older adults in an optimal position to experiment with previously unexplored services and products, e.g., CAM. There is often a sense of responsibility for personal self-maintenance that promotes concepts such as awareness of medical conditions, proactive intervention, wellness techniques, self-care of diet and exercise, and new learning. With this combination of factors, an increase in CAM use among this population is understandable (Andrews 2002).

Antiageing Movements

Antiageing movements through media and marketing have additionally influenced the use of CAM through increased consumerism of antiageing products (Milewa 2009). There exists a marked increase of interest in products and services that are marketed as being able to slow down or even reverse the natural ageing process. Improvements in access and marketing that targets consumers through media such as the press, television, and Internet have contributed to this increased interest. While CAM services have increased broadly, there has been a particular boom in CAM technologies aimed towards antiageing with middle-aged and older adults being primary consumers (Weiss and Bass 2002). An increased focus on positive frameworks of growing older that include the denial of physical signs of ageing and the promotion of healthy active living has been witnessed. In particular, the chronological process of ageing has been reframed as a transition, emphasizing a distinction between chronological age and cognitive age of individuals.

Personal Motivators of CAM Use

Some researchers have categorized the motivators for individuals choosing to use or not use CAM as being in terms of push/pull influences. Pushes indicate factors that "push" an individual away from conventional medicine. Typically, these experiences are underpinned by dissatisfaction with conventional medicine, e.g., poor communication, adverse side effects, poor treatment options (Sirois and Gick 2002). Pulls in contrast indicate factors that draw the individual towards CAM, e.g., holistic approach, long appointment times, and perceived safety of the approach (Furnham 2005). Typically, there appears to be a mix of motivators that change over time and an interplay factors that influence whether an individual is a CAM user or nonuser. It is often the case that older adults use CAM in conjunction with conventional medicine, as a concurrent service to the management of their health care. Indeed, in some studies CAM users were found to consult with a specialist doctor more frequently than non-CAM users (Adams et al. 2003). The researchers hypothesized that this suggested a pragmatic approach to selecting treatments that "best fit" their health concerns.

Research on push versus pull factors has been varied and there is little consensus in the literature on which variables are consistently associated with CAM use in the past or future. For example, one found that personal control over health and dissatisfaction with conventional medicine were inversely related to CAM use (Testerman et al. 2004). In previous research however, criticisms of the existing medical system have been proposed to influence CAM use (Willison and

Andrews 2001). A more recent study that found dissatisfaction with conventional medicine was positively correlated with past but not future use (McFadden et al. 2010). An important variable that is not always addressed in research is dissatisfaction with conventional medicine treatment versus dissatisfaction with the treating physician. For some individuals, there were high rates of satisfaction with their physician; however, they felt that the use of CAM would assist in relieving symptoms in a way that conventional medicine was not able to provide (Testerman et al. 2004).

A number of attitudinal dimensions have been identified as being related to CAM use. Those who are more likely to seek CAM have been identified as having a heightened awareness and commitment to environmental issues (Astin 1998; Kranz and Rosenmund 1998). Other attitudes that have been linked to CAM use include a belief in personal responsibility towards health and holistic healthcare approaches (Astin 1998). Holistic beliefs include views of the mind–body relationship as being in balance and maintained by self-healing. Some studies have noted that as holistic beliefs and health complaints increased, so too did CAM use, indicating that both personal beliefs about health care and a desire to relieve illness symptoms influence CAM use (Vincent and Furnham 1996). It has been proposed that conventional medicine, through focusing on the physical elements of a disease, fails to account for the person as a whole (Kranz and Rosenmund 1998). For individuals holding this perspective, CAM provides an appealing alternative.

It has been suggested that CAM users perceive that they have increased control over the active management and choices concerning their health (Astin 1998). Previous researchers have hypothesized that a desire for control (Astin 1998) and a sense of personal responsibility towards health and holistic healthcare approaches (Furnham and Kirkcaldy 1996) are important factors that influence an individual's choice to use CAM. The desire to seek holistic, natural, and preventative approaches is often motivators for commencing CAM use (Kranz and Rosenmund 1998). A systematic review explored 94 studies that included themes of control, illness, holism treatments, natural treatments, and life philosophies and how they related to CAM use (Bishop et al. 2007). The researchers reported that a desire for participation in treatment decisions, active coping styles, and holistic approaches to health were all significantly related to CAM use, however control was not. Many of these studies use a cross-sectional design so directionality cannot be easily established to determine if beliefs about CAM use, active coping styles, and holistic approaches to health were formed before or as a result of CAM use. Other research has found positive relationships between personal control and CAM use for healthy individuals (McFadden et al. 2010). Testerman et al. (2004) did not find such a link but his population was recruited from a medical clinic. These studies demonstrate that the specific relationships between predictor variables are often complicated.

Structural and Sociodemographic Influences on CAM Use

There are also a number of structural and personal sociodemographic influences that influence frequency and type of CAM use (Kelner and Wellman 1997). The physical availability and access to CAM products, personal income, insurance plans, private health care, and distance travelled to access services have all been linked to CAM use (Kelner and Wellman 1997). Studies have consistently shown that CAM use is higher in rural and remote regions compared to urban settings (Robinson and Chesters 2008), and lower in Metropolitan areas compared to nonurban locations (Adams et al. 2003). This is an issue of particular concern to older adults as there are often mobility and driving restrictions that further complicate their access compared to younger cohorts (McLaughlin and Adams 2012). Difficulty accessing conventional health services in rural regions compared to urban areas may be influential in the decision to use CAM (Robinson and Chesters 2008). Indeed, the relationship between geography and location to CAM use is not as strongly established in the literature as other

elements including health status, gender, income, and level of education. Connected elements to geography may include population of available clinicians, proximity of specialist services and range of services, socioeconomic status of the region and policies, and politics of the region (Adams et al. 2011). A number of studies specifically exploring older adult CAM use in rural settings found that CAM is used far more broadly than the treatment of existing health complaints, but also for maintaining current health status and well-being (Adams et al. 2003; Robinson and Chesters 2008).

Conclusion

The ageing population, the antiageing movement, and shifts in consumerism and disease patterns have all contributed to changing the way in which older adults consume traditional health care and CAM. CAM use amongst older adults is an increasing phenomenon that is uniquely impacted on by a number of broader cultural shifts. The combination of the ageing population and the rise of chronic illness requires all health providers, independent of their qualifications or personal beliefs, to recognize and be informed about the processes and factors influencing CAM uptake in the older population. There is a need for future research to investigate directional relationships to explain the mechanisms which influence decisions to adopt and maintain CAM therapies. This information will potentially provide guidance for healthcare service providers who seek to understand how CAM usage interacts with conventional medicine, and will help ensure that the most effective health-related outcomes for those in later life.

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Conceptual Model of Habit Reforming to Improve Balance and Prevent Falls

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Synonyms

Automatic behaviors; Challenge your balance; Cues to action; Do more and be safe; Integrate balance and strength training within daily tasks; Load your muscles; Visualize and plan

Definition

Understanding how habitual behaviour can be adapted and changes maintained are core concepts in an applied model of behaviour change to embed balance and strength training into daily life activities and routines with the goal of reducing the risk of falling.

Definition Statement

Habits: automatic behavioral responses to environmental or situational cues developed through repetition in consistent contexts.

Falls: an event which results in a person coming to rest inadvertently on the ground or floor or other lower level (WHO).

Balance: the ability to maintain an upright posture and keep the body within the base of support with minimal postural sway. Maintaining balance involves motor planning and the integration of input from multiple sensory systems.

Functional exercise: training that is performed with purpose to enhance a certain movement, movements, or activity that is closely aligned with daily tasks (Liu 2014; Chou 2012).

Lifestyle-integrated exercise: This is a specific type of functional exercise whereby activities or actions that are designed to improve physical ability, such as to challenge balance or improve muscle strength, are embedded within everyday tasks and routines (Clemson, 2012).

Introduction

This entry outlines a conceptual framework that underpins the adoption of an innovative approach to balance and lower limb strength training to reduce the risk of falls. The Lifestyle-integrated Functional Exercise (LiFE) program, proven effective in reducing falls and improving function in a randomized trial, (Clemson et al. 2012) embeds balance and lower limb strength activities within daily life tasks and routines. Activities are tailored to the person's capacity and their lifestyle. The framework is an applied one and is based on a

habit reforming theory, principles of self-efficacy, and an understanding of occupation-person-environment demand theories.

Functional Exercise Programs That Improve Balance, Reduce Falls, and Improve Function

There is strong evidence for the core role of balance in providing protection from falls for older people with studies demonstrating that balance training is more effective than strength training alone in preventing falls (Sherrington et al. 2008). Further, the evidence for functional exercise training having direct benefit in improving balance, physical function, and the capacity of older adults to perform activities of daily living is growing (Liu et al. 2014). Functional training has been defined as any type of training that is performed with purpose to enhance a certain movement or activity (Liu et al. 2014). Functional exercise appears to be most effective when the training content is specific to the outcome (Liu et al. 2014; Chou et al. 2012) and activities that involve dual or multitasking have a greater capacity to reflect function.

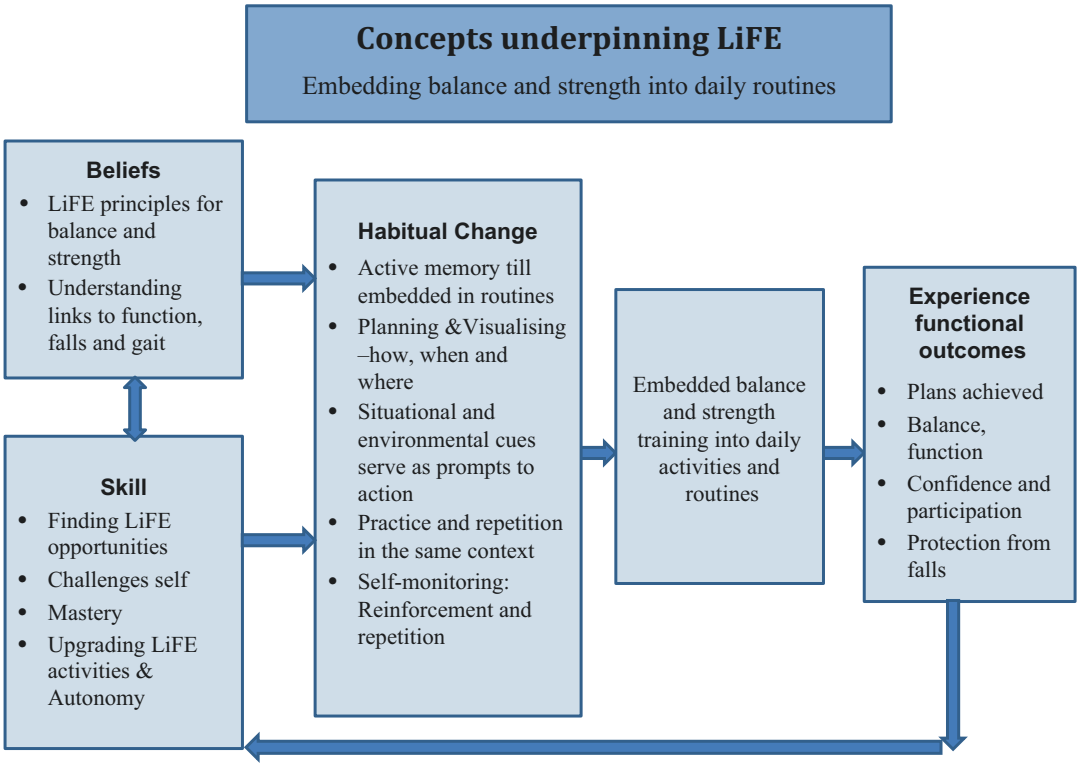
Exercise programs that involve multiple components are suggested as the most appropriate for physically frail older adults because they align more closely with the demands of functional situations (Cadore et al. 2013). Examples of specific functional training programs include a music-based multitask training program which improved gait and balance and reduced falls through activity to music and involved dual tasking (Trombetti et al. 2011). Other approaches to improving physical fitness and capacity to perform daily life activities have tested programs that specifically incorporate activities of daily living. One such program used a multistation circuit approach which mimicked daily functional tasks (Dobek et al. 2007). The Lifestyle-integrated Functional Exercise program (LiFE) (Clemson et al. 2012) is different to these in that it embeds balance and strength training into daily life activities throughout the day and is performed within the participants home and their community environments.

With poor health, slow gait, and unsteady balance predictive of difficulty in long-term engagement in exercise, it is not surprising that the effect of any exercise dissipates after the program ceases (Gine-Garriga et al. 2013). To maintain outcomes, the program needs to have an effect more than just preventing falls, for example, improving functional capacity. Typical positive comments from LiFE participants such as "I can keep catching the buses so I can still get to visit my daughter" or "I can stand up now to put on my trousers" or "I can keep going to the club because I can easily get out of the chair" reflect that personal outcomes must be relevant to the person and their lifestyle. Understanding what enables older people to continue to exercise will also provide guidance as to what features are essential when undertaking training and also what tools are needed to facilitate adoption and personal sustainability.

LiFE Trial Outcomes

LiFE was tested in a three-arm randomized trial (Clemson et al. 2012) where LiFE and a structured exercise program were compared to a control group who received a "sham" gentle exercise. The trial recruited 317 people 70 years or older who had either had two falls in the previous year or one injurious fall. After a 12-month follow-up, there was a 31% significant reduction in rate of falls (IRR = 0.69) for the LiFE participants compared to the control group who received a gentle exercise program. The structured program (balance and strength exercises performed three times a week) showed reduced falls, but this was not a significant difference compared to the control group. In the LiFE program, there were significant and moderate effect sizes for both static balance and dynamic balance and for balance confidence. For LiFE, while there were steady improvements for hip and knee strength, ankle strength was the only strength measure to show a significant effect. LiFE demonstrated moderate to large effect sizes in measures of function and daily activity and in a measure of participation. Adherence was sustained with 64% still engaged in LiFE activities at 12 months.

The LiFE program has been successfully implemented in a restorative home care service showing positive outcomes in a pragmatic



Conceptual Model of Habit Reforming to Improve Balance and Prevent Falls, Fig. 1 Conceptual framework underpinning embedding balance and strength training into daily life activities and routines (Lifestyle-integrated Functional Exercise (*LiFE*) Program to prevent falls. Trainer's manual. Clemson, Munro and Fiatarone Singh, 2014 Sydney University Press)

randomized trial (Burton et al. 2013). It has also been incorporated in a group-based program for women at retirement (Fleig et al. 2015).

The Lifestyle-integrated Functional Exercise (LiFE) Conceptual Model

Embedding Balance and Strength Training into Daily Routines

Figure 1 summarizes the main concepts underpinning how to embed balance and lower limb strength activities into daily life activities and routines (Clemson et al. 2014). The LiFE program includes features that enhance beliefs, attitudes, and understanding of the program as well as training in skills specific to the program. A central and core process of change are strategies to encourage habitual change, based on habit re-framing theory (Lally and Gardner 2013). LiFE activities are linked to specific daily tasks using situational and environmental cues that serve as prompts to action. Planning includes both setting what activities and where and how they will be performed and visualizing doing this in selected situations. They are performed intentionally and consciously until they become habitual and embedded in daily occupation. Feedback, monitoring, and positive reinforcement are strategies used to improve skill and enhance self-efficacy in the performance of the activities. The experience of positive functional outcomes will sustain engagement in the program. These outcomes may include protection from falls, increased function, self-confidence in balance demanding activities, and greater participation in activities and life roles.

Beliefs

When training people to implement such programs, we believe it is important for participants to

understand the principles of balance and strength training underlying the program. Motivation can be enhanced if people are able to link doing the particular activities to specific outcomes. Features of the model are designed to inform and enhance beliefs, attitudes, and understanding of the underlying principles of the program. To engage in an embedded exercise program, it is necessary to have a belief that it is possible to improve balance and strength and that this will have a direct impact and benefit; this may be to reduce fall risk, to improve gait or to improve functional capacity in performing activities of daily living.

LiFE Principles for Balance and Strength

Many people are unaware that they have poor balance. Only 6% of the general older population engages in any balance challenging activities. Being able to safely and functionally maintain posture requires motor planning and sensory input from the vestibular system, vision, and proprioception. Being able to maintain balance is a complex process. Further, the notion that balance is something that a person can improve is a very poorly understood phenomenon. Most people do not understand that they can improve their balance. Nor are they aware how they could do this, that is, by challenging themselves in specific ways that are tailored to their personal capacity. The program outlines several principals for challenging balance (Clemson et al. 2014). The LiFE principles for improving muscle strength are applied to the groups of muscles known to provide protection from falls – hip, knee and ankle muscles. The program does not use weights or resistance bands as these would not be part of the participant's daily routine. Instead it relies on the person using their own body weight (e.g., standing up from a chair slowly to increase quadriceps strength).

The overarching LiFE principles are (i) to improve balance, we must challenge balance and continuously increase the challenge to our balance, and (ii) to improve strength, we must continue to load the muscles.

Understanding Links to Gait, Function, and Falls

Providing brief but targeted explanations about how the type of exercises directly link to beneficial outcomes can impact motivation. We suggest that there would be numerous opportunities during assessment and training to provide examples which link the exercises to improved function in doing daily living tasks, to improved gait, and how the LiFE activities can provide protection from falling. These examples need to be relevant to the person. This is intended as conversation during training at appropriate moments when the opportunity arises and not intended as a didactic lecture. For example, "moving sideways" or sideways stepping is one of the balance activities. This could be illustrated by referring to how strong hip abduction is important if a sideways stepping response is required to protect from overbalancing. Further, people with a previous hip fracture are more likely to have poor hip abduction strength suggesting the importance of strong hip muscles.

Improving Balance and Strength Can Improve Walking Stability and Strength

Other examples could relate to the ability to walk safely. Understanding how the gait changes and how this impacts fall risk may provide a motivation for older people to engage in balance and strength training which can also improve their mobility. The changes in gait in the older person may be influenced by a variety of factors including musculoskeletal changes such as decreased strength, reduced range of motion at a variety of joints, neurological factors, or low confidence.

Gait analysis is complex. However, a simplified analysis of the gait of older people generally states that older people have a shorter stride length, a wider base of support, and a slower pace. Anecdotally, many older people shuffle. This means that their feet are in contact with the ground for longer periods of time through the phases of the gait cycle. This may make them feel more stable but may not necessarily protect them from falls. The inability to lift the foot to effectively clear an obstacle may make the person more likely to trip and therefore fall.

Improving balance and strength in the legs should translate to an improved ability to walk. For example, strengthening the dorsiflexors may lead to an improved ability to lift the forefoot for

heel strike and less chance of "catching" the toe and tripping. If this is added to better balance while standing on one leg, therefore a more stable supporting leg in the stance phase in the persons gait cycle will be improved. This in turn should lead to safer walking and possibly more confidence walking. The program encourages participants to think about the way they walk, with the heel down and the toe up. That is, they need to concentrate on making contact with their heel and then consciously pushing off with their toe. With improvements in both strength and balance, the person is encouraged to walk with an improved gait and encouraged to scan ahead as they walk (Clemson and Swann 2008).

Balance Challenges While Dual Tasking Can Have a Functional Benefit

LiFE activities often involve tasks that require multiple skills to be used at the same time. This is often referred to as dual tasking as the tasks involve varying combinations of physical movement and upper and lower limb coordination, as well as attention to the task at hand. Examples of dual tasking include a one-legged stand while cleaning your teeth or squatting (bending at the knees) rather than bending at the waist when selecting items from a lower shelf in the supermarket.

By embedding LiFE activities in daily life routines, the person is automatically placed in situations of competing demands. This connects balance and strength training to daily living tasks which naturally adds challenging demands. This can include, for example, selectively paying attention to the environment around them as well as dual tasking as they are doing the LiFE activity.

Having a poor capacity to perform dual tasking in tasks that involve gait variation and demand attention has been shown to predict an increasing risk of falls (Kuptniratsaikul et al. 2011). This risk is increased for repeat fallers (Beauchet et al. 2008). Training in dual-task activities that challenge balance in clinic situations has been shown to improve gait stride and variability and dynamic and static balance (Silsupadol et al. 2009). LiFE has shown that this can be done in everyday situations and that these skills transfer to other functional tasks. It may be that the tailored and embedded activities of LiFE enhance the integration of skills such as task coordination, postural control, and spatial processing.

Functional Activities Also Involve Planning, Concentration, and Attention

Activities that involve planning, concentration, attention, and strategizing could have a direct impact on function (Liu-Ambrose et al. 2008). Think of what is involved in challenging balance when talking on the phone, carrying things while turning around or going up stairs, or tandem walking down the hall carrying a cup of tea. Liu-Ambrose et al. (2012) propose that it is not just physiological improvements that can be gained from exercise but that executive function and functional plasticity can improve from targeted exercise. They draw on understandings of brain function, evidence from their own and others work in resistance training, and on studies exploring the relationship between fallers' performance on tasks that demand attention and tasks involving executive function (Anstey et al. 2008). They assert that, along with physiological change, such mechanisms may play an important role in how exercise improves function and reduces fall risk.

Skills

Finding LiFE Opportunities

There are many opportunities throughout the day to embed balance and strength activities. The starting point is to chart a typical day routine over a week. LiFE activities are then matched to specific daily routines or tasks for that individual. Rather than looking for ways to do less, participants are encouraged to look for ways to do more and to add balance and strength activities into more daily tasks.

Challenges Self and Mastery

The concepts of challenging oneself, mastery, and upgrading are interconnected. They are all important skills that underpin most exercise programs. To improve and continue to improve balance, a person will need to practice challenging balance

activities. To improve strength, a person has to continue to load their muscles and continue increasing the load on their muscles. To continuously upgrade their activities, the participant needs to be able to set a goal related to a LiFE activity, determine when they have mastered that activity or achieved the goal, and then set a new, more challenging goal. Self-efficacy refers to the perception of one's ability to reach a specific goal (Bandura 1997). The ability to set realistic, short-term, achievable goals as well as mastering an activity can increase the participant's beliefs about self-efficacy when they prove that they can master the activity.

Mastery refers to the ability to perform an activity at a certain level. Inherent in this concept is the idea that new challenges can always be created once a particular challenge has been met. Mastering a skill involves breaking it down into simple and manageable steps and having incremental goals working toward achieving these steps. In the LiFE program, participants have to master an activity at a lower level before they can safely progress to a more challenging activity. For example, when a participant can stand on one leg with two-hand support, then the goal becomes moving to a one-hand support and then one-hand intermittent support. Participants master the activity and then set a new goal which upgrades their level of activity.

Upgrading LiFE Activities and Autonomy

Upgrading is based on the principles, that is, progressively increasing challenges to balance or increasing load on lower limb muscles within one activity or combining activities that target two or more principles (e.g., sway to limits of stability sideways when standing on one leg and climbing up stairs two steps at one time without using the handrail for support are both very advanced LiFE activities).

Finally, and most importantly, the aim is to give the participants the skills to become autonomous in implementing the program themselves, to understand how to upgrade, and to select appropriate activities that will continue to challenge their balance and load their muscles in safe and correct ways. Thus, planning and setting goals require joint decision-making, a sense of ownership of the goal, and encouragement to contribute "how, when, and where" more LiFE activities can be undertaken.

Habitual Change

Facilitating habit change requires strategies that transition the novel activity into a routine part of the daily task (Lally and Gardner 2013). That is, LiFE activities need to become habitual. When the activities become habitual, they are more likely to be sustained.

Active Memory Till Embedded in Routines

Habits are automatic actions. So to change a habit requires thinking and planning within active memory until it becomes stronger than the current action and becomes automatic or "embedded." This suggests also that the number of activities chosen to change at one time should be manageable.

While learning the program during the training phase, participants must consciously think about the activities and embed them into daily tasks. That is bringing them into consciousness or active memory. We learn new habits by incrementally processing over time using our active (or procedural) memory. Over time they become habitual and automatically embedded in daily occupation. Habits are routine, goal-directed behaviors that are set in motion by situational or environmental cues (Ronis et al. 1989). These can be automatic and may go unnoticed or may be intentional where the situation needs to prompt us to action.

Changing habits requires time. This is why training in the LiFE program was taught over five sessions, two phone calls, and two booster sessions but which extended over a 12-week period. LiFE requires working with active memory until the activity becomes a stable and enduring habit and is embedded in routine. This is facilitated by practice and repetition in the same context.

Planning and Visualization: How, When, and Where

Holland et al. (2006) stated that planning and visualizing changes were important because they helped formulate the intent to action and acted to strengthen the association between the situation or

environment and the action. Participants in the LiFE program are expected to plan when and where they will perform the activities and to which of their daily tasks they will link the activity. They are also asked to visualize themselves performing the activity while doing their daily tasks. The particular task then becomes the cue for remembering to do the LiFE activity. For example, a participant could practice tandem standing while washing up; then doing the washing up becomes the cue to do the tandem stand. But in addition to practice, they are also encouraged to imagine or visualize themselves in the future doing this.

When they have mastered the skill of performing the desired activity embedded in a specific daily task and are doing this routinely, they should then try to visualize themselves performing it in other daily tasks. Participants can then generalize the activity performance to other contexts. The idea is to be able to transfer the activities to as many tasks and places as possible through their daily routine. They can plan to embed the activity in the new task in addition to the former task.

For example, they might start with bending their knees (squatting) to get the detergent from below the sink. Once this is mastered, they then plan and visualize themselves bending their knees in other situations such as the bathroom to get the toothpaste out of the cupboard or in the kitchen when getting the plates out for dinner.

Visualization is a strategy to assist intent to action and included as a step in planning where the activities can and will be embedded. It also assists participants to generalize the activities to a variety of tasks and places. Recording how, when, and where on the "LiFE Activity planner" is important to clarify steps and to commit to action, but it is the visualizing and planning that are the key features of this process. Such intentions to implement the action and planning will greatly increase the chance of carrying out the action.

Situational and Environmental Cues Serve as Prompts to Action

A planned commitment to a behavioral response occurs within a particular situation and in response to a particular cue. The ability to replace old habits with new ones is dependent on both conscious planning and the influence of situational cues (Lally and Gardner 2013; Holland et al. 2006; Lally et al. 2011). Changing behavior requires prompts to elicit the desired behavior. In LiFE there are several methods of providing the cues to prompt the desired behavior. There are general prompts that apply to all participants. These include bending your knees if you need to reach for anything below waist height or go on your toes if reaching above waist height.

To facilitate the embedding process, the participants plan which daily tasks the LiFE activities will be linked to or embedded within. These tasks then become the situational cues to prompt the performance of the LiFE activity. Situational cues can be a place and time, for example, the kitchen sink in the morning; a feature of the environment, for example, the doorway between the hall and the bathroom; or a pattern of interaction with the environment, for example, standing in the supermarket line. These cues act as a prompt to elicit the behavioral response – the performance of the LiFE activity.

The program encourages participants to make changes to their environment to facilitate the performance of the LiFE activities such as moving commonly used items to a different place to promote repeated performance. Some examples include moving the detergent to a lower shelf to prompt knee bends and moving the tea cups to a higher shelf to prompt toe raises. The aim is to have participants performing the strength and balance activities without having to consciously think about including them in their daily tasks. This way, they become habitual.

Fleig et al.'s (2015) implementation of LiFE with younger women in a group setting particularly noted the importance of habit theory and how using activity and object-based cues were particularly effective in generating action and automaticity.

Practice and Repetition in the Same Context

Practice and repetition is crucial to habit formation. Lally and Gardner (2013) outline the stages of habit formed in a similar context each day. So rather that planning too many different contexts,

you might start with squatting (instead of bending your back) every time you close a drawer in the bedroom and kitchen. Once habits are formed, this can be generalized to broader contexts such as the supermarket, the garage, or other places that the participant goes.

Planning and practice are both critical in implementing new habits. Participants have to plan to do the activity, visualize themselves doing the activity, and then practice doing the activity consciously and repeatedly until it becomes habit. When a new action is performed, a mental association between situation and action is created, and repetition reinforces and establishes this association in memory.

Self-Monitoring, Reinforcement, and Repetition

Participants engage in planning the changes. The therapists demonstrate the activities and provide opportunity for participants to practice, self-monitor through planning and recording sheets between sessions, and provide feedback and positive reinforcement. To enable habit change, this approach to exercise needs to be taught over a period of at least 8 weeks and preferably 12 weeks. Therapist support is needed to assist in setting session goals initially and then to move to increasing autonomy so participants are planning, setting "how, when, and where" themselves, and monitoring their progress. To change habits, there must be continual repetition and practice.

The power of goal setting, feedback sheets for monitoring exercise that are acknowledged by the trainer, and other forms of encouragement and self-incentives relative to personal goals cannot be overestimated. In resistance training, self-regulation is known to directly contribute to enhanced confidence in maintaining performance at challenging levels, to using correct form and to continual upgrading as one level is mastered (Winett et al. 2009). This requires cognitive (knowing what to do), motivational (wanting to perform and the confidence that you can), and behavioral (being able to do it) factors.

Experience Functional Outcomes

Participants gain intrinsic reinforcement for the performance of the activities in a variety of ways. If they engage in the planned activities and can upgrade over time, they will achieve improved balance and function and increased confidence in mobilizing and in desired activities and will have more protection against future falls.

In fact, protection from falls alone, although a major outcome, is not going to be an ongoing incentive. Other outcomes are needed, such as better balance and function, in order to enhance motivation sufficiently to adopt and sustain the program.

Applied Theory in Practice

The innovative LiFE program is different to a usual exercise program and may require a shift in thinking or focus for therapists and trainers and the participants. Occupational therapists look for ways of making tasks *easier* for their clients or of having them do *less*. The LiFE program encourages participants to look for ways of doing *more* and seeking out more demanding environments. Physical therapists are more familiar with prescriptive programs where dosage is increased by repetition, weights, or external resistance and performed in sets at regular times each week.

The model is intended to be applied in practice, and providing this framework enables the assessments, planning, and recording tools as well as the training process be conducted such that they integrate the key elements and features of the model. This kind of program requires the participant to spend time implementing the program throughout their day, and it therefore needs to be tailored, relevant, practical, and functional.

The LiFE approach has been shown to work in different settings and provides another choice for a successful fall prevention program with potential to maintain function. Further work could elucidate which groups of people an embedded approach of balance and strength training would benefit the most. In addition, qualitative inquiries would be welcome that can further elucidate the features and mechanisms of the concepts underpinning the program which are essential to successful uptake and long-term sustainability of such programs.

Cross-References

- ▶ Decision Making
- ▶ Environmental Influences on Aging and Behavior, Theories of
- ▶ Everyday Cognition
- ▶ Mindfulness Approaches
- ▶ Physical Activity and Aging
- ▶ Risk Taking in Older Adulthood
- ▶ Working Memory in Older Age

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Conflict Management and Aging in the Workplace

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Synonyms

Conflict strategies; Conflict styles

Definition

Workplace conflict emerges when there is a disagreement between two or more parties in the organization or when a person perceives incompatible needs, goals, desires, or ideas with another person (Deutsch 1994). There are two major forms of conflict in the workplace: Interpersonal conflict takes place when a worker perceives that his/her valued outcomes are deprived due to interference from the opposing worker, while intergroup conflict arises when a group of workers perceive a deprivation of valued outcomes due to interference from the opposing group (De Dreu 2011).

Introduction

Conflict is inevitable in the workplace as long as there is social interaction between two or more parties, including individuals, units, departments, and organizations. It involves cognitive and behavioral reactions toward incompatible goals, competing interest in scarce resources, and interference in goal attainment (Hocker and Wilmot 1991). Depending on one's attitudes, values, and goals, a social situation can be perceived as either a threat to one's interests or an opportunity to cooperate and maximize the benefits of both parties. This behavioral intention in turn determines whether escalatory or de-escalatory action should be taken.

Abundance of conflict research has provided evidence for the detrimental effects of conflict when it is managed poorly. In particular, prior research has found that workplace conflict contributes to reduced job satisfaction and organizational commitment, poorer health and well-being, and disruptive behaviors that are costly to employers, such as absenteeism and turnover (De Dreu 2011). However, although it is undeniable that conflict can result in a number of negative outcomes, research from the past two decades shed light on the positive and constructive benefits of conflict when it is managed appropriately in the workplace. For example, workplace conflict has been found to enhance communication, resolve continuing problems, facilitate team performance, stimulate learning, and promote creative thinking under the condition that the conflict is problem-focused, cooperatively oriented, and involves integrative efforts to achieve optimal solutions (De Dreu 2011). Therefore, effective conflict management is crucial to team effectiveness and work productivity.

The number of mature workers aged 45 and above in the labor force has been growing drastically over the past decade, for example, from 34.9% to 42.9% in the United States (US Bureau of Labor Statistics 2011). The composition of labor force becomes more diverse, comprising mature workers from the baby boom cohorts (1946–1964) and later cohorts from generations X (1965–1976) and Y (1977–1992). The presence of workers from multiple age groups within an organization intensifies the occurrence of conflict because of differences in work values, work ethics, goal orientations, and conflict styles between younger and older workers.

In the face of changing demographic trends, how conflict can be managed effectively is a major concern for many organizations. It is therefore a pressing task to identify and unravel the underlying mechanisms of conflict in the mature workforce. By drawing from various areas of research, valuable insights can be obtained to reveal the influences of motivational orientation, goal orientation, and social identity on conflict strategy preferences among younger and older workers. Effective measures can then be proposed in light of the conditions that are required for conflict to result in positive outcomes. In the first section of this entry, the dual concern model (Rahim 2011) and the theory of cooperation and competition (Deutsch 1994) will be discussed to identify the major determinants of conflict strategy in the workplace. The second section will discuss the socioemotional selectivity theory (Carstensen 2006) and the social identity theory (Tajfel and Turner 1986) and review the empirical findings on age differences in conflict management. Implications and future directions on managing the workplace conflict will be discussed in the concluding section.

Conflict Management in the Workplace

Working adults' responses to conflict can yield diverse consequences. According to the dual concern model, the ways to deal with interpersonal conflict can be categorized into five styles, including obliging, dominating, integrating, avoiding, and compromising (Rahim 2011). The selection of conflict styles is determined by one's motivational orientation, i.e., the degree of attempts to satisfy concern for self and concern for other parties. In particular, obliging strategy is used when concern for self is low and concern for others is high. This involves meeting the needs of the opposing party and giving into his/her demands. Dominating strategy is used when concern for self is high and concern for others is low. This involves forcing the opposing party to accept and give into one's personal views and demands. Integrating strategy is used when concern for self and others are both high. This involves collaborating with the opposing party in order to reach a mutually agreed solution so that the interests of both parties are satisfied. Avoiding strategy is used when concern for self and others are both low. This involves neglecting the conflict entirely to allow the conflict to dissipate on its own. Compromising strategy is used when concern for self and others are both moderate. This involves a give and take negotiation so that an intermediate position can be reached.

Similar to motivational orientation, another line of research examined goal orientation as the underlying determinant of conflict behaviors. According to the theory of cooperation and competition (Deutsch 1994), goal interdependence, which is the perception of how goals are related, influences social interaction. Specifically, goal interdependence can be grouped into three categories: cooperative goals, competitive goals, and independent goals. These three types of goal orientation are proposed to have a significant impact on the way conflict is handled. For cooperative goals, individuals perceive their goals to be positively related to each other so that successful achievement of one's goal would lead to the successfulness of another in reaching his/her goal. Individuals who are motivated by cooperative goals would avoid the escalation of conflict since working cooperatively as a group would be more effective in achieving the most desirable outcome for both parties. In comparison, for competitive goals, individuals perceive their goals to be negatively related to each other; so increasing the chances of success for one person would diminish the chances of success for another person. Under this win or lose perspective, conflict will most likely be escalated since individuals are motivated to do better than others and behave competitively in order to ensure that they succeed while others fail. For independent goals, individuals perceive their goals to be unrelated to the goals of others; so their personal goal attainment is prioritized, while other people's goals are irrelevant to their concerns and efforts. Motivated by an independent orientation of goals, actions are taken in order to ensure one's personal interests are met, regardless whether the other party is satisfied or not.

Age Differences in Conflict Management

Although the dual concern model and the theory of cooperation and competition are prominent in the literature on conflict management, they generally assume that goals and motivation remain more or less constant over the life span. Applying these two frameworks to the age-diversified workforce would lead to the prediction that a worker's behavioral responses are determined by his/her motivational or goal orientation, regardless of his/her age. For example, an older worker who has high concern for self and low concern for others would be as likely as a younger worker to prefer the use of dominating strategy. However, the literature on life span development stresses that older adults shift their goal orientation from knowledge-related goals to emotional goals when they perceive future time as increasingly limited (Carstensen 2006). Therefore, it is doubted whether these two models can fully explain the patterns of conflict strategy use in an age-diversified workforce.

Socioemotional selectivity theory (SST; Carstensen 2006) can be applied to understand conflict behaviors of older workers since it provides a theoretical explanation for age-related changes in developmental goals and social behavior. According to this theory, the way emotion is regulated is guided by future time perspective, which becomes increasingly limited as the person ages. Younger individuals who are likely to perceive an expansive future time prioritize knowledge-related goals, including knowledge acquisition, career advancement, and expansion of social network. As individuals grow older, they are more likely to perceive limited time and therefore shift their priority to emotional goals such that emotionally meaningful experiences are emphasized and valued. Therefore, the emphasis of emotional goals motivates older individuals to make use of adaptive emotion regulatory strategies that can maximize positive emotional experiences, while younger individuals are less likely to focus on emotion regulation.

When applying SST to predict conflict styles of younger and older workers, it is expected that older workers' emphasis of emotional goals motivates them to concern for others more than themselves and to cooperate instead of to compete, such that they are more likely to use passive strategies such as obliging or avoiding. Assertive strategies such as dominating style are less likely to be utilized by older workers as these strategies will prevent them from maximizing positive emotional experiences. In contrast, younger workers tend to use more assertive strategies to manage conflict situations as they focus on knowledge-related goals and are concerned for themselves more than others. These speculations are supported by research findings. For example, in a national survey of 1785 working adults in the United States, Schieman and Reid (2008) revealed that among male workers with higher authority, younger workers engaged in more aggressive and competitive conflict behaviors than did older workers. Similarly, Davis et al. (2009) examined behavioral responses toward workplace conflict in a sample of 2513 American working adults. This study demonstrated that both younger and older workers used active–constructive strategies such as perspective taking or creation of solutions to deal with conflict incidents at work, though older workers displayed a greater tendency to utilize passive-avoidant strategies such as yielding or adapting.

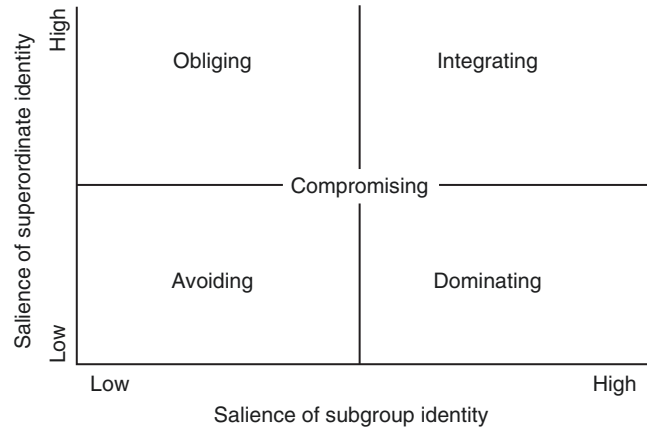
Past research on conflict management showed that the selection of conflict strategies varies by role of the conflict partner. For instance, in the study measuring conflict styles of 1219 managers in the United States, Rahim (1986) demonstrated that employees were more likely to use obliging to handle conflict with superiors and utilize compromising with peers. When resolving conflict with subordinates, they tended to use integrating as primary styles and avoiding as backup styles. Both Lee's (1990) and Nguyen and Yang's (2012) experimental studies further support the influence of the role of the conflict partner in the selection of conflict strategies. Specifically, there was a greater tendency to use direct and assertive strategies to resolve conflict with subordinates, compromising strategies to deal with peer conflict, and indirect and harmony-preserving strategies to handle conflict with supervisors. However, these studies did not take age into consideration in

the examination of conflict behaviors. To address the limitation of the prior research, Yeung et al. (2015) measured behavioral responses to workplace conflict in a sample of 280 Hong Kong Chinese managerial and executive employees aged between 22 and 66 years. The participants were asked to recall a personal workplace conflict experience that happened in the past 3 months. They also reported their goal orientations and conflict responses during the conflict situation. Results of this study revealed that relative to younger employees, older employees utilized more avoiding to handle conflicts with supervisors and less dominating with subordinates. These age differences could be explained by the higher level of cooperative goals held by the older workers relative to their younger counterparts, supporting the proposition of SST on the age-related variation in goal orientation.

In addition to the influences of motivational orientation and goal orientation reviewed above, one's social identity can also affect the selection of conflict strategies, especially during intergroup conflict. The social identity theory, which was developed to provide theoretical contributions toward social phenomena such as intergroup relations, stereotyping, and group processes (Tajfel and Turner 1986), is suitable to explain the intergroup dynamics of an age-diversified workforce. Social identity is defined as an individual's self-concept based on his/her perceived membership of relevant social groups that are of value and emotional significance to him/her. In a conflict involving a younger worker and an older worker, the individuals may identify themselves as members of the younger or older age group, which subsequently influences their thoughts, feelings, and behaviors toward the intergroup conflict (De Dreu 2011). Members of an in-group are motivated to enhance positive distinctiveness compared with the out-group members. This in-group–out-group bias is commonly manifested in intergroup conflict where members of opposing parties utilize strategies that favor the in-group and denunciate the out-group. Intergroup conflict is expected to be most severe in organizations with age diversity and distinct group boundaries between younger and older workers, as this can foster intergroup competition and social conflict, causing a higher likeliness for opposing intergroup relations to be formed (Dencker et al. 2007).

While the social identity theory makes general assumptions about the behavioral responses of conflict, five types of conflict strategy can be predicted by integrating with the dual concern model (Haslam 2004). According to the integrated model of conflict, the two axes of the dual concern model, concern for self and concern for others, can be reconceptualized as the salience of subgroup identity and the salience of superordinate identity, respectively. Salience of subgroup identity refers to one's social identification with a subgroup (younger or older workers), while salience of superordinate identity refers to one's social identification with a superordinate group (employees of an organization). This reconceptualization is possible because concern for self is consistent with the behavioral intentions of subgroup identity, while concern for others is consistent with the behavioral intentions of superordinate identity. As presented in Fig. 1, conflict between younger and older workers is escalated when dominating strategy is utilized by those who have a salient age group identity. In order for the conflict to be reconciled, social identity must be salient on both subgroup and superordinate dimensions so that an integrative solution can be reached.

To test the effect of social identity on conflict behaviors, Ho (2014) examined the relationships among social identity, goal orientation, and conflict strategies in a cross-sectional survey among 380 clerical workers in Hong Kong. Two hypothetical scenarios involving conflict with a younger worker and an older worker were used to stimulate workplace conflict. In response to each conflict scenario, participants were asked to respond to a questionnaire on how they perceived their goals as related to the opposing worker and the type of conflict strategies that they prefer to utilize under the circumstances. Results of the moderated mediation models revealed that organizational and age group identities had a combined influence on conflict strategies through goal orientation, but the pattern differed by the age of the opposing party. In the conflict with a



Conflict Management and Aging in the Workplace, Fig. 1 The integrated model of conflict (Adapted from Haslam 2004)

younger worker, individuals were more likely to use integrating when both of their organizational and age group identities were high. Individuals who were identified as members of the organization but had moderate age group identification were more likely to use compromising toward the younger worker. Furthermore, organizational identification was related to the use of obliging toward the younger worker when age group differentiations were minimal. It was also found that these relationships could be explained by the low level of independent goals held by the respondents.

In the conflict with an older worker, individuals were more likely to use integrating strategy when their organizational and age group identities were high. Individuals who were identified as members of the organization but had minimal age group identification were more likely to use obliging strategy toward the older worker. Furthermore, organizational identification was related to the use of compromising strategy toward the older worker when the level of age group differentiations was moderate. These relationships could be explained by the high level of cooperative goals held by the respondents.

Ho's (2014) study suggests that social identity contributes more to independent goal orientation with younger workers and cooperative goal orientation with older workers. This difference in goal orientation when the age of the opposing party differs may be explained by values deeply rooted in the Chinese culture. According to Confucius' ideology, it is a virtue to respect senior adults and sacrifice one's own interests to establish and maintain relationships with older people. Therefore, during conflict with older workers, one's cooperative intention is a major determining factor of how the conflict should be managed. Nevertheless, consistent with the findings of the literature on intergroup conflict, in-group membership can diminish conflict of interest and facilitate cooperation between opposing parties.

Implications for Managing an Age-Diversified Workforce

In general, the literature on conflict management in the workplace holds the assumption that the same set of predictive factors of conflict behaviors is applicable to all working adults, regardless of their age. However, as reviewed above, goal orientations change as a person grows older, suggesting that the way older workers deal with conflict incidents may not be the same as those utilized by younger workers. Even though researchers can infer from past aging research on interpersonal tensions to predict conflict responses of older workers, these studies focus largely on conflicts with family members and close friends. Therefore, it remained unclear whether younger and older workers react to workplace conflict differently, as it usually involves coworkers and clients who are not perceived as emotionally close as family members and close friends. The findings of our research tentatively suggest that similar to other nonwork conflicts,

older workers utilize more passive strategies (e.g., avoiding) and fewer destructive strategies (e.g., dominating) to manage workplace tensions than do younger workers (Yeung et al. 2015). Putting research findings from the literatures on life span development and conflict management together, it seems older individuals manage daily interpersonal conflicts in a similar way, regardless of the context. This proposition awaits future investigation to explicitly compare within-individual use of conflict strategies and goal orientations across different life domains to confirm whether the age-related pattern of conflict management is context-specific or not. In addition, by integrating the dual concern model and social identity theory, Ho (2014) further demonstrated that social identity can influence goal orientation, which would in turn influence one's preference for conflict strategy. Specifically, workers with higher organizational and age group identities tend to hold more cooperative goals and therefore use more integrating strategies to handle conflicts with an older conflict partner. Future research should include the assessment of social identity to accurately predict conflict strategies of working adults.

The majority of conflict management research was conducted on Western populations. Past cross-cultural studies on conflict management suggest that Chinese employees, in general, are more likely to utilize non-confrontational strategies (such as avoiding or compromising) than their Western counterparts (Bazerman et al. 2000). Yeung et al.'s (2015) study demonstrated a robust age effect, even in a sample of working adults with cultural norms of non-confrontational conflict approaches. Older Chinese workers displayed higher level of avoiding strategies when handling conflicts with supervisors than did younger Chinese workers. Future studies should replicate this age effect in a cross-cultural comparison study by recruiting both Western and Asian working adults of a wide age range.

In addition to the examination of age variation in conflict management, future studies should also investigate the impact of conflict strategies on work outcomes. Past studies often suggest that avoiding strategies are related to higher work and conflict stress (Friedman et al. 2006) and reduced job satisfaction (De Dreu and Dijkstra 2004). It is questioned whether older workers' greater preference for avoiding strategies is associated with poorer work outcomes and psychological well-being. However, according to SST, older adults' use of passive strategies is indeed consistent with their developmental goal orientation that emphasizes on emotional goals and interpersonal closeness (Carstensen 2006). Therefore, greater use of passive strategies should contribute positively to their well-being or have a less harmful effect. Cross-sectional studies of Yeung and Fung (2012) and Yeung et al. (2015) have demonstrated that the use of emotional suppression and avoiding strategies is beneficial to the older workers by improving their sales productivity and lowering the level of negative emotions and interpersonal tensions. These findings imply that the use of passive strategies is not always harmful to working adults but depends largely on the age of the users. The long-term beneficial effects of passive strategies on older workers though await future investigation.

Conclusion

Age differences in conflict management are observed, which can be explained by age-related changes in goal orientation and social identity.

Acknowledgments Both Ho (2014) and Yeung et al. (2015) measured conflict strategies by the Rahim Organizational Conflict Inventory II (Form C), which was used with permission from the © Center for Advanced Studies in Management. Further use or reproduction of the instrument without written permission is prohibited.

Cross-References

► Socioemotional Selectivity Theory

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Contextual Adult Life Span Theory for Adapting Psychotherapy (CALTAP) and Clinical Geropsychology

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Synonyms

Case conceptualization; Formulation

Definition

The Contextual Adult Lifespan Theory for Adapting Psychotherapy (CALTAP) model is a transtheoretical model developed to assist in increasing the understanding of both who the older adult client is and the broad context within which he or she presents for therapy.

Introduction

The Contextual Adult Lifespan Theory for Adapting Psychotherapy (CALTAP) (Knight and Lee 2008) is a model that has been developed with an older adult population in mind. Fundamentally, the model provides a framework within which a holistic and in-depth understanding of older adult clients can be developed. In order to achieve this, the CALTAP model draws on lifespan developmental principles and social contexts (both current and historical and at a cultural and cohort level). The model has also been designed to be transtheoretical in nature rather than being

wedded to any one particular type of therapy (e.g., cognitive behavioral therapy, interpersonal psychotherapy, etc.). The CALTAP model therefore offers the opportunity for the clinician to explore the case history of the client at a broad level and then determine the best therapeutic approach to meet the goals of therapy.

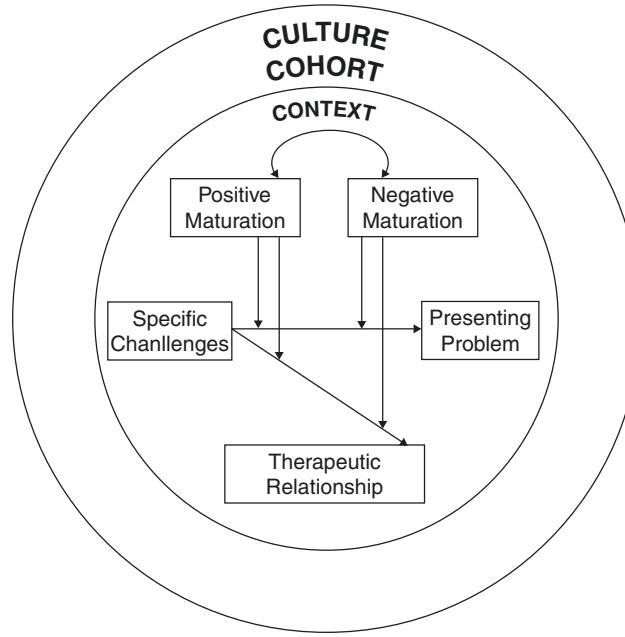
Drawing on Knight's (1996) contextual, cohort-based, maturity-specific challenge (CCMSC) model of psychotherapy, the CALTAP model elaborates on the CCMSC model by outlining a more integrated approach to psychotherapy with older adults and adding consideration of the importance and relevance of culture (Knight and Lee 2008). CALTAP identifies the following factors for consideration in psychotherapy with older adults: context, culture, and cohort. The CALTAP model (like the CCMSC model) is designed to be transtheoretical; that is, the model is not linked to any one particular approach to therapy and as such may be used across approaches to psychotherapy. Regardless of therapeutic focus, the model has the goal of increasing the therapists understanding of the client, outside the context of any one particular type of therapy, by encouraging the importance of understanding and incorporating the depth and breadth of contextual influences (Knight and Poon 2008). Having such an understanding not only guides case conceptualization but provides a frame for selecting and adapting therapeutic modalities, the use of clients' idiosyncratic strengths and challenges, and choice of therapeutic method which avoids reliance on stereotypical beliefs which can be subtle in nature and insidious in effect. For example, while older adults are more likely to experience chronic illness, some cope better with chronic illness than others. The CALTAP model therefore encourages the clinician to explore the client's experience of chronic illness both with respect to their current circumstances and to current and historical contextual factors that may be contributing to their ability to cope. A stereotypical mind-set without guidance from a model such as CALTAP, on the other hand, might assume that all older adults have difficulty coping with chronic illness, resulting in treatment missing the most appropriate therapeutic goal(s).

The CALTAP model also encourages consideration of both strengths and challenges within individual (e.g., maturation, presenting problem), environmental (e.g., context), and social contexts (e.g., culture, cohort). The focus of this model is on exploration and adaptation, encouraging the psychologist to adapt to the needs of the client (based on the information they gather) rather than having the client adapt to the psychotherapy or the underlying beliefs of the therapist. At its broadest level, the model considers both intra- and interindividual factors as they relate to the client. The model also encourages consideration of interpersonal, intergenerational, and intercultural elements. Therefore, the CALTAP model is a tool that encourages a structured approach to gathering information about the client, which is multifactorial in nature and considers the client from a number of different perspectives (e.g., interpersonal, intergenerational, and intercultural). Such a comprehensive method of collecting data guides therapy goals and offers both the therapist and the client a means of understanding who the client is and what they bring to therapy.

The Elements of the CALTAP Model

The Element of Context

The inner circle of the model (see Fig. 1) focuses on the individual and immediate context. The central diagram (i.e., "positive maturation," "negative maturation," "specific challenges," "presenting problem," "therapeutic relationship") encapsulates intraindividual factors, while the domain of "context" within which this central diagram sits considers both interindividual and interpersonal factors. This portion of the model therefore highlights the importance of consideration of the elements that might be broadly framed as the everyday context in which the client lives, including personal, environmental, and social factors. With regard to personal factors, consideration is given to what the clients themselves bring to therapy and the therapeutic relationship, as well as the interactions between those elements, which are captured via the central diagram within the center circle. In considering environmental



Contextual Adult Life Span Theory for Adapting Psychotherapy (CALTAP) and Clinical Geropsychology,
Fig. 1 Contextual Adult Lifespan Theory for Adapting Psychotherapy (CALTAP) model

and social factors, the focus is on the context in which the individual currently lives and socially engages, including such things as housing and living arrangements, the medical environments in which they engage, recreational settings, interpersonal environments, and family and social settings, for example.

The maturation elements capture lifespan developmental processes, those positive and negative changes that are posited to occur naturally as people age. Positive maturation reflects gains with increasing age, and negative maturation includes decrements in functioning with age, along with those things that people are more at risk of with increasing age (e.g., reduced processing speed, increased risk of illness, etc.). The broad and generic nature of the model also allows for consideration of variations in developmental processes, acknowledging the fact that while the lifespan developmental literature offers insight into normative developmental processes, individual differences in development can and do occur.

"Positive maturation" refers to the elements of cognitive and emotional complexity (Knight and Poon 2008). Cognitive complexity encompasses the accumulation of knowledge and skills across a lifetime, as a result of both structured and unstructured learning, that result in what can be summarized as maturation in cognition. Emotional complexity refers to the notion that as people age, they become better able to regulate their emotions (Mather and Carstensen 2005) and also experience more complex, as well as less intense, emotions than those perceived to be experienced by younger adults (Ong and Bergeman 2004). "Negative maturation," on the other hand, encompasses the broad areas of both physical decline and cognitive decline. Physical decline encompasses the idea that as people age, their body and bodily functions tend to become less efficient and less effective, and the risk of illness increases. Variability in decline is influenced by lifestyle choices of the individual as well as the normative changes associated with aging. Cognitive decline refers to the normative changes in cognition as the individual ages. Such changes include decrements in processing speed, attention, and memory (e.g., Kemper et al. 2003; Light 2000; Salthouse and Ferrer-Caja 2003). As with physical decline, and all elements of maturation, the level of decline and/or development (i.e., "negative maturation" and "positive maturation") will, in part at least, depend on the life that the individual has led and the genetic hand they have been dealt.

The CALTAP model structures a holistic approach, neglecting neither the positive nor the negative aspects of developmental processes – at an individual level – in order to build understanding of the client within a therapeutic context.

"Specific challenges" refer to life circumstances that challenge the individual and therefore can impact on the sense of self and the sense of well-being. Examples of such challenges can include chronic illness, disability, and changes in interpersonal functioning (e.g., dealing with grief, caregiving, role changes, etc.). To illustrate, with regard to chronic illness and disability, not all older adults will develop such conditions, and how much of a challenge such factors are to the individual will depend on a number of elements, not the least of which being the severity of the illness or disability, the coping ability of the individual, and the support available. Grief is another example of a "specific challenge," which may not only cause the person to think about his or her own existence but can also impact on psychosocial functioning. Length and intensity of relationship, manner of death, coping skills, and support all play a role in how well the individual might cope with the challenge of grief. "Specific challenges" also include role changes such as caregiving. Older adult caregivers can be frail and ill themselves; they may lack support or experience emotional distress as a result of the changes in their partner and themselves. With regard to the challenges that role changes may create, traditional partner roles can be challenged when the person who always saw themselves as the caregiver becomes the care receiver. Like the elements of maturation, there is no clear formula or template here, which is considered a strength of the CALTAP model as it encourages consideration of the individual, in his or her own context and specific circumstances.

As illustrated in the central portion of the diagram via the arrow configurations, the CALTAP model also highlights that the elements of "positive maturation," "negative maturation," and "specific challenges" each play a role in shaping the "therapeutic relationship" as well as the "presenting problem." An individual's context will necessarily impact on his or her ability to form relationships, including with a therapist, and will shape the therapist's ability to form a good rapport with the older client. The direction of the arrows and links they create among the elements within the center circle make intuitive and clinical sense, although such relationships have not been established via research specifically focused on the CALTAP model. One might need to consider at the very least, for example, whether bidirectional arrows should exist between "specific challenges" and "therapeutic relationship" and between "specific challenges" and "presenting problem." The bidirectional arrow between "positive maturation" and "negative maturation" highlights the interrelationship between these elements as coexisting within lifespan development.

As a group (i.e., the central portion of the diagram), the aforementioned elements are located within the center circle labeled "context." The construct of "context" itself looks to capture details of the settings within which older adults currently engage, including the environments in which they live, work, and play. It therefore looks to emphasize consideration of what elements of the individual's living arrangements, work or volunteer commitments, and socializing (at professional and personal levels) might be relevant to the presenting problem and therapeutic intervention choices.

"Context" is an apt name for this central portion of the model given that exploration of such elements provides the psychotherapist with an appreciation of the immediate context within which the client both exists and presents. One of the key strengths of this portion of the model then is to discourage stereotypical beliefs about the older adult and call attention to both environmental and intraindividual influences as a firm basis upon which to begin effectively meeting the therapeutic needs of the individual client. However, the positioning of the central portion of the diagram (which focuses on intraindividual factors) specifically within "context" (which focuses on interindividual factors) can be confusing since intuitively it makes sense to look at each of those factors separately outside the realms of such a model. It may therefore be beneficial for

the clinician to think of the central diagram and "context" as two separate elements, rather than as one embedded within the other.

The Elements of Cohort and Culture

Moving out from the center circle, "cohort" and "culture" form the outer ring of the model and represent consideration of interindividual factors. This is a change from the first iteration of the CALTAP model (Knight and Lee 2008), where the two elements were initially presented as separate rings. The significance of the two elements now being encapsulated within the one ring represents a recognition by the authors that, realistically, cohort and culture are inseparable, with each having an effect on the other, and so now present them together (Knight and Poon 2008). While the illustration of the model does not highlight this point, consideration of both historical and current contextual factors for "cohort" and "culture" is encouraged.

Cohort

At a population level, cohort refers to portions (sometimes arbitrarily determined) of the population thought to share common characteristics as a result of what might be termed shared world experiences. Knight and Lee define cohort, specifically in relation to the CALTAP model, as a group of people, often determined based on when a person was born, who are therefore assumed to have been ". . .socialized into certain abilities, beliefs, attitudes, and personality dimensions, which remains relatively stable with age and distinguishes the group from other cohorts" (Knight and Lee 2008, p. 61). For example, an individual born between the years of 1946 and 1965 is defined as belonging to the baby boomer cohort, a group of people born in the Western world after World War II, when conception rates were high with the arrival of peace. Slight variations in definition can occur depending on, for example, in which country the individual was born. Further, Knight and Lee's definition implies that to think of someone as belonging to a larger cohort such as baby boomers may risk stereotyping the individual by characterizing the client in terms of the overarching qualities assumed to be characteristic of a particular population rather than seeing clearly the qualities of the individual. Clinicians are encouraged to avoid pigeonholing their clients within one "popularized" cohort by using information about one fact in the context. Consideration should also be given, therefore, to the potential areas of influence within the cohort portion of the model, which may include such things as intellectual abilities, education level, personality development, historical experiences, norms, and values. As such, the cohort influences are based primarily on life experiences and the impact those experiences have on the development of the individual.

More specifically, cohort encourages the psychologist to explore and gain an understanding of the older adult's sense of self, which has been developing over a lifetime. As previously mentioned, consideration should be given to both the historical context and the current context in order to understand where the older adult has "come from" and where she or he is now. Cohort influences are historical in nature, which act to build the individual into who they are today and how they interpret their world. A key implication of the cohort portion of the model is that many of the distinctions that can be made between young people and older people at any point in time may be due to cohort influences and the sociohistorical context in which the individual became an adult rather than developmental changes due to aging or of being at different points in the lifespan. Recent discussions regarding the CALTAP model have made it clear that the model is also seen as useful in terms of helping clients understand their own aging processes and the meaning of variations between themselves and younger family members as caused at least partially by differences in cohort rather than age (Knight and Pachana 2015).

Culture

The final element of the CALTAP model is "culture," which Knight and Poon (2008) describe as twofold, with variations in both cultural values and beliefs, as well as ethnic and racial considerations, being important considerations.

These factors contribute to not only who the clients are but also how others treat them, how the clients interpret psychological distress, and their willingness to seek assistance.

Knight and Lee (2008) offer a definition of culture that encompasses the idea of the individual taking on group characteristics via the process of socialization, expressed as customs, language, beliefs, and behaviors. The element of culture highlights the importance of interpreting each client in the context of her or his own cultural existence, thus refraining from relying on ill-informed or stereotypical beliefs when it comes to exploring the element of culture with the client. Assumptions about culture from such concrete factors as skin color and general appearance miss important factual information with regard to how the client actually interprets themselves under the banner of culture.

Also encouraged is the exploration of the cultural beliefs toward older adults within the client's own environment. The model therefore also encourages consideration of culture from two perspectives, that of the client and that of those around them. The importance of this consideration is that it helps to determine the client's place within her or his environment, potentially highlighting such things as the availability of support and the degree of respect (or place they hold) within the particular environment. As with all the elements of the CALTAP model, such in-depth considerations highlight the need to have an understanding of the individual beyond stereotypical beliefs, one that specifies the individual within the heterogeneous older adult population as a guide toward appropriate and effective treatment decisions.

Summary

As a transtheoretical model, CALTAP offers the psychotherapist the ability to develop an understanding of the individual that can assist in guiding therapeutic approach by focusing the clinician's attention on both intra- and interindividual factors of relevance. The importance of this is that formulation models (i.e., models for conceptualizing a client's case in order to guide treatment focus) for specific types of therapy often neglect such factors, providing instead only a snapshot of the client as applicable to the needs of the therapeutic approach being used. Contextual factors, however, are an important addition in understanding how to best apply therapy to the case of the individual client. The CALTAP model therefore encourages consideration of both the forest and the trees.

The breadth of scope of the model, however, is also one of its limitations. There is comfort in having small, targeted goals as can be established from formulation models associated with specific types of therapy. The CALTAP model, on the other hand, looks to incorporate much more data, which can lead to lack of clarity with regard to establishing the goals of therapy. However, by exploring the elements of the CALTAP model with the client, the clinician has the opportunity to assist the client in broadening their understanding of their own context, which may in fact help provide for the development of more nuanced goals.

The CALTAP model recently was explored as a useful tool for consideration within the cognitive assessment context as well (Knight and Pachana 2015). Knight and Pachana (2015) expand on the model's utility by highlighting its relevance within the cognitive assessment domain. The authors encourage clinicians to become similarly aware of the depth and breadth of the client's individual context given that such knowledge contributes detail and richness to the data available in the assessment arena, as well as influencing assessment decisions, thereby improving validity overall and allowing for more targeted assessment choices and more individualized recommendation strategies.

The CALTAP model encourages psychologists to consider the range of contexts within which the older adult client presents at the level of the individual, offering a transtheoretical tool to assist in individualizing therapy and to help both the client and the psychotherapist understand the intra- and

interindividual factors of relevance to the presenting problem. Authors of the model primarily leave the decision of how to use the model in practice up to the individual clinician although the model is intended to guide more than the intake interview. CALTAP was designed as a tool to guide case conceptualization and as a broader framework that can guide assessment, selection, and adaptation of therapeutic approaches and identify relevant factors for assessing outcomes.

Cross-References

► Interpersonal Psychotherapy

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Creative Aging, Drawing on the Arts to Enhance Healthy Aging

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Definitions

The term "creative aging," in the broadest sense, describes an aging policy idea that focuses on highlighting the creativity of older adults in order to prepare individuals and communities to manage old age. Programs focus on the evolution of creativity over the lifespan and aim to provide meaningful participatory engagement, especially through the arts.

A General History of the Creative Aging Movement and Best Practices

The history of professionally led creative aging programs may be traced back to the origins of the constructs of successful aging and healthy aging. These gerontological concepts were developed in the 1960s in opposition to the prevailing construct at that time, namely disengagement theory. At the same time, aging interest groups emerged which promoted cultural and lifestyle issues for older adults.

Some of the well-known creative aging programs started in the 1970s in the United States (USA) with combining art and activities for older adults. These programs were led by professional artists, such as Susan Perlstein (the founder of Elders Share the Arts) and Liz Lerman (the founder of the Dance Exchange). Also, organizations such as the Society for the Arts in Healthcare, founded in 1990, and Generations United, established in 1986, began various activities and programs related to the creativity of older adults in the context of health care, intergenerational programs, and public policies.

Cutler (2009) describes the creative aging movement also emerging in Europe in the 1970s. However, at that time similar early initiatives

related to the arts and aging were usually described as part of the community arts movement. Examples in the United Kingdom (UK) include the Plymouth Arts Centre and community arts funding initiatives of the Calouste Gulbenkian UK Trust. More specialized programs emerged in the 1980s, such as the Age Exchange (a center of reminiscence and intergenerational arts). Moreover, in Europe various initiatives were (and still are) established through the Universities of the Third Age movement, such as courses, workshops, and debates focused on the arts and humanities.

In recent years, the creative aging movement became widespread around the world. There is a growing diversity of activities, but the arts remain at the core of initiatives. In the USA in 2001, Gene Cohen and Susan Perlstein established one of the best-known such organizations, the National Center for Creative Aging (NCCA) by building a partnership with the National Council on Aging and the National Endowment for the Arts (NEA), in affiliation with George Washington University. The organization advocates on issues concerning the arts and aging, promotes combining of the arts and aging policy, organizes events and conferences, provides training and e-learning courses and toolkits, and maintains databases of resources and best practices.

Creative Aging Programs

Creative aging programs aim to foster older persons' social engagement, skills, and opportunities for creative expression ("Creative Aging Toolkit for Public Libraries" (2016)). Three forms of creative aging practice include: (1) health and wellness programs (e.g., use of art therapies in institutionalized settings for older adults with dementia); (2) community engagement programs that focus on civic involvement of older people through the arts (e.g., volunteering, mentoring, and intergenerational programs); and (3) lifelong learning (LLL) programs that aim to improve the quality of life of older adults by building skills during various courses. Thus, creative aging programs are not simply synonymous with art workshops for seniors and tend to be delivered by professionals in diverse settings (e.g., long-term care facilities, public libraries, senior centers, and non-governmental organizations that focus on education, culture, heritage, and socialization).

Creative aging programs may also be considered as examples of new healthcare services that deliver enjoyable and fun activities in safe environments. As Hanna and Perlstein (2008) argue, creative aging may also provide a new perspective that encourages and promotes the potential (capital) of older adults rather than emphasizing their problems. To achieve this, creative aging programs should be aimed at increasing morale and passing on a legacy to younger and future generations of older adults as a means of sustaining the culture (a cultural and symbolic capital), improving physical health (human capital), and building relationships (social capital). In other words, such programs provide the basis to foster the empowerment of older adults by the promotion of emancipation or social justice, democratic citizenship, and human capital (Payne 2012).

Creative Caregiving

Creative caregiving techniques and exercises mainly draw on creative and art therapies to enhance the quality of life in both older people and caregivers, the latter including both informal (e.g., family) and professional caregivers ("NCCA Creative Caregiving Guide" 2016). In addition to the arts, creative approaches can draw on culture, science, business, and technology. Artistic creativity, for example, involves exploring new ways of interpreting the world that can produce texts, sounds, and images in response to stimulating thought-provoking questions. Creativity can also result from innovation and design. The innovation may involve the translation of ideas into new products, services, management models, or social processes. The design includes processes integrating creativity and innovation, leading to useful solutions in a caregiving context. Creative caregiving is congruent with "older-person-centered and integrated care" promoted by the World Health Organization (2015).

Creative Aging Policy

Creative aging policy can be used both as theories (descriptive models) and as ideologies or strategies (normative models) that provide frameworks for constructing positive responses to population aging. This form of policy is typically considered in the context of other aging policies ideas such as successful aging, productive aging, healthy aging, active aging, positive aging, aging in place, and intergenerational policy.

Creative aging policy aims to engage older adults in creative activity and involves a shift away from highlighting problems of aging to promoting the potential of older adults (Klimczuk 2015). It focuses on providing opportunities, technological innovations (gerontechnologies), and social innovations for all older adults, not only those who have had careers within cultural and creative industries. It supports a creative approach to leisure time in old age, regardless of whether the focus is on professional or amateur activities.

There is a complementarity of creative aging policy to the official United Nations active aging policy and thus to the related concept of healthy aging, both referred to in the 2002 "Madrid International Plan of Action on Ageing" (MIPAA). A "glocalization" of policy ideas, that is, translating and implementing general policy ideas from international organizations' policies to the local level (cities and communities) and regional level, is also implied.

Selected Theories and Research on Creativity and Aging

There are two contrasting frameworks – the "peak and decline model" and the "lifespan developmental model" – that provide frameworks to understand creative aging as a means of constructing positive responses to population aging.

The "peak and decline model" is based on the Western cultural definitions of creativity that highlight production, quantity, and novelty (Levy and Langer 1999). These features can be evaluated through use of psychometric and productivity tests that usually lead to the conclusion that with age, people tend to lose their creative abilities. This model has been criticized for excessive attention to results from standardized tests of creativity, which may not tap creativity as it is expressed throughout the lifespan. In contrast, the "lifespan developmental model" (also known as the continuity model) relies more on the qualitative measurement of creativity, with a greater focus on mechanisms leading to growth, change, and the evolution of creativity over the lifespan (Reed 2005).

Research conducted by Gene D. Cohen is considered groundbreaking in the field of arts and aging. Cohen has focused on the development of the brain in old age and its relation to creativity. His studies explore the hypothesis that maintaining a high level of creativity in old age requires not only appropriate external stimulation but also the inner need to solve increasingly complex problems with the use of creativity, and that this leads to positive health outcomes.

According to Cohen (2009), creativity in old age may be presented as the creativity equation ($C = me2$). Here creativity (C) may be seen as the result of one's mass (m) of knowledge, which is multiplied by the effects of one's two dimensions of experience (e2). These dimensions include an individual inner world experience (emotions and personality), and the outer world (experience and wisdom). From this perspective, aging has a positive influence on creativity due to the accumulation of knowledge and experience. Thus, the aging brain is still developing with new experiences and learning (Cohen 2001, 2005). These activities lead to the creation of new brain cells between our early 50s and late 70s. Thus, with proper stimulation and good health, further intellectual development is possible. Moreover, with age, brain functioning becomes more balanced in the areas responsible for emotions, and the brain's two hemispheres are more evenly used. These changes allow older people to be more creative.

Cohen and his team (2006) carried out a study of the impact of community-based cultural programs on the physical health, mental health, and social activities of older people (aged 65 and older). The research sample consisted of 166

older people from the region of Washington, DC. Participants were divided into two groups – an intervention (chorale program) and comparison (usual activity) group. These groups were assisted by researchers at the beginning of the project, after 12 months, and after 24 months. The programs included artistic activities such as painting, ceramics, dance, music, poetry, theater, and talks on material culture and spoken histories. The research demonstrated that the cultural program participants reported a better overall degree of physical health, fewer doctor visits, less medication usage, fewer falls, and fewer other health problems than the comparison group. Advantages in sociological terms were primarily better morale, increased activity, and less loneliness than the control group. In other words, the intervention helped in reducing the risk factors that may increase the necessity for long-term care services. This is potentially due to an increase in a sense of control and meaningful social engagement.

Potential Personal and Societal Benefits of Creative Aging

The literature about the arts and creative aging programs provides various examples of effects that may be achieved by the arts and creative expression intervention programs. For example, Moloney (2006) and Ehlert et al. (2010) proposed several groups of beneficiaries from such programs. First, older adults themselves may achieve personal fulfillment, a sense of meaning, new competencies to cope with daily challenges, new social relationships, and opportunities for maintaining and improving health. Second, organizations that are developing and implementing programs, particularly within the arts sector, may find benefits including engagement of older artists, access to new audiences, the development of learning communities, and changes in program funding opportunities. Third, the health sector may benefit through increased health benefits for older adults, such as fewer visits to doctors and lower levels of depression (Castora-Binkley et al. 2010). Moreover, the engagement of older adults in creative activities in care settings may lead to increased quality of life for staff, improved retention of personnel, facilitation of points of communication for visitors, increased social cohesion, the development of volunteering, and the establishment of new programs of activities. Finally, benefits may also accrue to the general public. Positive outcomes include here the promotion of intergenerational solidarity, the development of positive older role models, the establishment of cooperation between different sectors of society, and the provision of new strategies to reach diverse groups of older adults.

Conclusion and Future Directions

In recent years, the dissemination of creative aging practices has appeared across the globe (Bloom 2014). However, at this point, barriers and challenges remain for the development of creative aging programs. These observations may be at the same time considered as potential directions for further research.

One set of challenges concerns insufficient dissemination among the public and healthcare professionals about outcomes from arts and aging programs. In addition, there has been only limited development of standardized techniques for evaluating the use of the arts in healthcare programs and identifying best practices (e.g., Thomas and Lyles 2007). Use of the knowledge and skills of professional artists in engaging with older adults within the community and healthcare settings remains limited. Aside from creative aging's greatest advocate, Gene Cohen, there is limited promotion of knowledge about the benefits of creative aging. There is a need for greater research efforts and a common language concerning creative aging. Finally, funding for interdisciplinary strategies in healthcare regarding the arts remains scarce.

Cross-References

- ▶ Age-Friendly Communities
- ▶ Gerontechnology
- ▶ Healthy Aging

- ▶ Leisure Activities in Later Life
- ▶ Music Therapy, Applications in Geropsychology
- ▶ Person-Centered Care and Dementia Care Mapping
- ▶ Workplace Creativity, Innovation, and Age

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Cross-Cultural Aging

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Synonyms

Aging in different cultures; Cross-cultural differences in aging

Definition

In the current entry, cross-cultural aging is defined as cultural differences in aging of human psychology, including cognitive aging, socio-cognitive aging, and socio-emotional aging. The scope of cultural difference in the extant literature focuses mainly on comparison between East Asian and Western (North American and Western European) cultures.

Introduction

Population aging is a worldwide phenomenon. This entry provides an overview of extant research on how age differences in cognition, affect, and behavior vary across cultures. While this inquiry is driven by the need for science to understand the relative contributions of culture in explaining the impact of aging on human

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psychology, it also underscores the importance of recognizing the role of culture, in a world growing in its awareness of cultural diversity. The contents of this entry are thematically organized into cognitive aging, socio-cognitive aging, and socio-emotional aging with a focus on differences between Eastern (typically East Asian) and Western (typically North American) cultures.

Age Differences in Cognition Across Cultures

Cognition has long been theorized to comprise two components: one is the biologically based hardware of basic cognitive functions, supporting speed of processing and working memory, for example, and the other is the culturally based software of cognitive functions, supporting language and decision-making. These components of cognitive functions have also been characterized as fluid and crystallized intelligence, cognitive mechanics, and cognitive pragmatics, as well as primary and secondary processes.

This division provides a possible framework to understand cultural differences in age-related cognition. Specifically, biologically based hardware of basic cognitive functions declines with age and does so equivalently across cultures, whereas culturally based software of cognitive functions could be cultivated by culture and be more resistant to the effects of aging (Park et al. 1999). According to this view, few cultural differences would be detected in the hardware of cognition in either younger or older adults. In contrast, one might expect more profound cultural differences in the life-span developmental trajectory of the software of cognition.

Recent evidence, however, suggests that culture also moderates the aging of the hardware of cognitive processes (Park et al. 1999). For instance, Hedden and colleagues found superior performance in Chinese versus American younger adults on auditory digit span task (a working memory measure), but no difference in Chinese and American older adults (Hedden et al. 2002). Park et al. posited that culture might bias people at the very beginning phase of cognitive encoding to attend to certain types of information at the expense of other information (e.g., context-object bias). This, in turn, has a major influence on follow-up cognitive processes of the selected information (including those that were once thought of as basic processes) (Park et al. 1999). Therefore, cultural differences in cognitive aging may not neatly follow the dichotomous characterization of cognitive processes.

To better comprehend the interplay of age and culture in cognition, Park, Nisbett, and Hedden developed a new theoretical framework, based on a distinction between culture-invariant and culture-saturated cognitive tasks and measures (Park et al. 1999). These authors asserted that the effects of culture and age on cognition were task dependent. On culture-invariant cognitive tasks, individuals from different cultures would perform similarly, and age-related declines on the tasks would happen at an equivalent rate across cultures. On culture-saturated cognitive tasks, however, individuals' performance would vary as a function of culture. Specifically, cultural differences would increase with age if the differences are based on automatically activated processes and would decrease (termed as cultural convergence) with age if they are based on effortful, strategic cognitive processes. Accordingly, age-related cultural convergence could result from the leveling effects of biologically based functional declines on basic cognitive processes, influencing one's cognitive resources. On a resource-demanding task, older adults would have insufficient resources to support flexible use of strategies, resulting in cross-culturally equivalent task performance.

According to Park et al.'s framework, culture is more likely to interplay with age on culture-saturated than on culture-invariant cognitive tasks and measures. To understand this influence, it is necessary to identify culture-saturated cognitive measures and then discuss the interaction effects of culture and age on these measures.

Holistic-Analytic Thinking

Previous literature has well documented a preference for holistic thinking in collectivistic Eastern cultures and a preference for analytic

thinking in individualistic Western cultures. Individuals with holistic thinking tend to attend to contextual information, emphasize relationships and group functions, make relatively little use of natural categories, and rely on intuitive, dialectical reasoning. Individuals with analytic thinking, however, attend to objects, emphasize individual functions, readily make use of categorical information, and rely on rational, logical reasoning (Masuda et al. 2008).

Context-Object Bias

The cultural divergence on holistic-analytic thinking results in different attentional biases in Easterners and Westerners. Easterners normally pay greater attention to contextual information (e.g., a picture's background) and tend to bind context and object together, whereas Westerners normally pay greater attention to objects, even when they are embedded in the background (Masuda et al. 2008).

Cultural differences in context-object bias have been found to diminish with age. For example, some studies find that younger East Asians are more sensitive to the context of facial expressions than younger North Americans. However, this cultural discrepancy disappeared in older adults (Ko et al. 2011; Masuda et al. 2008). The results of these studies are consistent with Park et al.'s framework in which they assert that cultural differences in cognition could decrease with age on tasks that require effortful and controlled processing. In these studies, it was highly resource consuming to integrate contextual and facial information, making both Asian and American older adults unable to complete the tasks well and leading to age-related cultural convergence (Park et al. 1999).

Categorical Processing of Information

The divergence on holistic-analytical thinking also leads to differences in categorization strategies used by Easterners and Westerners. First, Easterners typically make less use of natural categories compared to Westerners when categories are not highly salient. Second, Easterners use more thematic categorization, whereas Westerners use more taxonomic categorization when categories are salient enough to be accessed (Park et al. 1999). Taxonomic information refers to similarity of features and attributes among objects, whereas thematic information refers to causal, spatial, and temporal relationships among objects (Ji et al. 2004). For example, in the "chicken-cow-grass" test (Chiu 1972), Westerners tend to pair the chicken and cow together due to their shared taxonomic similarity (i.e., both are animals), while Easterners tend to categorize the cow and grass together due to their functional relationship (i.e., cows eat grass).

These cultural differences in processing of categorical information become amplified with age. For example, cultural differences in memorizing categorical information are larger among older than younger adults, and the age-related decline in memorizing categorical information is more pronounced in Eastern versus Western cultures (Gutchess et al. 2006; Yang et al. 2013). These interaction effects could be interpreted within Park et al.'s framework. Specifically, limitations in cognitive resources make it increasingly difficult for older Easterners to employ an unfamiliar strategy (i.e., categorization), and therefore Easterners may suffer more severe age-related loss in using categories. In contrast, cultural preferences and prolonged experience make it less resource demanding for older Westerners to categorize, and therefore their age-related decline in category processing may be reduced (Gutchess et al. 2006).

In short, divergent thinking styles make people from Eastern and Western cultures process information differently. The cultural differences in cognition are especially evident in measures of context-object bias and categorical processing of information – all of which appear to be readily accounted by Park et al.'s theoretical framework of the interaction between age and culture on cognition.

Age Differences in Social Cognition Across Cultures

Attributions of Social Behavior

A well-established finding in social psychology is errors of attribution error. People tend to explain causal relationships in terms of dispositional (e.g., personality traits), rather than situational forces

(e.g., social pressure). This bias manifests as the correspondence bias, which refers to one's lack of awareness of situational constraints, leading to insufficient correction for these constraints when making dispositional inferences.

Besides social psychologists, life-span psychologists have also focused on social attributions in the context of aging. With an American sample, Blanchard-Fields and Horhota (Blanchard-Fields and Horhota 2005) found that older and middle-aged adults displayed the correspondence bias to a greater extent than did younger adults (Blanchard-Fields and Horhota 2005). The difference between older and younger adults was eliminated only when a plausible motive (but not other situational constraints) for the actor's behavior was made salient. The researchers attributed this finding to cognitive decline and insufficient motivation of older adults to consider the situation faced by the actor if they were not prompted to consider the actors' plausible motives.

The cross-cultural difference in susceptibility to the correspondence bias is well established. People from relatively individualistic cultures, such as the United States, Canada, and Western Europe, are more susceptible to this bias than people from relatively collectivistic cultures, such as East Asian countries including Japan, Korea, and China. This tendency is chiefly explained in terms of East Asians' subscription to the holism – the notion that nothing is isolated and everything is connected and their tendency to take constraints faced by individuals – imposed by the social collectives and situational contexts they are embedded in into account (Nisbett et al. 2001). Blanchard-Fields, Chen, Horhota, and Wang inquired into cultural differences in correspondence bias at different ages by comparing adults from two age groups, younger and older, in two cultures, American and Chinese (Ko et al. 2011). In addition to finding a cultural difference (the Americans showed stronger correspondence bias than the Chinese regardless of age group), they found that this cultural difference was affected by age – older Americans demonstrated a stronger correspondence bias than younger Americans (replicating prior findings), whereas older Chinese showed a weaker bias, albeit statistically insignificant, than younger Chinese (Blanchard-Fields et al. 2007). The researchers suggest that age-related changes in susceptibility to the correspondence bias are not driven by decline in cognitive processing capacity but rather by "lifelong accumulation of cultural experience," which helps older adults to "internalize cultural-specific models of attribution."

Implicit Theories and Their Consequences: Dialecticism and Holism

Another psychological domain investigating the effects of culture on age concerns the lay theory of naive dialecticism (often simply referred to as dialecticism). Naive dialecticism is a "constellation of lay beliefs about the nature of world" whose roots can be traced to folk Taoism, with influences from Buddhist thoughts (Spencer-Rodgers et al. 2009). The beliefs related to naive dialecticism revolve around three themes: that everything is related to one another (*holism*), that change is cyclical, and that we should be tolerant of contradiction. These themes are endorsed by members of a number of East Asian cultures, including Japan, China, and Korea. Dialecticism influences cognition, affect, and behavior in a number of ways. For example, members of dialectical cultures are more likely to prefer dialectical proverbs to nondialectical proverbs, reason more dialectically about social contradictions, and perceive emotions of opposite valence as compatible with each other (Spencer-Rodgers et al. 2009).

As the culture-specific influence of dialectical beliefs on emotional experience and well-being across the life-span will be covered in another entry, this section will focus on how dialecticism influences self-concept and cognitive-behavioral tendencies in older adults. Zhang and his colleagues examined age-related changes in dialecticism (and its close conceptual counterpart, *holism*) cross-culturally (Zhang et al. 2014). Comparing younger and older adults in Hong Kong and America, they found distinct age-related changes in self-reported dialecticism and a behavioral measure of holism, the framed-line test (FLT). Specifically, while older people reported being less dialectical than younger

people in both cultures, only Chinese older adults, not their American counterparts, exhibited stronger holistic tendencies on the behavioral measure of holism, the FLT. These findings suggest a potential for the influence of culturally endorsed implicit theories to grow with age, but such growth is likely to be domain specific.

Age-Related Changes in Personality Across Cultures

Personality is characterized by habitual patterns in behavior, thought, and emotion. This section reviews some models of personality and examines their manifestation in younger and older age groups in different cultures.

Big Five and Indigenous Models of Personality

Often regarded as the most influential model of personality, the five-factor model (FFM) has been supported in cross-sectional and longitudinal studies in multiple cultures (McCrae et al. 1999). The model comprises five dimensions of personality – extraversion, openness to experience, neuroticism, agreeableness, and conscientiousness. Evidence further suggests that, across cultures, older people are more conscientious, more agreeable, less neurotic, less open to experiences, and less extraverted than younger people (McCrae et al. 1999).

However, some personality psychologists have argued that the FFM is culturally biased and is insufficient when it comes to explaining personality variability in cultures outside of North America and Western Europe. This sentiment has spurred an emic (indigenous) approach to the study of personality. In China, this has resulted in the development of the Chinese Personality Assessment Inventory (CPAI) (Cheung et al. 2001), which argues that a sixth personality construct, interpersonal relatedness, should be added to increase its relevance to the Chinese context. Interpersonal relatedness comprises harmony (avoidance of interpersonal conflict), Ren Qing (abiding by the rules of social exchange), face (concern of others' opinion of oneself), and flexibility (seeing others' views or methods). Notably, these CPAI personality factors, which include interpersonal relatedness, replicate fairly well in European American populations, hence supporting the CPAI applicability in cross-cultural personality research (Lin and Church 2004).

Interestingly, when measured across the life-span, changes in interpersonal relatedness showed cross-cultural variation. Fung and Ng found that interpersonal relatedness is higher among older Chinese than younger Chinese, but this age difference is not found among European Canadians (Fung and Ng 2006). This suggests that Chinese exhibit culturally valued norms and traits more strongly as they age. The same trend is also observed in the domain of dispositional optimism: Americans (who live in a culture that value optimism) become more optimistic with age, whereas Hong Kong Chinese (who live a in a culture that value optimism considerably less) become less optimistic with age (You et al. 2009).

Collectivistic and Individualistic Tendencies

Research on personality development across the life-span using nonfactor-based approaches has corroborated the aforementioned finding that age-related differences in personality across the life-span can vary among cultures. In Labouvie-Vief, Diehl, Tarnowski, and Shen's exploratory study, they examined how 20 "folk concept" scales of personality – taken from the California Psychological Inventory – changed over the life-span in Americans and Mainland Chinese (Labouvie-Vief et al. 2000). They discovered that older Chinese, compared to younger Chinese, expressed increases in self-control and good impression, together with a reduction in self-acceptance and flexibility. These results suggest that "collectivistic tendencies," which are related to norm orientation, are stronger among older Chinese, whereas "individualistic tendencies," characterizing extraversion and individual initiative, are weaker among older Chinese, compared to younger Chinese. In general, the age-related patterns found in the Chinese sample

are either absent or less pronounced in the American sample.

Taken together, findings from these cross-cultural studies suggest that aging can strengthen the endorsement and expression of traits and characteristics valued in one's culture (e.g., social reciprocity and collectivistic tendencies in the Chinese culture and optimism and individualistic tendencies in the American culture).

Age-Related Gains in Wisdom Across Cultures

Most cultures tend to agree that we gain wisdom as we age, though recent evidence shows that age-related gains in different aspects of wisdom vary as a function of culture. With three age groups (younger adults, middle-aged adults, and older adults), Grossmann and his colleagues examined wise reasoning (e.g., acknowledging multiple perspectives, recognizing likelihood of change, perceiving flexibility in conflict development) about interpersonal and intergroup conflicts in Japanese and Americans aged 25–75 years (Grossmann et al. 2012). They found that younger and middle-aged Japanese, compared to their American counterparts, showed greater use of wise reasoning strategies only for reasoning about interpersonal conflicts, but not for intergroup conflicts, and this cultural difference did not extend into old age. In terms of intergroup conflicts, while Japanese and Americans started out at a similar level of intergroup wisdom at a younger age, only Americans exhibited age-related growth in this type of wisdom. The findings were interpreted as evidence for interpersonal wisdom to emerge at a younger age among Japanese than Americans, due to the relevance of wise reasoning to keeping harmonious relationships with others. Conversely, age-related growth in wise reasoning about intergroup conflicts is only observed in America. This may be because of the United States' relatively higher ethnic diversity that calls for wisdom in the intergroup domain. This finding suggests that although wisdom is a psychological quality that shows age-related growth across cultures, the trajectory of the growth is influenced by domain-specific importance of different types of wisdom in each culture.

Age Differences in Emotion and Well-Being Across Cultures

Emotion Perception

As people grow older, they tend to show preference for processing positive information rather than negative or neutral information. This effect was coined as "positivity effect" (Charles et al. 2003). For example, Charles and colleagues found that, while young participants demonstrated a negativity dominance during memory tasks (remember negative images better), such an effect was less pronounced among older adults, suggesting a reduction in negativity with increasing age. However, recent cross-culture studies suggest that this aging-related positivity effect might not be universal. In Western cultures, positive information is perceived as more emotionally useful because it helps individuals maintain optimism and self-esteem, which in turn fulfills culturally endorsed values of autonomy and uniqueness. In East Asian cultures, social harmony and interpersonal relationships are more important than individual uniqueness or autonomy. Thus, to maintain social harmony and avoid social mistakes, individuals may pay attention to different social cues from the environment, including both positive and negative information, and then provide appropriate responses accordingly. Hence, in these cultures, negative information may not be perceived as less important as positive information. This may, in turn, lead to a cultural difference in the aging-related positivity effect, such that the bias for processing positivity is not generalized to interdependent cultures.

Evidence showing this cultural difference comes largely from comparisons of Western and the Hong Kong Chinese cultures – studies conducted in Korea demonstrated the same age-related positivity bias as in Western cultures (Ko et al. 2011). For example, Fung and her colleagues found that, although older participants remembered positive information better than

neutral information (positivity enhance effect), they also remembered negative images as well as the neutral images (no negativity reduction effect) (Fung 2013). In another study, older adults recognized an announcement that conveyed negative emotions better than an announcement that conveyed neutral emotions. Using eye tracking methodology, Fung and colleagues demonstrated that Chinese older participants looked away from positive stimuli (Fung 2013).

Later, Fung and colleagues tested whether the cultural value of interdependence held by individuals moderated the age-related bias for positive information (Fung 2013). In both studies with memory tasks and attention tasks, results suggested that the age difference in negativity reduction effect was only observed among participants with lower levels of interdependence, similar to the result that has been demonstrated by Western samples. Yet, among Chinese participants with higher level of interdependence, no age difference was found.

To summarize, accumulated evidence has demonstrated the cultural variation in age-related positivity effect. Individuals from Chinese culture, who value interdependence more than Western individuals, may not regard negative information as more important than positive information and thus exhibit the age-related positivity effect to a lesser extent.

Emotional Experience and Well-Being

In the Western literature, previous findings have demonstrated that older people exhibit a higher level of emotional well-being (more positive emotions and fewer negative emotions) compared to their younger counterparts (Shiota and Levenson 2009). The same pattern was found in the Chinese culture. Pethtel and Chen compared the emotional experience among a group of Mainland Chinese participants and found that older adults reported lower levels of negative emotions than did younger adults (Pethtel and Chen 2010). However, some recent studies observed a different pattern in other Asian cultures. Grossman and colleagues argued that although emotional well-being might be a universal goal, the way to achieve it might vary across cultures (Grossmann et al. 2014). In Western cultures, well-being might be enhanced by experiencing more positivity and less negativity, and research shows that this is what Westerners tend to pursue, being more strongly motivated to maximize their positive emotional feelings and minimize negative one. However, in East Asian cultures that encourage tolerance for contradictions and changes, well-being is defined by a dialectical way of mixing positive and negative experience. Based on this dialectical belief, maintaining positive feelings and avoiding negative feelings may become less important for East Asians; they might instead prefer to strive for a balance between the positive and negative (Grossmann et al. 2014). Indeed, in Grossman's study, older Japanese participants reported a higher level of positive emotions than did their younger counterparts. Yet they reported the same level of negativity as did their younger counterparts, including the intensity of negative emotions, the focus on past negative experience, and the proportion of perceived negative interpersonal relationships. In another study conducted in Hong Kong, a similar pattern was found, such that age was associated with more positive emotions, but there was no correlation between age and negative emotions (Yeung et al. 2011).

In summary, in both Western and Eastern cultures, aging correlates with an increase in positive emotions, while a decrease in negative emotions is more frequently observed in Western cultures.

Emotional Regulation

As outlined above, older people tend to report higher emotional well-being. Urry and Gross proposed that the underlying mechanism might be that older adults become better at regulating their emotions (Urry and Gross 2010). More specifically, to regulate emotions, older adults may tend to employ antecedent-focused strategies (e.g., cognitive reappraisal, attentional deployment) more than response-focused strategies (e.g., expression suppression) (Carstensen et al. 1999). The former is also associated with healthier outcomes. For example, as abovementioned, compared to younger adults, older adults pay more attention to

positive information and stimuli, suggesting they tend to use the strategy of attentional deployment. Given that the antecedent-focused strategies downregulate the negative emotions before they are full-blown, preventing individuals from negative and stressful experience, they tend to be associated with healthier outcomes.

Cross-culturally, age differences in emotion regulation only partially hold true in East Asian cultures. During the SARS outbreak in Hong Kong, Yeung and Fung found that compared to young participants, older participants reported more emotional-focus coping and lower levels of anger both at the peak of the SARS epidemic and at its end, suggesting that older people were more successful in managing their negative emotions under stressful situations (Yeung and Fung 2007). In another study conducted in Hong Kong, Yeung and colleagues found that an age-related increase in using cognitive reappraisal partially accounted for the age differences in positive feelings (Yeung et al. 2011). These data support the hypothesis that older people are better at antecedent-focused emotion regulation.

However, in the same study, no age difference in suppression was found. Yeung and colleagues speculated that because Asian cultures emphasized interpersonal harmony, suppressing one's emotions to avoid social conflict was always encouraged across different life periods (Yeung et al. 2011). Hence, older adults exhibited the same level of suppression as younger adults. In another study, older adults benefited from suppressing emotion. This emotional suppression was positively correlated with a lower intensity of negative emotion and better work performance among older adults but not younger adults (Yeung and Fung 2012).

Interestingly, although most of the aforementioned evidence suggests that older adults tend to control their emotions to preserve their social relationships, a study found that in Mainland China, where the hierarchy within family was emphasized, older adults were more likely to express anger to their kin to preserve their authority in the family hierarchy (Fung and You 2011).

Conclusion

This entry provides an overview of how age-related changes in cognition, affect, and behavior vary as a function of culture. It should be acknowledged that most "cross-cultural" comparisons reported in this entry are mostly "East versus West" comparisons – in other words, imprecise depictions of the rich cultural diversity in our world. This bias in current research on culture should be an inspiration for researchers to broaden the scope of inquiry of age differences into cultures that are, at present, underrepresented. Similarly, most of the reported studies are cross-sectional (reflecting existing aging research in general), and their conclusions may be confounded by cohort effects. Despite these limitations, our review suggests that aging does take different forms, or at least manifest in different ways, in some domains across cultures. Examining the intersection of aging and culture may reveal important mechanisms about adult development.

Cross-References

- ▶ Age-Related Positivity Effect and its Implications for Social and Health Gerontology
- ▶ Aging and Psychological Well-Being
- ▶ Emotional Development in Old Age
- ▶ Positive Emotion Processing, Theoretical Perspectives
- ▶ Psychology of Wisdom

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Crystallized Intelligence

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Humans have recognized the difference between having knowledge and being able to use it for at

least 2,000 years. In 1963, Raymond B. Cattell was the first to propose a psychometric model for these distinct abilities (1963). Horn and Cattell (1966) further developed his theory and Horn (Horn 1968, 1982; Horn and Noll 1997) applied it to changes in cognitive abilities in old age. Horn showed that our abilities to solve problems rapidly and accurately (and so achieve high scores on intelligence tests), to respond fast to simple signals, and to quickly learn unfamiliar material such as lists of random words peak in our early twenties but decline as we grow older. These changes are slight from our 30s through our 50s but accelerate throughout our 60s, 70s, and 80s. Horn and Cattell termed these "fluid abilities" or "fluid intelligence" (gf) because they are not specific to particular problems but support performance in all mental tasks. In contrast to waning fluid abilities, Horn showed information that we have learned throughout our lives is relatively age robust. Following Cattell, Horn called such bodies of acquired information "crystallized intelligence" (gc). Their choice of the word "intelligence" emphasizes that Cattell and Horn did not regard gc only as a mental archive of semantic information, such as vocabulary, or collections of names of birds or trees, or athletic records but also as tool kits that we have invented or learned to carry out "procedures." Some examples of these procedures might be constructing grammatical sentences, doing algebra, working out lines of play in chess or go, or managing a bank, a business, or a kitchen. This distinction is clear in Horn's discussions but while his experiments do show that vocabulary and other kinds of semantic knowledge can survive well into old age with little loss, he did not systematically explore how far this is also true of complex procedural skills that we have learned over our lifetimes. Horn's early experiments and discussions also do not make the important point that, in contrast to "fluid intelligence" or "fluid abilities," the "crystallized" skills are intensely "domain specific." That is, mastery of a particular skill may be of little help in learning or using others, even if these may seem quite similar. An analogy from information technology is that computer programs written to efficiently carry out particular tasks are usually useless for any others.

Horn and Cattell's distinction also implies a contrast between the difficulty of inventing, learning, and using a difficult procedure for the first time and its easy and automatic deployment once it has become familiar. This applies to cultural as well as individual accomplishments. Clay tablets, papyrus, libraries, and the World Wide Web can all be envisaged as means of "crystallizing" and indefinitely preserving semantic and procedural information that most individual humans could not discover or invent on their own: For example, it took Leibniz and Newton years of hard thought to invent the Calculus that schoolboys can now easily learn from textbooks in a few weeks.

The Cattell/Horn distinction raises interesting practical questions as to how we should view our likely trajectories of competence in our everyday lives throughout our lifespans. Though our fluid intelligence declines as we get older, can we still continue to practice demanding professions supported by information and skills that we have learned throughout our lives and still retain in our old age? An associated question is whether some kinds of crystallized abilities may be more age robust than others so that professional competence based on these durable abilities can be maintained longer than on more age-fragile skills?

A key issue is that retaining effective procedures is one thing, but carrying them out is quite another. Another helpful metaphor from information technology is the difference between developing and storing a program that is ideal to perform a particular task and having a system that is adequate to run it. As the "benchmark" bandwidth and memory capacity of an information processing system reduce, so will the maximum complexity of the programs that it can run. For humans "working memory" (*see also entry Crystallized Intelligence in this volume*) is a convenient term coined by Alan Baddeley and Graham Hitch (1974) as a blanket label for our abilities to rapidly shift attention from less to more important information, to process new information and to relate it to other information that has been recently registered or held in memory for many years, and to reorder all of this old and

new information so as to decide and implement what we should do next. All of the abilities implicit in the general concept of "working memory" are, in Cattell and Horn's terms, "fluid" and age fragile. However, without a well-functioning "fluid" working memory system, we cannot manage to do complicated things for which we, long ago, learned reliable procedures: e.g., to produce a long, grammatical sentence, to understand and solve a complex business problem, to cook a complicated dish, or to plan and carry out apt sequences of moves in chess. So, as the efficiency of working memory sharply declines with age (Salthouse et al. 1989), we may still be able to perfectly describe effective procedures for completing complex tasks but become unable to meet the demands these make on our diminishing working memory capacity when we attempt to put them into practice.

A neat illustration of this is Susan Kemper's (1990) analyses of diaries written by citizens of Kansas during the late nineteenth and early twentieth centuries. These often covered 40 or 50 years of their authors' lives. As diarists aged the ranges of words that they used only slightly reduced (as Horn and Cattell's empirical results predicted). Nevertheless, although their youthful diary entries were often long sentences and complex grammatical constructions, as they grew old, their sentences became shorter and their grammatical constructions increasingly simple. Retaining large numbers of words and retaining the ability to assemble them into complex sentences are different things.

This raises the interesting practical question whether some "crystallized abilities," that is, kinds of learned knowledge and skills, can survive later in life than others. In 1935 Lehman (1935) pioneered studies of the ages at which distinguished mathematicians, scientists, poets, novelists, musicians, and artists had made their most remarkable contributions (Lehman 1942; Lehman and Ingerham 1939). Ages of greatest productivity and achievements were the early 20s and 30s for mathematicians, physicists, and chemists; the 40s and 50s for historians, philosophers, and novelists but might be as late as the 60s, 70s, or even 80s for some visual artists and musicians. Does this mean that some skills are more age resistant than others?

Lehman pointed out that his data were not ideal to address these questions. Many of the careers documented took place in the eighteenth and nineteenth centuries when life expectancy was much shorter and career trajectories were very different. Recent studies confirm early age-related losses in scientific productivity but suggest that these now happen much later than in the historical periods for which Lehrman collated data. Studies of British psychologists in the 1970s and 1980s (Over 1982); of large groups of less eminent physicists, geologists, physiologists, and biochemists in 1989 (Levin and Stephan 1989); and of the careers of economists and other scientists (Cohen 1991; Bayer and Dutton 1977), all found that, as they grow older, all academics publish less and in less prestigious journals. Recent studies of average or slightly above-average scientists find that their plateaux of greatest productivity last more than a decade longer than Lehman's analyses suggested. Studies of artistic productivity also revise his conclusions. A 1999 analysis of the number of paintings produced by 739 graphic artists, works by 719 musicians, and books by 229 authors found that, like most contemporary scientists, their periods of maximum output were in their 30s and 40s. Unfortunately literary skills are not immune to changes that come with old age and with approaching death. Suedfield and Piedrahita (1984) analyzed the late work of distinguished novelists and found that the quality of writing in their correspondence declined during the 10 years before they died.

Other recent studies find that while the learned skills of bankers and business executives allow them to competently do their jobs in late middle age and even give them some advantage over younger colleagues with less experience, their ability to correctly analyze and cope with novel problems tends to have decline by their late 40s and 50s (Colonia-Willner 1998, 1999).

The current consensus is that while competence, even at learned and highly practiced skills, does decline with age, these changes are much smaller and slower than the earliest surveys suggested. The contrast between "early flowering

and early decline" in the hard sciences and "late flowering and late decline" in the humanities and visual arts now seems less clear-cut. One problem is finding comparable standards across different disciplines. Assessments of quality in the arts are much more contentious and differ sharply between various kinds of achievement. Standards of comparison are more elusive than the earliest studies assumed. For example, a tally of the year 2000 market value of paintings by 51 modern US artists found that for painters born before 1920, the average peak age for the valuation of their paintings was 50.6, but for those born after 1920, it was only 28.8. Changes from a cautious to a speculative market account for similar discrepancies (Colonia-Wilner 1999). From current sale prices, we might conclude that artists who are now elderly are painting much better (or at least much more profitably!) than their young contemporaries or, indeed, than themselves when young.

Ideal data to examine differences between "fluid" and "crystallized" abilities would be the achievements of large numbers of extremely gifted people on the same, difficult, mental skill on which they can be compared against each other in terms of a common objective standard. The careers of chess masters are as close to this as we get. Chess requires high levels of both fluid abilities, such as working memory and intelligence. It also requires crystallized knowledge because it has been so exhaustively researched and documented that, even for young prodigies, success at the highest levels needs long and intensive study. Chess play requires an ability to simultaneously hold many variables in mind and to recognize, as rapidly as possible, how patterns of relationships between these variables will alter if particular moves are made. Clearly there is a "natural talent" for chess because some prodigies play at a remarkably high standard at ages as early as 6–12 years. However, a study by Charness and colleagues found that even maintaining success at much lower levels than "grandmaster chess" requires 5,000 or more hours of deliberate practice over 10 years (Colonia-Wilner 1999). In terms of John Horn's dichotomy, chess mastery requires both considerable fluid intelligence and a formidable body of learned crystallized knowledge of tactics and strategy.

Statisticians such as Arpad Elo developed very sensitive and reliable systems for rating the relative strengths of different chess players. Because these have been used and validated for at least 50 years, even small changes in the playing strengths of individual grand masters can now be tracked from their 20s through to their 70s. Elo's initial studies (Charness et al. 2005) found that nearly all the careers he compared showed improvements until 30s or 40s, a plateau of the best achievement until the late 50s or, in some few cases, early 60s but then a significant decline. During the historical spans of this and later analyses, chess at the highest level evolved so rapidly that players could not keep or improve their ranks unless they continually revised a vast body of theory on openings and end games. It is cheering to find that gifted individuals can, though perhaps with gradually increasing effort, remain at the very peak of an extraordinarily demanding profession until their seventh decades. Evidently, acquired knowledge and endless practice can support even a skill that is, essentially, computational and demanding of fluid intelligence until late in life. We must also remember that long after they had retired from competitive chess, these remarkable people could still play at a level that most humans cannot hope to reach at any age. We should also remember the wise comment of Gary Kasparov, perhaps the greatest player yet: "Excelling at chess has long been considered a symbol of more general intelligence. That is an incorrect assumption in my view, as pleasant as it might be." Crystallized intelligence is intensely task specific.

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