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Early and Unplanned Retirement

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Early and unplanned retirement refers to a retirement process or decision that was not anticipated. Because retirement has been increasingly conceptualized as a process rather than a discrete event, it has become more challenging to conceptualize early and unplanned retirement. Early and unplanned retirement combines the timing of retirement as well as the extent to which the process of retirement was anticipated.

Synonyms

Early retirement age

Definition

Early retirement refers to the timing of leaving the labor force, but the notion of early is relative, and therefore, there is not one single definition of what constitutes early retirement. One definition of early retirement is economically driven (e.g., earliest age of eligibility for pension plan benefits). The exact age that defines early retirement varies across countries due to differences in public policies. In the United States, early retirement is currently considered prior to age 62, because age 62 is the earliest age of eligibility for Social Security benefits. The second definition is early relative to one's own expectations regarding the timing of retirement. The third definition is based on societal, cultural, or institutional norms. Unplanned retirement refers to a retirement process or decision that was not anticipated. Because retirement has been increasingly conceptualized as a process rather than a discrete event, it has become more challenging to conceptualize early and unplanned retirement. Early and unplanned retirement combines the timing of retirement as well as the extent to which the process of retirement was anticipated.

Introduction

Given the rapid aging of the large baby boom generation and global aging generally, understanding the retirement transition and its impact on retirement well-being is more important than ever. A key factor in this transition is whether retirement is planned or unplanned. Another important distinction is whether retirement occurs at an early age or a normal retirement age. What constitutes "early" retirement is relative. This entry addresses issues around early and/or unplanned retirement. The study of early and unplanned retirement has implications for determining when and how workers may depart from the workforce, as well as for understanding consequences, including adjustment and well-being postretirement.

A great deal of research in the 1980s and 1990s focused on retirement timing and particularly decisions to retire early (e.g., Feldman 1994) because studies of labor force participation clearly

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documented a trend toward increasingly younger average age at retirement. For a variety of reasons, that trend now appears to have reversed, yet a significant proportion of workers in their late 50s and early 60s continue to leave the labor force, both voluntarily and involuntarily. Therefore, understanding the antecedents and consequences of early and unplanned retirements remains an important research and policy focus. A variety of antecedents to retirement have received research attention, including characteristics of workers (e.g., health status, sociodemographics, preferences), characteristics of their families (e.g., spouse's health status and other caregiving needs), and characteristics of the work environment. Each of these is described below (see "Antecedents"). Other researches direct attention to the consequences of early and unplanned retirement such as impacts on mental and physical health, family, and financial well-being (see "Consequences"). Lastly, a growing literature addresses the variety of paths workers are now taking as they exit the labor force. The traditional model of moving from full-time employment to full and permanent retirement is growing less common. Retirement is seen as a process rather than an abrupt transition (Shultz and Wang 2011). Implications for this trend on early and unplanned retirement are discussed (see "Bridge Employment").

Background

The concept of early retirement is relatively new historically. As far back as 1850, approximately 75% of men age 65 or older were in the US labor force (Zickar 2013) When the US Social Security program was introduced in 1933, approximately 58% of men were still working at age 65 (Costa 1998). Combined with Social Security and other pension incentives, most American workers began retiring when they could afford to do so.

Retirement timing is driven to a large extent by economic circumstances. This includes government- as well as employer-provided pensions. For example, two notable peaks in retirement at ages 62 and 65 in the United States (the ages of early eligibility and full Social Security retirement benefits) are evident (Gustman and Steinmeier 2005). This provides evidence that pension eligibility is a powerful retirement incentive. Although the early retirement age in the United States currently remains at 62, the age of eligibility for higher monthly benefits has increased from 65 to older ages determined by birth date, with additional incentives to delay retirement benefit claims to age 70. In addition, the financial penalty for continued work while receiving Social Security benefits has decreased (Gruber and Wise 1998). Many other countries (e.g., Germany, Italy) have recently modified public policies to increase the age of eligibility for government pensions, thereby modifying the age that constitutes early retirement (Gruber and Wise 2007). In terms of private pensions, the shift from defined benefit plans to defined contribution plans beginning in the 1990s has provided stronger incentives to continue working (i.e., disincentives for early retirement).

Other changes in public policy have changed the retirement landscape as well. For example, the US Age Discrimination in Employment Act (ADEA) was passed in 1967 to protect workers age 40 and older from discriminatory employment practices. In 1986 it was amended to eliminate mandatory retirement ages for all but a few occupations (e.g., those involving public safety, including airplane pilots and federal law enforcement).

Even though policy has moved toward a focus on extending working lives, a considerable number of workers depart the labor force early for a variety of reasons. Thirty percent of retirees indicate that their retirement was forced (Szinovacz and Davey 2005). Others choose to leave the workforce at relatively young ages despite substantial work capacity. Here a range of factors that influence both voluntary and involuntary early work force departure have been described.

Theory

Psychologists studying retirement trends have sought to provide theoretical grounding. Multiple

theories have been offered in the psychological literature to facilitate understanding of retirement behavior and retirement decisions. Theories relevant to early and unplanned retirement include continuity theory (Atchley 1999), role theory (Kahn et al. 1964), the life course perspective (Elder 1994), and the push/pull model of retirement (Shultz et al. 1998; Barnes-Farrell 2003).

Continuity theory indicates that maintaining continuity or stability is related to positive outcomes. This theory would suggest a negative relationship between early and unplanned retirement and outcomes because by its very nature early and unplanned retirement may disrupt or significantly modify one's life.

Role theory proposes that life is comprised of multiple sets of roles or expectations, such as work, family, and community (Kahn et al. 1964). Early and unplanned retirement involves a change in roles in which an individual who worked must now adjust to retirement, perhaps having more of an opportunity to develop nonwork roles. Unplanned retirement in particular likely involves a more abrupt role change, particularly as work may provide an individual with a source of identity with a work role, and one must adjust to no longer working.

Related to role theory, the push/pull model of retirement indicates that some workers will retire because they are pushed out of the work role, whereas others will be pulled toward retirement for nonwork reasons. Unplanned and early retirement may result from push factors (e.g., declines in worker health, organizational incentives for early retirement) or pull factors (e.g., caring for a spouse, receiving a financial windfall, or desiring leisure more than work). Barnes-Farrell (2003) described four factors related to the retirement decision process beyond health and wealth: job attitudes, job conditions, organizational climate, and societal pressures. Negative job attitudes (e.g., low job satisfaction), poor job conditions, a negative or unsupportive organizational climate, and societal pressures (e.g., norms regarding retirement age or retirement timing) may lead to early retirement.

Recently, Kanfer et al. (2012) proposed an organizing framework for understanding work motivation among older adults. They developed a person-centered approach, explaining goals for individuals at work, to work, and to retire. These goals take into account multiple reasons for working or retiring, including financial, social, personal, and generative, as well as fluctuations in motivation to work and motivation to retire.

Antecedents

While not an exhaustive review, this section highlights major findings from research exploring reasons for, or antecedents to, early and unplanned retirement. Although each of these reasons is described separately, reasons for retiring early interact in important ways. Many of the studies mentioned investigate several retirement antecedents simultaneously.

Health

One of the most widely studied potential reasons for early workforce departure is poor health. Much of what is known about the impact of health on retirement decisions in the United States comes from studies using rich information from the Health and Retirement Study (HRS) (see the chapter "▶ Health and Retirement Study, A Longitudinal Data Resource for Psychologists" by Sonnega and Smith, 2015). As a whole, these studies reveal that health plays a large role in the timing of retirement (e.g., Aaron and Callan 2011; Cahill et al. 2013), especially in early and unplanned labor force exit (Dwyer 2001) and perceptions of forced retirement (Szinovacz and Davey 2005). HRS data include widely used questions about expected age at retirement, which have been shown to relate closely to actual retirement. McGarry (2004) studied how changes in health affect retirement expectations, finding large effects of self-rated health on when workers expected to retire. Importantly, she also showed that changes in retirement expectations were affected to a much greater degree by changes in health status than by changes in income or wealth.

Similar findings emerge in other countries as well. Studies in Canada (Park 2010) and Europe (García-Gómez 2011; van Rijn et al. 2014)

revealed that a leading cause of early and unplanned retirement is poor health that results in a diminished capacity to work. Results from the well-known Whitehall II study showed that health is a strong predictor of early retirement in British civil servants (Mein et al. 2000). More recently, the Survey of Health, Ageing and Retirement in Europe (SHARE) showed that poor self-reported health is a strong predictor of labor force exit even after controlling for factors predictive of poor health such as obesity, problem use of alcohol, job control, and effort-reward balance (van den Berg et al. 2010). Jones et al. (2010) examined the effect of health on early retirement in 12 waves of the British Household Panel Survey. In the sample of men age 50–65 and women age 50–60, health was a highly significant risk for early retirement. Interestingly, however, the relatively low incidence of health problems in this age group means that relatively few retirements result from poor health. Other studies consider alternate paths to retirement potentially affected by poor health. A recent meta-analysis of longitudinal studies found poor health is a major cause of workforce exit, especially through disability, unemployment, and early retirement (van Rijn et al. 2014).

Finally, research in this area distinguishes particular aspects of health that may affect the timing of retirement. For example, although some workers with chronic health conditions expect to retire at younger ages (Dwyer 2001), others may experience an unexpected health event that causes them to have to leave work (McGeary 2009). Health conditions that commonly lead to early retirement include musculoskeletal conditions (e.g., back pain or problems), cardiovascular conditions (e.g., heart problems, stroke), circulatory problems, and mental illness (e.g., anxiety or depression) (e.g., Karpansalo et al. 2004).

Marital Status

The decision regarding whether and when to retire is often made collaboratively among spouses/partners, and research has shown that spouses often coordinate the timing of their retirement with one another (Gustman and Steinmeier 2000). Although marital status and having children have not been shown to predict early retirement, Kim and Feldman (1998) found that individuals with an employed spouse are less likely to take early retirement incentives compared to individuals whose spouse is not working. Perceived pressure from spouses (i.e., the antithesis of support) impacted individuals' intentions to retire early. In fact, perceived spousal pressure for early retirement was the strongest predictor of early retirement (van Dam et al. 2009).

Men with a working spouse were much less likely to exit the labor force themselves, accounting for health and other demographics (Ozawa and Lum 2005). How much spouses enjoy spending time together is a strong predictor of whether or not they time their retirement to coincide (Gustman and Steimeier 2004). The timing of retirement among couples is also related to gender and marital quality, with higher levels of marital conflict taking place when one individual retires while the other is still working (Moen et al. 2001).

Family Caregiving

In addition to early retirement due to one's own health, workers may also depart early to care for a family member (Matthews and Fisher 2013). This may take the form of caring for an infirmed family member or providing care to children or grandchildren.

Spousal Caregiving

Pienta and Hayward (2002) found that women were more likely to take their partner's health status into account when formulating a decision to retire than they are to consider their own health status. In fact, personal health status was not a significant predictor of retirement decisions for women, but was for men.

Dentinger and Clarkberg (2002) found that when women were required to provide physical care to their disabled husband, these women were significantly more likely to retire early. Conversely, though, men who were required to provide physical care to their disabled wife were more likely to delay retirement. Such results could be interpreted using a sex-role perspective wherein men may be more likely to perceive a need to shoulder the financial burden of having an ill spouse, whereas women more frequently

assume the caregiving role. The stress associated with family care demands may be exacerbated by the suddenness with which such demands may develop.

Children and Grandchildren

Other caregiving responsibilities related to early and unplanned retirement include taking care of grandchildren (Matthews and Fisher 2013). Some workers, and more likely women than men, may be drawn to or "pulled" into early retirement in order to care for grandchildren. A few studies have found that early retirement is negatively related to the number of children one has as well as having financial responsibility for children (Matthews and Fisher 2013). One explanation is that women may enter the workforce because of the need to financially support their children. Therefore, continued economic pressure may prevent women from early retirement to ensure that children are supported.

Job and Organizational Characteristics

Characteristics of work and the work environment are related to early retirement, though most of these issues do not lead to unplanned retirement and are therefore not discussed here in much detail. Early and unplanned retirement may result from organizational efforts to reduce the size of their labor force. This may happen by offering wage, bonus, or health insurance incentives to entice workers to retire early (Zhan 2013) or forced layoffs, producing both voluntary and involuntary mechanisms by which workers may retire early. In other words, an employee may retire earlier than he or she anticipated and without much advanced planning to accept an early retirement incentive from their employer. Many employers are reducing longer-term healthcare costs by reducing the amount of coverage or proportion of premiums paid to retirees. In an effort to retain high-quality health insurance, workers may opt to retire sooner than they originally planned in order to retain such benefits during retirement. This example would constitute a voluntary early unplanned departure. Early and unplanned retirement may also take place as a result of a layoff followed by not obtaining subsequent employment elsewhere. Layoffs are an example of an involuntary cause of retirement.

Raymo et al. (2011) found that workers' prior experiences with involuntary job loss (unemployment) as well as working in jobs characterized by not offering retirement plans, health insurance benefits, and good wages were associated with a lower likelihood of early retirement.

Economic Factors

Pension Plans

As noted above, one of the more significant changes to retirement incentives has been the transition of both private and, to a lesser extent, public pensions from defined benefit to defined contribution plans. Defined benefit plans provide a certain monthly dollar amount received during retirement based on age, years of service, etc. Defined contribution plans (e.g., 401ks, 403bs) in the United States consist of financial savings and/or investment accounts to which employees and sometimes employers contribute money, usually a percentage of wages. The value of accounts fluctuates based on how money is invested. Generally, longer work tenure means more retirement savings. Defined benefit plans produce economic incentives for workers to retire when they reach a particular age or tenure with the organization, offering little financial benefit for continued work. Not surprisingly then, research demonstrates a robust effect of the presence of a defined benefit pension plan on earlier retirement (Mermin et al. 2007; Aaron and Callan 2011; Cahill et al. 2012)

According to Butrica et al. (2009), employee participation in defined benefit pension plans was reduced from 38% to 20% in the United States between 1980 and 2008. Participation in defined contribution plans increased from 8% to 31% during the same time period. This shift in pension plan type provides some economic incentives for employees with a pension plan to remain in the workforce – to continue saving for retirement and postpone spending down retirement savings. Likewise, the decline of defined benefit pension plans means that this cause of early retirement is likely to diminish over time.

Health Insurance

Prior to the Affordable Care Act of 2010 in the United States, the link between employment and health insurance meant that those wishing to retire early or who were forced to leave the workforce prior to the age of 65 (i.e., age of eligibility for government-sponsored health insurance through Medicare) could also risk going without health insurance. Most workers receive health benefits from their employers, but they often forfeit their insurance when they retire. Not surprisingly then, health insurance provision has been shown to affect retirement decisions. For example, potential costs of health insurance reduced retirement rates in workers age 51–61 (Johnson et al. 2003).

Some work places offer health insurance as a benefit to their retired employees, and this may have an impact on early retirement. In a review of the literature, Gruber and Madrian (2004) reported that the availability of retiree health insurance increases the odds of retirement by 30–80%. Others have shown that it substantially increases the probability of retirement by age 62 (French and Jones 2011). Nyce et al. (2013) investigated this effect in a large data set representing individual data from 54 US firms. Presence of employer-provided health insurance has its biggest effects between ages 62 and 64, increasing the rate of retirement at 62 by 6.3% and nearly 8% at age 63. Health status may affect the value individuals place on employer-provided retiree health insurance. For example, Blau and Gilleskie (2008) demonstrated that the cost of health insurance has a modest effect on retirement rates for men in good health but a large effect on retirement decisions of men in poor health. Specifically, having retiree health insurance available appears to provide a path to early retirement for men in poor health.

Lastly, aspects of public and private insurance programs vary across countries, and thus effects vary by country, as some nations have government-sponsored health insurance that is provided independent of labor force status. For example, Zissimopoulos et al. (2007) found that the retirement rate is higher in England compared to the United States, and the overall earlier age at retirement by age 55 and beyond is partly accounted for by the availability of public health insurance. In other words, workers are more likely to retire early when public health insurance is provided.

Wealth

Theoretical economic models of savings and labor force participation posit that higher levels of wealth are associated with a higher probability of labor force exit (Gustman et al. 2011). In general, empirical results support this hypothesis: early retirement is more likely when individuals have greater financial resources. For example, among American workers between the ages of 55 and 66, greater wealth was generally associated with leaving the workforce (Aaron and Callan 2011), although interestingly greater education was associated with remaining at work. However, research demonstrating an empirical effect of personal wealth on retirement reveals relatively modest effects, net of other factors (Bloemen 2011). For example, Gustman et al. (2011) found that the recent economic recession, on average, had a modest effect on retirement. This is explained in part by the fact that a majority of Americans have no significant stock market investments.

It is important to note that economic resources, including personal wealth, pension wealth, and health insurance, are dynamically interrelated and decisions about work can unfold for many years leading up to retirement. Poor health is often a reason for leaving the workforce, yet low economic resources often have the effect of delaying retirement. Bound et al. (2010) followed men age 51–61 who were working in 1992 to evaluate the impact of health and financial resources on work choices. Men in good health were not likely to retire without fairly substantial economic resources behind them, whereas men in poor health were likely to retire even without pension benefits.

Outcomes

Retirement researchers have also extensively investigated outcomes of early and unplanned retirement. This section summarizes some of this research.

Economic

Economic outcomes of early and unplanned retirement are both macro- and microeconomics. At the macrolevel, early and unplanned retirement results in additional use of government resources (e.g., disability pensions, less employee contributions to Social Security). At the microeconomic level, Munnell and Sass (2008) indicated that many individuals do not save enough money for retirement and are therefore not likely to have the necessary financial resources to maintain their standard of living in retirement based on low savings rates. Early and unplanned retirement is likely to result in individuals spending down their retirement savings compared to individuals who remain in the workforce longer, because they have a longer amount of time on which to rely on their own financial resources. To the extent that individuals retired at earlier ages and without anticipation of retiring, it is quite possible that they left the workforce prior to attaining all the financial resources needed for financial security during retirement. Munnell and Sass (2008) pointed out that working two more years has a significant impact on the preservation of retirement wealth.

Health

Research examining health consequences of early retirement emphasizes the need to distinguish between voluntary and involuntary retirements. Van Solinge (2007) suggested that retirement itself has no categorically harmful or beneficial effect on health. Instead, it is the degree of perceived control over the retirement process (i.e., voluntary vs. involuntary retirement) that adversely affects health and emotional well-being. A great deal of research has found higher levels of physical and mental health associated with voluntary retirement compared to involuntary retirement (Isaksson and Johansson 2000; Shultz et al. 1998). For example, research has shown that involuntary retirement was associated with an increase in problem drinking behavior during retirement (Bacharach et al. 2008). This study found that after accounting for preretirement drinking behavior, having more control over the retirement decision was associated with less alcohol consumption and a lower risk of problem drinking behavior.

Methodological limitations, limited and cross-sectional data, differences in cultural norms, labor markets and economic incentives, and failure to differentiate between voluntary and involuntary retirement have likely contributed to inconsistencies in understanding the impact of retirement on health status. Dave et al. (2008) suggested there are two primary complications when attempting to identify the causal effect of retirement on health: unobserved selection effects (i.e., a sample selection bias) and endogeneity biases, which results in the inability to determine which comes first. A few studies have examined the effects of retirement on health. First, Dave et al. (2008) adjusted for selection bias (e.g., life history, retirement time preferences) and used a stratified sample, such that in waves prior to retirement individuals reported no major illness or health problems and no worsening of health between adjacent waves. Thus, any changes in health postretirement were likely due to factors exogenous to health. They found that these confounding biases accounted for the majority (80–90%) of the observed differences in health over time and that involuntary retirement was associated with greater adverse health effects. Second, Calvo et al. (2013) examined retirement timing in relation to physical and mental health. They found that retiring early (i.e., exiting the workforce at an earlier age than culturally and institutionally expected) can be problematic for both physical health and emotional health. Calvo et al. (2013) assessed the potential for reverse causality in the relationship between retirement timing and health by adjusting for endogeneity bias and controlling for confounding effects of unobserved factors (e.g., personality traits, genetic predispositions).

Contradictory results were found by Jokela et al. (2010) in a study of British social servants over 15 years. Jokela et al. (2010) found that both on-time retirement and voluntary early retirement were associated with better physical functioning and mental health compared to those remaining in the workforce. Moreover, results indicated that physical functioning and mental health prospectively predicted retirement timing. Compared to continued employment or having left the

workforce due to reasons other than retirement, poor mental health was associated with increased odds of subsequent voluntary early retirement, and those with poorer physical functioning were more likely to retire at the statutory age. Jokela et al. (2010) suggested that these results support a causal relationship between statutory and early voluntary retirement and positive health outcomes because analyses of reverse causality (using discrete-time survival analysis models) showed poor health increased the probability of retirement; thus it is unlikely reverse causality accounted for improved health postretirement. Further, longitudinal within-person analyses revealed that greater health benefits were obtained after retirement. Not surprisingly, both poor mental health and physical functioning increased the odds of ill health in retirement and were indicative of selection rather than causation.

Psychological Well-Being

An individual's transition and psychological adjustment to retirement is a dynamic, multifaceted process contingent upon many personal and contextual factors such as individual attributes, preretirement job-related variables, family-related variables, retirement transition-related variables, and postretirement activities (Pinquart and Schindler 2007; Wang et al. 2011). Because work is an integral part of people's lives, and is highly valued in society, work roles can serve as a source of psychological well-being by contributing to feelings of self-worth, meaningfulness, and personal identity (Steger and Dik 2009). Further, work can provide important social and financial resources. Given the significance of work, the loss of one's job through retirement can have adverse consequences for psychological well-being, especially when the event is unplanned, unexpected, or involuntary.

Early and unplanned retirees are especially vulnerable to maladjustment to retirement. A major determinate of well-being among older adults is perceived control over one's immediate environment (Lachman 2006). Similar to the empirical results regarding early retirement and physical health outcomes, research has shown a lack of perceived control over the timing or circumstances of retirement (e.g., unplanned or involuntary retirement) is related to lower levels of well-being, including life satisfaction (Isaksson and Johansson 2000) and happiness (Quine et al. 2007). From a life course perspective, the timing of retirement can have a significant influence on psychological well-being; specifically, transitioning into retirement either earlier or later than expected or preferred is thought to be disruptive and stressful, leading to greater difficulty in adjustment (Quick and Moen 1998; Isaksson and Johansson 2000). For example, Wang (2007) found that individuals who retired earlier than expected experienced declines in health. Those who were in unhappy marriages consistently experienced declines in well-being following retirement.

Research indicates that psychological and financial preparation is also important for individuals' well- being in retirement (Bender 2012; Noone et al. 2013). Although a substantial body of literature suggests that early retirement is detrimental to psychological well-being, Potočnik et al. (2010) found that retirees who acted in accordance with group norms favoring early retirement and retirees who perceived low capacity to continue working were more satisfied with early retirement and reported higher levels of well-being. Moreover, compared to retirees who entered retirement early by their own volition, retirees who perceived their retirement as forced or involuntary experienced lower levels of both satisfaction with early retirement and psychological well-being. These results are consistent with other studies that found when individuals transition into early retirement voluntarily, they can experience greater satisfaction with retirement and life and higher levels of psychological well-being (Quick and Moen 1998; Isaksson and Johansson 2000; Hershey and Henkens 2014; Noone, et al. 2013).

Although there is some heterogeneity in the empirical findings concerning the impact of early retirement on the transition and psychological adjustment to retirement, there is general agreement that unplanned and involuntary retirement is detrimental to retirees' well-being and adjustment. Further, it has been established that planning for retirement (both psychologically and

financially) and having control over the timing and circumstances of retirement are beneficial.

Family

Early and unplanned retirement may help address family caregiving needs, including the care of one's spouse or partner or other family members. Increasingly, workers (more often women than men) retire in order to have more time available to care for grandchildren (Matthews and Fisher 2013) (see "Antecedents").

Bridge Employment

Bridge employment is an increasingly common phenomenon, in which individuals continue working after they retire from a career job (Beehr and Bennett 2014). Feldman (1994) first highlighted the importance of bridge employment in relation to early retirement, and since then many researchers have paid a great deal of attention to the topic of bridge employment (e.g., Shultz 2003; Zhan et al. 2009). Bridge employment is relevant to early retirement because workers who may be considered early retirees in terms of their career job may continue to work in bridge jobs prior to leaving the workforce altogether. (See other entries on "▶ Bridge Employment.")

Bridge employment is increasing in prevalence. According to Cahill et al. (2005), half to two-thirds of workers transition to bridge jobs before retiring completely. Maestas (2010) reported that 44% of workers in 2004 were only partially retired, and a growing proportion of workers (initially 25% but recently more than 33%) return to work after retiring. Bridge employment can serve as a mechanism for workers to earn additional wages, easing the financial burden of early and unplanned retirement. Bridge employment may also fill a gap for individuals for whom work is an important role.

Conclusion

Early and unplanned retirement is important for understanding the retirement process. Economic and health factors play a large role in shaping the timing of retirement as well as the degree to which retirement may be planned or unplanned. Recent changes to government pension plans have increased the age of eligibility to receive retirement benefits, thereby increasing the age that defines early retirement in economic terms. In general the age at which retirement benefits first become available is a strong predictor of retirement timing. However, there are many additional antecedents of early and unplanned retirement, including health status, marital status, kinship and family caregiving roles, and organizational incentives that encourage employees to leave the workforce. Early and unplanned retirement is associated with more negative than positive economic, physical, and emotional health outcomes. Although retirement timing is important, the extent to which the retirement process is voluntary or involuntary is a strong determinant of health and well-being among retirees, with much more positive outcomes associated with voluntary retirement and negative outcomes associated with involuntary retirement. Bridge employment, which refers to continued work after retiring from one's career job, is an increasingly common work arrangement particularly for early retirees.

Cross-References

- ▶ Parents' Retirement Processes, Role of Children
- ▶ Retirement and Continuity Theory
- ▶ Retirement and Social Policy
- ▶ Women and Retirement

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Eating Disorders and Eating Disordered Behaviors

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Synonyms

Dementia; Eating disordered behaviors; Eating disorders; Older adults

Definition

Eating disorders are characterized by severe and persistent disturbances in eating behavior that may significantly impair physical health and psychosocial functioning in both men and women. According to the DSM-5 there are different types of feeding and eating disorders: pica, rumination disorder, avoidant/restrictive food intake disorder, anorexia nervosa, bulimia nervosa, and binge-eating disorder (American Psychiatric Association 2013). Eating disorders are common among women and have gradually increased over several years worldwide.

Disordered eating includes a variety of problematic eating behaviors ranging from dieting and extreme weight control methods (i.e., fasting, binge eating, and purging) to clinically diagnosed eating disorders (e.g., anorexia and bulimia nervosa). Accompanying these behaviors is also a range of disordered eating attitudes, such as the need to be thin as well as weight and shape fears. The majority of research on eating disorders concentrates on adolescents or young adult women, however, in the recent years data has emerged focusing on middle-age and older adults who may be experiencing eating disorders, namely anorexia nervosa, bulimia nervosa, and binge-eating disorder.

Eating Disorders as Defined by the DSM-5

The Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association 2013) made several recent changes to the criteria for feeding and eating disorders to better characterize symptoms and behaviors of patients across the lifespan. Some of the changes included recognizing binge eating as a disorder, revising the diagnostic criteria for anorexia nervosa and bulimia nervosa, and including pica, rumination and avoidant/restrictive food intake disorder (the latter three were originally included in the Disorders Usually First Diagnosed in Infancy, Childhood, or Adolescence section of the DSM-IV-TR).

Anorexia nervosa is defined by a distorted body image, a pathological fear of gaining weight, and excessive dieting that leads to severe weight loss. This disorder mostly affects adolescent girls and young women. Some of the changes that were made from the DSM-IV-TR include taking out the word "refusal" in terms of weight maintenance since that signifies intention on the part of the patient and is difficult to determine. In addition, in the DSM-IV-TR a diagnosis of anorexia nervosa required amenorrhea, or the absence of at least three menstrual cycles. This criterion was taken out, because it cannot be applied to males, premenarchal females, females taking oral contraceptives, and postmenopausal females. Moreover, some women may report some menstrual activity but still show signs and symptoms of anorexia nervosa (American Psychiatric Association 2013).

It is important to understand that older adults may experience anorexia of aging, which is different from anorexia nervosa. Anorexia is a medical condition that is characterized by reduced appetite or dislike of food therefore leading to the inability to eat. Symptoms such as fear of gaining weight or distorted body image, which are key in anorexia nervosa, are absent in anorexia of aging. Anorexia of aging, which is involuntary weight loss and protein-energy malnutrition, includes the normal physiological changes that cause an increase in the proportion of body fat and decrease in lean muscle mass and extracellular fluid mass. This change in body makeup is usually a result of decrease in energy needs and therefore a decrease in appetite and calorie intake (Champion 2011).

Bulimia nervosa is characterized by recurrent episodes of binge eating followed by inappropriate behaviors such as self-induced vomiting to avoid weight gain, and self-evaluation that is disproportionately influenced by body shape and weight. In contrast to the DSM-IV-TR criteria, which required the frequency of binge eating and compensatory behaviors to occur twice a week, the DSM-5 specifies that these behaviors must occur once a week (American Psychiatric Association 2013). Older adults may especially engage in the inappropriate behaviors as they move further away from the "cultural ideal" of looking young and thin.

Binge eating disorder is characterized as recurring episodes of eating significantly more food in a short period of time than most people would eat in the same circumstances. These episodes are also defined by feelings of lack of control over eating (e.g., a feeling that one cannot stop eating or control how much one is eating). A person with a binge eating disorder may eat more rapidly than normal whether he or she is hungry or not. The individual may experience feelings of guilt, embarrassment, or disgust and may binge eat alone to cover the behavior. Marked distress is usually associated with binge eating. Additionally, this disorder occurs, on average, at least once a week over three months (American Psychiatric Association 2013). Older adults suffering from binge eating disorder may feel lack of control or willpower. In addition, loneliness, depression, and other psychiatric or medical comorbidities may impact older adults' eating habits.

Prevalence Rates of Eating Disorders and Older Adults

Anorexia nervosa and bulimia nervosa are 10 times more common in females than males, and binge-eating disorder is three times more common (Treasure 2007). Though in recent years studies have shown that one in six males also suffer from an eating disorder (Andersen 2002). Eating disorders have become a major public health issue as it is the third most common illness in adolescent females, and is affecting more women of all ages worldwide. Research suggests that more than 20% of women aged 70 and older were dieting and experiencing unhappiness with one's body image and the desire to be thin; and these concerns do not disappear with age (Fisher et al. 1995). Anonymous questionnaires were administered to 1,500 Austrian women between the ages of 40 and 60 assessing for eating disorders (as defined by the DSM-IV), subthreshold eating disorders, body image, and quality of life. Subthreshold eating disorder was

defined by the presence of either binge eating with loss of control or purging behavior, without requiring any of the other usual DSM-IV criteria for frequency or severity of these symptoms. Of the 715 middle-aged to older adult women that responded, 33 (4.6%) reported symptoms meeting full DSM-IV criteria for an eating disorder. None indicated symptoms or behaviors consistent with anorexia nervosa, possibly due to the DSM-IV criteria of requiring amenorrhea. Another 34 women (4.8%) displayed subthreshold eating disorder (Mangweth-Matzek et al. 2013).

There are different patterns or categories into which older adults may fit with regard to eating disorders. Some older adults have struggled with an eating disorder since adolescence and never received treatment. Others likely received treatment in their younger years but relapsed later on in life as a result of a stressful life event (e.g., death or illness of family member or friend). Another group may be older adults who were always preoccupied with food and weight throughout their lives but experienced limited consequences of eating disorders when they were younger. Lastly, there is a small subset of older adults who developed an eating disorder later in life (American Psychiatric Association 2013).

Similar to adolescents and younger adults, middle aged and older adults also face devastating physical and psychological consequences of eating disorder. Issues such as social isolation, physical illness, bereavement, and minimal support are just a few factors that can impact the onset of late-life eating disorder (Cosford and Arnold 1992). Additionally, eating disorders in older adults are associated with anxiety, depression, and suicidal ideation and attempts (Hudson et al. 2007). Eating disordered behaviors may also increase the risk of medical morbidity, such as cancer and obesity (Ng et al. 2013).

Biology of Eating Disorders

Research on the biology of eating disorders has primarily focused on anorexia nervosa and bulimia nervosa. Studies show a genetic predisposition and a variety of environmental risk factors that contribute to eating disorders. Clinical studies with twins show an agreement for anorexia nervosa of 55% in monozygotic twins and 5% in dizygotic twins, and bulimia nervosa being 35% and 30%, respectively. In addition, much of the research focuses on the neurobiology of eating disorders, looking specifically at neuropeptide and monoamine (especially 5-HT) systems, which are thought to play a central role in the physiology of eating and weight regulation.

Studies incorporating functional imaging of the brain show altered activities in the frontal, cingulated, temporal, and parietal cortical regions in both anorexia nervosa and bulimia nervosa, and there is some suggestion that these changes persist after recovery. Whether these changes are a result of the eating disorder or have somehow contributed to the risk of developing an eating disorder is not well researched (Lapides 2010; Kaye and Strober 1999).

Eating Disordered Behaviors: Signs and Symptoms in Older Adults

It can be difficult to determine or diagnose an eating disorder in older adults. However, some signs and symptoms can be recognized as clues to changes in eating behavior in older adults. For example, significant change in weight over a short period of time; behavior changes such as disappearing after a meal or using the restroom after eating; new use of laxatives, diet pills, or diuretics; wanting to eat alone rather than with family; skipping meals; loss of concentration; physical symptoms such as enamel loss, chronic sore throat, cracked lips, sensitivity to cold, excessive hair loss, dental damage, or heart and gastrointestinal problems (e.g., constipation); excessive consumption of high-calorie foods that are sweet (especially prominent in people with binge eating disorders). Furthermore, osteopenia and osteoporosis are common symptoms of longstanding anorexia nervosa and are associated with an increased fracture risk in older adults.

Additionally, it is suggested that physicians complete a physical for medical conditions and review medications as medical conditions (e.g., thyroid and gastrointestinal conditions), medications, and substance use can mimic symptoms of an eating disorder (e.g., nausea, weight gain or loss) (Lapides 2010; Lapid et al. 2010).

Contributing Factors to Eating Disorders in Older Adults

Triggers of eating disorders may appear similar for younger and older adults; however specific differences occur, as life stressors change as people age. Body image issues and body dissatisfaction are some of the common risk factors for eating disorders and increase with age as the human body experiences natural changes (e.g., wrinkles, graying hair, and weight gain). Additionally, the development of eating disorders in midlife can be due to other changes or transitions that occur as one ages. For example, loss of loved ones, widowhood, divorce, traumatic illness or disability, children moving out of the house, growing old and facing mortality, and loss of independence can all have an impact on eating behaviors of midlife or older adults (Lapides 2010; Zerbe 2008).

Certain medical conditions can also contribute to developing an eating disorder. For example, older adults are at a higher risk for developing high cholesterol, diabetes, and other cardiovascular diseases and may be advised by their primary care physicians to be mindful of and careful with their diet. Some older adults may become anxious about their diets, but also lack knowledge about proper nutrition that lower the risk for cardiovascular diseases. They may begin restricting their diets and lose weight unintentionally. Their anxiety may maintain their eating disordered behaviors. Other contributing factors to eating disorders for older adults may be lack of enthusiasm for life, attempts to obtain attention from family members, financial difficulties, medical problems, and dissatisfaction or objection of living situations (i.e., nursing home, skilled facilities) (Lapides 2010).

Overall, stress is the most common trigger of eating disorders in both younger and older adults; stressors often change as one develops and become more prominent. Eating disorders are usually not about weight or food, but a way of coping with other stressors in life that the individual does not know how to handle. Disordered eating behaviors are often a way to avoid and numb emotions and feelings. If during adolescence or young adulthood the individual learned maladaptive coping mechanisms to tolerate stress, then the individual may utilize these unhealthy coping methods later in life as an older adult (Lapides 2010).

In one study, 50 women who were treated in a residential program and who eating disorder symptoms began after the age of 40 were examined. On an eating disorder inventory, midlife women scored higher than younger women on scales of ineffectiveness, perfectionism, interpersonal distrust, and asceticism, but scored lower on drive for thinness, bulimia, and body dissatisfaction. Both midlife women and younger women reported moderately severe depression and anxiety symptoms. On the Minnesota Multiphasic Personality Inventory (MMPI), midlife women indicated more denial than younger women. These midlife women also endorsed a higher frequency of sexual abuse (63%) than reported by younger women with eating disorders. There was no significant difference between midlife and younger women in alcohol or other substance use; however, midlife patients abused cannabis much less and opioids more than younger patients. Though not statistically significant, midlife patients more often abused sedatives, hypnotics, and anxiolytics suggesting a higher tendency to abuse calming/sedating medications. About 22% of older women reported a history of self-harm and 28% had attempted suicide. Though this study was limited to only patients who were seeking treatment in a facility, this suggests that older adults with eating disorders may under report some of their distress and need serious consideration and treatment in the community (Cumella and Kally 2008).

Eating Disorders and Neurocognitive Disorders

Dementia is not one specific disease; rather, it is a clinical syndrome characterized by a loss of cognitive functioning that negatively impacts a person's abilities to complete day-to-day activities. Dementia can affect many body systems and produce a variety of problems, such as poor or inadequate nutrition. Individuals with dementia may decrease the amount of food they eat, forget to eat and drink, or believe they have already eaten. Changes in an older person's daily routine (e.g., such as meal time) or other distractions (e.g., how the food smells or tastes, environmental issues such as too much confusion) may affect their eating patterns. In some cases, people with advance dementia may lose control of the muscles used to chew or swallow and this could put the person at risk of choking. Additionally, people with dementia may lose the feeling of hunger and the desire to eat. Other comorbid factors such as depression, medication side effects, and constipation, can decrease the individual's interest in food (Ikeda et al. 2002).

Frontotemproal dementia (FTD) encompasses several clinical syndromes all sharing frontal pathology. The FTDs include behavioral variant FTD (bv-FTD), progressive nonfluent aphasia (PNFA), and semantic dementia (SD). A variety of behavioral changes noted in bv-FTD, include loss of insight, disinhibition, impulsivity, apathy, poor self-care, mood changes, mental rigidity, and stereotypic behavior. Some research with bv-FTD individuals has also found a high prevalence rate of changes in food preferences, appetite, and eating behaviors. Individuals with semantic dementia characterized by anomia and impaired comprehension, also show behavioral changes, such as changes in appetite and food preferences that are similar to those observed in bv-FTD (Ikeda et al. 2002).

One of the most prevalent dementia syndromes, Alzheimer's disease (AD), accounts for about 35% of all dementia cases. AD is characterized by early onset of memory impairment (poor consolidation and recognition of information), poor confrontation naming (dysnomia), deficits in visuoconstructional skills, social withdrawal, and mood changes (symptoms of depression) can occur. Eating changes in AD have been shown to be less common. However, some research indicated anorexia is more common in AD (Ikeda et al. 2002). Research found more significant changes in eating behaviors in both bv-FTD and semantic dementia in contrast to Alzheimer's disease. Individuals with semantic dementia first typically see a change in food preference, whereas individuals with bv-FTD show changes in food preferences as well as alterations in appetite (Ikeda et al. 2002).

Though there is limited research on other types of dementias (e.g., vascular dementia) and eating disorders, overall, individuals with any type of dementia may suffer from a diminished interest to eat or forgetting to eat. Changes in food intake can lead to malnourishment and dehydration, increasing the risk of infections, abnormally low blood pressure, and other medical problems. Proper nutrition does not necessarily prevent weight loss in people who suffer from dementia, nor will it slow down the progression of the neurodegenerative process, however continuing to maintain a healthy weight and diet can support overall health and better quality of life. Primary care physicians, psychiatrists, psychologists, dieticians, family members and other caregivers play an important role in some of the treatment options for eating disorders in older adults.

Treatment Options for Eating Disorders

As people age, their interest in eating and enjoying food changes. Individuals with dementia have pronounced changes in taste or food preferences as well as changes in mood, behavior, and physical functioning, which can impact eating. Some general treatment goals for eating disorders in individuals both with and without dementia are to restore adequate nutrition, and weight to a healthy level, reduce excessive exercise, and stop binging and purging behaviors. Additionally, individuals that suffer from dementia may benefit from specific memory strategies (e.g., following a specific routine everyday or incorporating various

reminders or cues to remember to eat) or feeding tubes in later stages of the neurodegenerative disease. Multidisciplinary treatment teams such as a primary care practitioner, psychiatrist, dentist, nutrition specialist or dietician, and a mental health care professional may be needed to manage eating disorders (Fairburn 2010; Shapiro et al. 2007). In addition, health care professionals treating patients with eating disorders have to be mindful of different cultural and religious values and practices patients may possess.

Several psychological theories have been proposed to account for the development and maintenance of eating disorders, with cognitive behavioral theory being one of the most prominent with regard to treatment. Cognitive behavioral theorists propose that there are two main origins for the restriction of food intake. The first is the need to feel in control of life, which transfers into the need to control eating. The second is over evaluating one's shape and weight. In both cases, a dietary restriction is reinforcing. Following this, other processes such as social withdrawal, binge eating due to extreme and rigid dietary restraint, and negative impact of binge eating or concerns about shape and the sense of being in control, begin to play a role and serve to maintain eating disorders (Fairburn 2010; Shapiro et al. 2007).

Cognitive and behavioral approaches have been shown to successfully treat eating disorders based on studies with younger and middle-aged women and men. In addition, antidepressant medications may also be effective for some eating disorders as well as treating comorbid anxiety or depression. Medical consequences of an eating disorder can be devastating and life threatening, however, the internal dialog within the person and specific behavioral rituals that are constantly repeated can cause suffering and pain. The constant fear of judgment, self-imposing rules and demands can take over and cause negative emotions and perpetuate negative behaviors. Individuals with eating disorders often maintain negative view of themselves and their bodies. These negative thoughts can cause feelings of shame or anxiety that can then trigger behaviors to control weight. Cognitive behavioral therapy can focus on the specific factors that are maintaining the disorder and set specific goals throughout the therapy. Three phases can occur over the course of cognitive behavioral therapy: behavioral phase, cognitive phase, and maintenance and relapse prevention phase. During the behavioral phase the patient and therapist come up with a plan to stabilize eating and eliminate symptoms. In the cognitive phase, the therapist begins cognitive restructuring where the individual begins to recognize and change problem thinking patterns. Negative thoughts and beliefs (e.g., I will only be happy if I can lose weight) are identified and restructured. In addition, other concerns and issues such as relationship difficulties, self-esteem concerns, and emotion regulation are focused on. The last stage of CBT focuses on minimizing triggers, preventing relapse, and maintaining progress previously made (Fairburn 2010; Shapiro et al. 2007).

In addition to psychotherapy, psychotropic medications have also been shown to play a role in treating eating disorders. Research on medication use for anorexia nervosa have not found medication to promote weight gain, though some studies suggested fluoxetine as an option in preventing relapse in patients after normal weight is restored. In contrast, fluoxetine has shown to reduce binging frequency in bulimia nervosa, as well as anxiety and depressive symptoms (Zhu and Walsh 2002).

While research demonstrates the benefits of medication, the best results were seen with a combination of psychotropic medication and psychotherapy (Zhu and Walsh 2002; Maine et al. 2010). Research shows that patients who received cognitive behavioral therapy demonstrated more improvement in symptoms than those who only received medication. However, medication is efficacious for patients who have not responded to psychotherapy. When patients who did not benefit from cognitive behavioral therapy or interpersonal therapy were administered a placebo or fluoxetine, significant results in favor of fluoxetine were found (Walsh et al. 2000). While older adults have not been the focus of eating disorder randomized control trials, interpersonal and cognitive behavioral therapies were successfully used to treat other later-life psychiatric disorders, such

as depression (Hudson et al. 2007), which often co-occur with eating disorders.

In addition to psychotherapy and medication, nutrition intervention, such as counseling by a registered dietitian is an important aspect of multidisciplinary treatment of eating disorders, and would certainly contribute to determining the course of treatment in older adults. The dietitian can perform a nutrition assessment to identify nutrition problems related to the eating disorder and implement a care plan that might establish healthy eating patterns and restore the individual back to a healthy weight. In addition, the dietitian can monitor and re-assess the individual's progress with the plan and jointly work with other health professionals to address the individual's needs. The trained dietician can recommend keeping a daily food, hydration, and exercise log and this information can help identify if any new physical or medical problems may arise that can impact food intake and changes in weight. A full workup by a dietician is critical given the complexity of eating disordered behaviors and disorders in older adults. A dietician can monitor and refer older adults to other physicians or specialists as eating disorders can arise due to various causes (Walsh et al. 2000).

Conclusion

This chapter focuses on late-life eating disorders and eating disordered behaviors in older adults, and issues that have been largely overlooked or potentially under diagnosed. The dearth of information on eating disorders and related issues suggests that, although these issues are not common, it is possible for an older adult to have a disorder or issue with their eating. Those issues could be caused by various life stressors (e.g., abuse, loss of a loved one, loss of independence) and/or medical (e.g., neurodegenerative diseases, diabetes) or psychiatric (e.g., depression, anxiety) conditions, as is the case in many instances. Older adults are also not as physiologically resilient as younger adults. Physiological changes and vulnerability of an aging person could lead to more serious consequences of eating disorders much more rapidly than in a younger person. In rare instances, but certainly possible, the eating issue could be a longstanding disorder or newly diagnosed condition. For these reasons, health care professionals need to be cognizant of the possibility of eating disorders in the elderly, given the serious consequences of misdiagnosing or leaving them untreated in any population.

Cross-References

- ▶ Behavioral and Psychological Symptoms of Dementia
- ▶ Cognitive Behavioural Therapy
- ▶ Comorbidity
- ▶ Stress and Coping Theory in Geropsychology

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Effects of Stress on Memory, Relevance for Human Aging

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Synonyms

Changes in stress vulnerability during aging: Focus on the brain; Effects of stress on memory: Relevance for human aging; HPA axis alterations during aging: Impact on cognition

Introduction

Is aging associated with a more pronounced susceptibility to stress? Do older people respond differently to stress, and if so, how does this influence their cognitive performance? Might chronic stress be one of the reasons for the large interindividual variance observed in cognitive aging? The present chapter aims to answer these and related questions. A neuroendocrine perspective is taken, focusing on stress hormones and their action in the human brain. The response patterns of young people are described before age-related changes are discussed. Acute and chronic stress effects are then compared with each other, and finally, some possible lines of intervention are characterized.

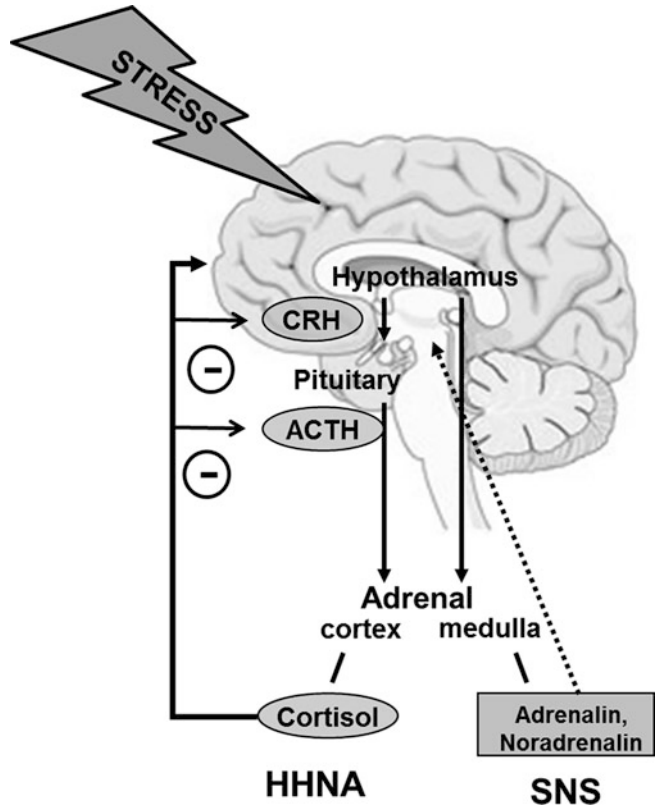
Definition of Stress

A common definition is that stress occurs when a person perceives a challenge to his or her internal or external balance (homeostasis; De Kloet et al. 2005). Thus, a discrepancy between what "should be" and "what is" induces stress. A stressor can be physical (e.g., cold, hunger) or psychological (e.g., work overload, mobbing, neighborhood violence, marital problems), as well as acute or chronic. The subjective evaluation of the stressor and of available coping resources determines its impact on the individual (Lazarus 1993). Something perceived as a threat by one person might be perceived as an exciting challenge by another. There is thus substantial interindividual variability in the vulnerability to stress. As humans are social animals, a threat to the social self (social evaluative threat), in combination with uncontrollability of the situation, is especially potent in prompting stress (Dickerson and Kemeny 2004). As further outlined below, genetic susceptibilities, when combined with early adversity, render an individual more vulnerable in adulthood.

The Two Stress Systems: HPA and SNS

Stress leads to neuroendocrine responses aimed at facilitating adaptation. In this context, the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS) play the most important roles. SNS activity leads to the rapid release of (nor)epinephrine from the adrenal medulla, which constitutes the first response wave. Activity of the HPA axis on the other hand leads to the release of glucocorticoids (GCs; cortisol in humans, corticosterone in most laboratory rodents) from the adrenal cortex. This response is slower and constitutes the second response wave (De Kloet et al. 2005). The two systems are illustrated in Fig. 1.

GCs are lipophilic hormones that can enter the brain, where they influence regions involved in cognitive functions (e.g., amygdala, hippocampus, and prefrontal cortex). These effects are mediated by the two receptors for the hormone: the mineralocorticoid receptor (MR) and the glucocorticoid receptor (GR), which differ in their affinity for GCs and in their localization. While MR activation leads to enhanced neuronal excitability, GR activation causes a delayed



Effects of Stress on Memory, Relevance for Human Aging, Fig. 1 Stress activates two neurohormonal systems: the rapidly acting sympathetic nervous system (*SNS*) and the slightly slower hypothalamic-pituitary-adrenal (*HPA*) axis. Activation of the hypothalamus stimulates the SNS to secrete (nor)epinephrine from the adrenal medulla. These catecholamines cannot easily pass the blood-brain barrier but can exert excitatory actions in the brain by stimulating the vagus nerve (hence the *dotted line*). The hypothalamus releases corticotropin-releasing hormone (*CRH*), which stimulates the secretion of adrenocorticotropin (*ACTH*) from the anterior pituitary gland into the blood stream. ACTH stimulates the adrenal cortex to release glucocorticoids (GCs, mostly cortisol in humans), which can easily pass the blood-brain barrier and modulate brain functions involved in learning and memory (see text). GCs exert negative feedback effects (indicated by the *minus* symbol) on the hypothalamus and the pituitary gland, leading to reduced activity of the HPA axis in the aftermath of stress

suppression or normalization of the neuronal network (Joels et al. 2008). Their activation furthermore leads to an altered expression of responsive genes. In addition, GCs can exert more rapid non-genomic effects which, in part, are mediated by membrane-bound MRs (Joels et al. 2008).

After acute stress, the HPA axis' negative feedback leads to GC levels returning to baseline values within hours (De Kloet et al. 2005; Dickerson and Kemeny 2004). In periods of chronic stress on the other hand, persistent alterations of the HPA axis can occur, leading to continuingly elevated cortisol levels. However, elevated cortisol concentrations, as typically observed in major depression, are not always the consequence of chronic stress (Wolf 2008). For example, reduced cortisol levels occur in several stress-associated somatoform disorders (Fries et al. 2005) as well as in post-traumatic stress disorder (Wolf 2008).

Age-Associated Changes in HPA Axis Activity/Reactivity

Since HPA axis alterations are a close correlate of or even a determining factor in the onset of different diseases, the assessment of the integrity and functioning of HPA axis regulation is of major interest in older individuals in particular.

Aging is accompanied by several distinct alterations affecting basal HPA activity as well as the system's response to stress or pharmacological manipulations (Lupien et al. 2009). Regarding the circadian profile, several studies have revealed an increase in nocturnal nadir levels with age, meaning that older people are exposed to higher levels of cortisol during the night (Wolf and Kudielka 2008). A somewhat different picture has emerged for the cortisol awakening response (CAR), which occurs directly after awakening and is associated with a robust increase in cortisol concentrations during the first 30 min after waking up. During aging, this response appears to become more blunted, a phenomenon which has been linked to atrophy of the hippocampus (Pruessner et al. 2010), a structure critically involved in the supra-hypothalamic control of the HPA axis and, at the same time, a structure of vital importance for episodic memory (see below).

Longitudinal studies indicate that not all older participants show an increase in basal cortisol levels over the years. A substantial interindividual variance exists, ranging from increasing or stable to even decreasing levels (Lupien et al. 2009). To summarize, the existing data point to altered basal cortisol concentrations during the nocturnal trough, while cortisol levels remain mainly unchanged or show only slight changes over the course of the day (Wolf and Kudielka 2008).

During the past decades, several studies have investigated the reactivity of the HPA axis using psychosocial laboratory stressors such as the Trier Social Stress Test. In this test, participants have to deliver a speech in front of an emotionally cold, nonresponsive committee. In addition, a difficult mental calculation task has to be performed. Based on observations made in rodents, older participants were expected to show a more pronounced and/or more prolonged stress response. Indeed, this is what several well-conducted studies observed, even though findings are not unequivocal (Wolf and Kudielka 2008), especially concerning some of the sex differences observed.

A different approach involves pharmacological stimulation of the HPA axis using, for example, CRH (with or without pretreatment with dexamethasone). The majority of these studies have found evidence for an enhanced HPA reactivity with aging, accompanied by an impaired negative feedback. Interestingly, these alterations appear to be more pronounced in older women (Otte et al. 2005).

The factors causing the HPA axis hyperactivity observed during aging in some individuals remain poorly understood. Possible candidates are early adversity or chronic stress (Lupien et al. 2009). However, metabolic alterations associated with glucose intolerance or type 2 diabetes (Convit 2005) should also be considered. Alternatively, degenerative processes in the central nervous system might be the starting point of the age-associated HPA axis alterations, since it is known that degeneration of supra-thalamic

control centers of the HPA axis (e.g., the hippocampus) leads to HPA axis hyperactivity. Of course, these explanations are not exclusive and might interact at multiple levels.

Stress and Cognition: Acute Effects

Stress affects the central processing of incoming information at multiple levels. Early influences on perception and attention have been documented, as well as later effects on working memory and long-term memory. The present chapter will focus on the influence of stress on long-term memory because it is the area which has been best characterized in young adults and at least partially investigated with respect to aging.

Long-term memory can be subdivided into declarative or explicit and non-declarative or procedural (implicit) memory. Based on its content, declarative memory can be further subdivided into episodic memory (recall of a specific event which can be located in space and time) and semantic memory (our knowledge of the world). The medial temporal lobe is critical for declarative memory, with the hippocampus being especially important for episodic memory (Wolf 2009).

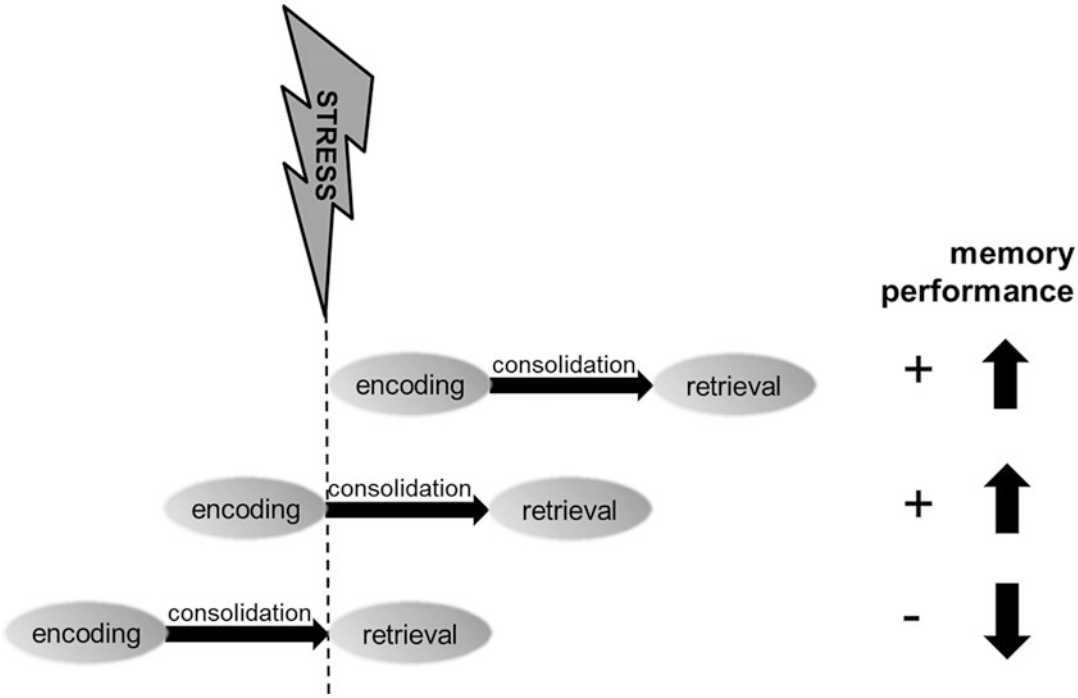
Long-term memory can further be subdivided into different memory phases, namely, acquisition (or initial learning), consolidation (or storage), and retrieval (or recall). The literature regarding the effects of stress on episodic memory was initially somewhat divergent and confusing, with groups reporting both enhancing and impairing effects of GCs on this form of memory. However, it has become apparent that this is largely due to the fact that the different memory phases outlined above are modulated by GCs in an opposing fashion (Wolf 2009).

GCs enhance memory consolidation, this process representing the adaptive and beneficial side of the action of GCs in the central nervous system (see Fig. 2). It has been conceptualized as the beneficial effects of "stress within the learning context," or "intrinsic stress." The terminology used emphasizes the fact that a stressful episode is remembered better, an effect which is mediated by the action of stress-released GCs on the hippocampal formation and which is very well documented in rodents. Studies have shown that an adrenergic activation in the basolateral amygdala (BLA) appears to be a prerequisite for the modulating effects of GCs on other brain regions (e.g., the hippocampus). Lesions in the BLA as well as beta-blockade abolish the enhancing effects of post-training GC administration (Roozendaal et al. 2009).

Comparable effects have been observed in humans: Immediate post-learning stress has repeatedly been linked to enhanced memory consolidation. Similar evidence comes from pharmacological studies, while neuroimaging studies have provided further evidence for a stress-induced modulation of amygdala and hippocampal activity (Wolf 2009). Pre-learning stress or cortisol studies have led to a somewhat less consistent picture. In this case, the exact timing of the stressor, the emotionality of the learning material, and the relation of the learning material to the stressor appear to be important modulatory factors (Wolf 2009).

While an enhanced memory consolidation is adaptive and beneficial, this process appears to occur at the cost of impaired retrieval (see Fig. 2). Using a 24 h delay interval, researchers were able to show that stress or GC treatment shortly before retrieval testing impairs memory retrieval in rats in a water maze. Further studies have revealed that, once again, an intact BLA and its adrenergic activation appear to be necessary for the occurrence of this negative GC effect (Roozendaal et al. 2009). Roozendaal has summarized these findings as indicative of stress putting the brain into a consolidation mode, accompanied by impaired retrieval. Such a reduction in retrieval might facilitate consolidation by reducing interference (Wolf 2009).

In humans, multiple studies have been able to demonstrate a stress-induced retrieval impairment using different stressors and different memory paradigms. Similar impairment has been induced using pharmacological cortisol elevations (Wolf 2009). Interestingly, the beneficial effects on consolidation and the impairing effects on retrieval in humans are more pronounced for emotionally arousing material. This observation fits the



Effects of Stress on Memory, Relevance for Human Aging, Fig. 2 Memory phase-dependent effects of stress on long-term memory. Immediate pre- or post-learning stress enhances memory consolidation, thus leading to enhanced memory retrieval hours, days, or weeks later. In contrast, stress shortly before memory retrieval impairs long-term memory by temporarily blocking the accessibility of the memory trace

mentioned observation in animals that GCs can only exert effects on memory in the presence of adrenergic activity in the amygdala. This arousal can result from specifics of the learning material and/or specifics of the testing conditions.

In a meta-analysis, time of day appeared as an additional modulatory factor. Studies in which cortisol was administered before initial acquisition observed impairing effects on memory when conducted in the morning, a time of high endogenous cortisol levels in humans. In contrast, studies in the evening were more likely to observe beneficial effects (Het et al. 2005). This supports the idea of an inverted U-shaped function between cortisol levels and memory in humans, with levels too low as well as levels too high at the time of acquisition being associated with impairments, especially when retrieval is tested while cortisol levels are still elevated (Het et al. 2005).

In sum, studies in animals and humans converge on the idea that GCs acutely enhance memory consolidation while impairing memory retrieval (see Fig. 2). Within this framework, emotional arousal and a nonlinear dose-response relationship are important modulatory variables (Wolf 2009).

Age-Associated Changes in Acute Stress Effects

Few studies have investigated age-associated changes in the impact of stress or stress hormones on memory. Findings thus have to be considered as somewhat preliminary. A pharmacological study observed a cortisol-induced memory retrieval impairment in both young and old participants (Wolf 2009). Stress studies have revealed a somewhat different picture, with older adults less impaired by the stressor. At the same time, stressed older adults appeared to be more susceptible to distraction. Interesting correlational findings have been provided by a neuroimaging study. In young participants, increasing cortisol

concentrations were associated with more neural activity in several memory-relevant brain regions. In older participants, the opposite pattern was observed: Here, increasing cortisol concentrations were linked to less brain activity in the hippocampus.

In sum, the currently available literature indicates that the memory of older participants is in some cases differently affected by acute stress (Wolf and Kudielka 2008). Importantly, enhanced and reduced stress responsivities have been reported. It is therefore likely that the impact of acute stress on aging is specific for certain processes and brain regions.

Stress and Cognition: Chronic Effects

The following paragraphs will focus on the impact of chronic stress on cognition in aging. First, the long-term consequences of early life stress will be summarized. These changes have an impact throughout the lifespan leading up to old age. Next, the impact of chronic stress on memory in adulthood is reviewed, before specific age-associated changes in the chronic stress effects associated with aging are highlighted.

Long-Term Consequences of Early Life Stress

Several studies support the notion that early stress exposure is associated with accelerated neurodegenerative processes and early onset of memory decline in the course of aging (Lupien et al. 2009). Neurodevelopmental impairments in association with early stress exposure may be one of the factors explaining such cognitive disadvantages at an older age. Changes in stress susceptibility programmed early on in life might account for such deficits (Schlotz and Phillips 2009). There is evidence for pre- and postnatal stress exposure being associated with a chronically increased reactivity of the HPA axis, potentially resulting from a reduced expression of central glucocorticoid receptors (Meaney 2001). Animal models show increased corticosterone concentrations and lower GR density in the hippocampus in the offspring of stressed mothers. Also, postnatal maternal separation and poorer maternal care have been associated with reduced GR gene expression in the hippocampus, which, in turn, is associated with reduced feedback sensitivity of the HPA axis. Recently, a mechanism has been discovered in rodents that explains how environmental stimuli can impact gene expression. Permanent alterations of GR gene expression result from methylation/demethylation of specific GR promoters, a process associated, among others, with variations in maternal care (Meaney 2001). Initial evidence suggests that the human GR gene is also subject to early life programming (Schlotz and Phillips 2009). Moreover, elevated cortisol concentrations have, for example, been reported in association with reduced birth weight or preterm birth.

In the following, the consequences of chronic stress exposure throughout life on cognitive functioning will be described. It will become apparent that individuals with an increased stress susceptibility (reflecting genetic susceptibilities and/or early adversity) are especially vulnerable to stress-induced cognitive impairments in adulthood and aging (Lupien et al. 2009).

Chronic Stress During Adulthood: Effects on Cognition

Animal research provides insights into the structural alterations caused by chronic stress. One main finding is that the integrity of the hippocampus and the medial prefrontal cortex is compromised, while, in parallel, the amygdala (the "fear center" of the brain) and parts of the striatum (the "habit center" of the brain) become hyperactive (Roozendaal et al. 2009). In the hippocampus, chronic stress leads to a retraction of dendrites (dendritic atrophy), and similar effects occur in the medial PFC (Lupien et al. 2009). This atrophy is reversible after stress termination, pointing to substantial neuroplasticity. In addition, stress leads to reduced neurogenesis in the

dentate gyrus and the mPFC. Even though the function of these newborn neurons is discussed controversially, impairment of memory and learning resulting from reduced neurogenesis is likely. At the behavioral level, impaired performance in hippocampal-dependent spatial memory tasks and impaired PFC-dependent set-shifting capabilities can be observed (Roozendaal et al. 2009).

In contrast to the hippocampus and the PFC, the amygdala becomes hypertrophic in conditions of chronic stress. Increases in dendritic arborization and spine density take place (Roozendaal et al. 2009). Moreover, activity of the CRF system in the amygdala, which is involved in anxiety, is enhanced. Chronically stressed animals show enhanced fear conditioning and are characterized by a more habitual and less goal-directed response style. Thus, the balance between brain regions involved in cognition is altered by chronic stress (Lupien et al. 2009). While "analytic" cognitive functions mediated by the hippocampus and PFC are impaired, "affective" fear-related amygdala functioning and habit-related striatal functioning are enhanced (Wolf 2008).

In humans, exposure to chronic stress (e.g., shift workers, airplane personnel, soldiers) is associated with cognitive deficits in several domains such as working memory and declarative memory (Lupien et al. 2009; Wolf 2008). These observed cognitive deficits can, in part, be explained by GC overexposure in the presence of chronic stress, a finding supported by studies administering GCs for days to weeks, resulting in cognitive impairments. Further evidence comes from studies with patients receiving GC therapy. Whether the negative effects on memory reflect acute or chronic effects is sometimes hard to disentangle, and at least one study showed a rapid reversal of the deficits after discontinuation of the GC treatment. Data from patients with Cushing's disease point in the same direction, with cognitive impairments and hippocampal volume reductions reported. Hippocampal atrophy might be reversible once successful treatment has occurred. This would be in line with the remaining plasticity of this structure observed in animal studies (Wolf 2008).

Chronic Stress or Rising Cortisol Levels During Aging: Effects on Cognition

In older laboratory rodents, an increase in basal corticosterone levels and a less efficient negative feedback of the HPA axis can be detected. Studies have reported that enhanced HPA activity is associated with poorer memory in those animals (Lupien et al. 2009).

As reviewed above, increases in basal cortisol levels occur during human aging. In addition, pharmacological or behavioral challenge studies observe an increased HPA response. Moreover, HPA-negative feedback in older subjects is less efficient. These alterations might reflect age-associated diseases, stress exposure over the lifespan, genetic vulnerabilities, the long-term consequences of exposure to early life adversity, or a combination of the above (Lupien et al. 2009). In older adults, correlations between elevated or rising cortisol levels and cognitive impairments have been reported (Lupien et al. 2009). The association between rising cortisol levels and atrophy of the hippocampus is not sufficiently understood, and the current empirical situation is heterogeneous. Similar associations with other GC-sensitive brain regions (e.g., PFC) have received less attention so far.

Evidence for HPA hyperactivity has been observed in patients with Alzheimer's dementia (AD). This could reflect the damage to HPA feedback centers in the brain, but it might also be causally involved in disease progression (Wolf and Kudielka 2008). Work in animals has documented that HPA hyperactivity can influence amyloid metabolism as well as tau phosphorylation, the two hallmarks of AD pathology. In human patients, treatment with prednisone resulted in exaggerated memory loss. Moreover, a genetic susceptibility to AD could be linked to the gene encoding 11beta-HSD, which influences local GC metabolism. In addition, at the self-report level, evidence exists that enhanced stress susceptibility is associated with a greater risk of dementia (Wolf and Kudielka 2008).

Another condition associated with HPA hyperactivity is the metabolic syndrome, as well as type

2 diabetes. There are close links between the stress system and the glucoregulatory system. Several authors have suggested that chronic stress facilitates the occurrence of the metabolic syndrome by influencing visceral fat deposition, impairing insulin sensitivity, or by changing eating habits toward unhealthier (comfort) food. Alternatively, the negative impact of glucose intolerance on the brain might lead to HPA hyperactivity and, in turn, elevated cortisol levels (Convit 2005).

Intervention Strategies

In laboratory animals, stress-induced dendritic atrophy and reduced neurogenesis can be prevented with antidepressants and anticonvulsants. Also, treatment with a glucocorticoid receptor antagonist is effective in preventing such stress-induced changes in neurophysiology. Similarly, memory impairments can be prevented with these drugs (Wolf 2008).

In humans, chronic stress without an associated psychopathology could be alleviated by psychological stress intervention strategies. Possible examples are stress inoculation training and mindfulness-based stress reduction training. In addition, social support is an effective stress-buffering factor.

Pharmacological treatment with beta-blockers can prevent the effects of acute GC elevations on memory retrieval. It remains to be shown whether similar approaches are effective in conditions of chronic stress. In addition, GR antagonists and/or CRF antagonists might be candidate drugs. Moreover, drugs that influence the local GC metabolism in the brain could also be effective. Depression is often associated with HPA hyperactivity. Successful treatment with antidepressants leads to a normalized HPA axis. One study observed that treatment with a selective serotonin reuptake inhibitor (SSRI) improved memory performance and reduced cortisol levels. More direct interventions targeting the HPA axis have been tested in laboratory animals, and clinical trials are on the way. In this context, CRF antagonists and GR antagonists appear promising. In sum, reinstating appropriate HPA signaling appears to be a promising treatment approach both in chronically stressed animals and in human patients suffering from stress-related psychiatric disorders (De Kloet et al. 2007).

Intervention strategies specifically designed for older people could be developed based on the following findings. In rodents, behavioral (e.g., neonatal handling) and pharmacological (adrenalectomy with low-dose corticosterone replacement) intervention strategies, leading to stable HPA activity throughout life, prevent age-associated cognitive decline. Similarly, a pharmacological reduction of active GC concentrations in the hippocampus (inhibition of 11beta-HSD synthesis) is efficient in preventing memory impairments in aging mice. In humans, a pilot study showed that the 11beta-HSD inhibitor carbenoxolone improved some aspects of memory in older men and in older patients with type 2 diabetes (Wyrwoll et al. 2010). Future studies are needed to better investigate possible side effects of long-term treatment with these kinds of drugs. Regarding treatment of the metabolic syndrome, lifestyle modifications are often successful if started early enough. In addition, pharmacological approaches are available. They should be able to prevent or reduce memory impairment and hippocampal atrophy associated with diabetes and the metabolic syndrome (Convit 2005).

Summary and Outlook

This chapter illustrates that chronic stress has a negative impact on cognition throughout life. A lifespan approach in research on stress and cognition emphasizes the long-lasting effects of exposure to early life adversity. Genetic risk factors, in combination with early life adversity, render an individual more susceptible to stress and stress-associated diseases during aging.

By reducing early adversity, it would thus be possible to support the development of a more

resilient phenotype less susceptible to stress-associated cognitive disturbances in later life. Importantly, a previously unappreciated amount of neuroplasticity remains in adulthood, allowing an optimistic view of the potential to successfully treat stress-associated neurophysiological changes in the future. These interventions should aim at reinstating appropriate HPA signaling and will thus rely upon a thorough diagnostic neuroendocrine workup of the phenotype.

Taken together, considerable progress has been made in understanding the impact of acute and chronic stress on the human brain. This knowledge has substantial relevance for aging, since age-associated changes in HPA (re)activity have been found to occur, and the sensitivity of the brain to stress appears to be altered in aging. Preventing or diminishing the age-associated increase in HPA activity appears to be a promising future research avenue to foster successful (mental) aging (Lupien et al. 2009; Wolf and Kudielka 2008).

Cross-References

- ▶ Cognitive and Brain Plasticity in Old Age
- ▶ Emotion–Cognition Interactions
- ▶ Memory Training Methods and Benefits
- ▶ Memory, Autobiographical
- ▶ Memory, Episodic
- ▶ Mild Cognitive Impairment
- ▶ Process and Systems Views of Aging and Memory
- ▶ PTSD and Trauma
- ▶ Stress and Well-Being: Its Relationship to Work and Retirement for Older Workers

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Elder Abuse and Neglect

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Synonyms

Elder maltreatment; Elder mistreatment; Mistreatment of older adults; Victimization of older adults

Definition

Elder abuse was first publically recognized in the United Kingdom and the United States in the 1970s. It is now a recognized phenomenon found around the world, led by the advocacy work of the International Network for the Prevention of Elder Abuse. The definition of elder abuse has expanded over time. However, across countries elder abuse is frequently defined as a single or repeated act, or lack of appropriate action, occurring within any relationship where there is an expectation of trust which causes harm or distress to an older person and typically encompasses six types of abuse: physical abuse, caregiver neglect, financial exploitation, psychological abuse, sexual abuse, and (in some countries) abandonment (World Health Organization 2002a). Since abandonment has received virtually no empirical attention, it is omitted from this review.

The trust component of the definition serves to distinguish elder abuse from other harms perpetrated against older adults. Abuse in later life, for example, focuses on domestic violence and sexual assault of older adults (particularly women). Although overlapping to a degree with elder abuse, it is narrower than elder abuse and typically espouses a very different theoretical position. Crimes against older adults (e.g., burglary, financial scams, assault) that are committed by strangers are not typically considered elder abuse, although homicide committed by a family member would be a form of elder abuse. And abuse of vulnerable adults (ages 18 years and older with some statutorily defined vulnerability) may overlap with elder abuse but only when the vulnerable adult is over the age of 60.

Prevalence and Consequences of Elder Abuse

Nationally representative studies in the USA find that overall, one in 11 older adults experience some type of elder abuse in a given year, although prevalence varies by the type of abuse involved: financial exploitation (5.2%), caregiver neglect (5.1%), emotional/psychological abuse (4.6%), physical abuse (1.6%), and sexual abuse (<1%) (Phelan 2013). However, between 30% and 40% of reported abused older adults experience more than one type of abuse simultaneously. Prevalence studies conducted in the European Region find that about 2.7% of people age 60 and over have experienced physical abuse in the preceding year, 0.7% sexual abuse, 19.4% psychological abuse, and 3.8% financial abuse (World Health Organization 2011). Throughout Asian countries, prevalence estimates vary wildly from 0.2% to 62%, although again, prevalence rates vary by the type of abuse involved (Phelan 2013). In Portugal, it is estimated that 12% of older adults fall victim to elder abuse in a given year, although again prevalence rates vary across types of abuse (Gil et al. 2014). In Western Australia, the prevalence of elder abuse is estimated to be 4.6% (Phelan 2013). Due to methodological differences within and between countries, comparisons are imprecise. However, it is generally accepted that the prevalence of elder maltreatment increases among people with a disability, cognitive impairment, and/or dependence (World Health Organization 2011).

There is evidence that elder abuse is underreported, with only one in 24 cases reaching the authorities, with rates of reporting differing across types of abuse (Phelan 2013). Although elder abuse occurs in long-term care facilities (Payne 2011), the majority of elder abuse occurs in the community, where most (95%) older American adults reside. However, residence varies tremendously in other parts of the world. In the

European Region, for example, more affluent countries have higher rates of paid caregiving and institutional care compared to less affluent countries where care is provided primarily by family members (World Health Organization 2011).

The field is recognizing the unique ways in which historically marginalized groups are impacted by the experience of elder abuse (Teaster et al. 2014). Distinct ethnic/racial groups may perceive the experience of abuse differently, experience elder abuse in different ways, and even at different rates. Individuals who self-identify with certain groups (LGBT, veterans) may have unique vulnerabilities that place them at risk for abuse, including financial exploitation. For example, threatening an LGBT older adult with outing may be sufficient to produce silence.

The myriad consequences of elder abuse are not often recognized (Payne 2011). They include psychological problems such as depression, emotional problems, disruptions in social and family relationships, compromised health, physical injury, hospitalization, and mortality, restrictions on and elimination of autonomy such as institutionalization or imposition of a guardianship, changes in living arrangements, and loss of assets including one's home. In some cases, there are secondary victims as well. For example, family members or the state may become physically and/or financially responsible for the older adult, or those who stood to receive an inheritance will not do so. The economic costs to society (direct costs to health, social, legal, police and other services) imposes a substantial financial burden. The consequences of elder abuse routinely lead to a diminished quality of life for abused older adults regardless of nationality.

Case Identification and Reporting

Some countries (e.g., Israel, Brazil, South Korea, United States) have implemented a system for responding to reports of elder abuse, typically referred to as adult protective services (APS) (World Health Organization 2002b, 2011). Since the 1970s, all states in the USA have APS, a government agency guided by state statute, although statutes vary considerably from state to state (Jackson 2015). Albeit somewhat controversial, all but one state (New York) have some form of mandatory reporting. Australia, in contrast, has eschewed mandatory reporting. APS is guided by the principle of self-determination and does not compel compliance with the provision of services unless the older adult is incapacitated or in certain emergency situations and the court approves such intervention. However, some states do compel compliance with an investigation. In practice, studies in the USA generally find that approximately a quarter of APS clients decline services, some of which will have a subsequent APS report. Over the decades, elder abuse has shifted conceptually to that of a crime, implicating the involvement of law enforcement and prosecution, although prosecution remains uncommon (Payne 2011).

Concern over financial exploitation (i.e., the illegal or improper use of an elder's funds, property, or assets) has consumed much of the attention towards elder abuse (Factora 2014). Financial exploitation has captivated the federal and state responders in the USA and Australia, with the majority of new movement within this defined area of elder abuse. As lawmakers bear witness to older adults being financially ruined, they have responded in kind with increased legislation (albeit not funding). There are now 39 states in the USA that criminalize financial exploitation (Jackson 2015). The primary form of financial exploitation prevention has been education, but researchers are suggesting that this may be ineffective for many older adults (Payne 2011).

The field of elder abuse has suffered from a lack of theory (Payne 2011; Bonnie and Wallace 2003). However, the adoption of a lifecourse approach is recommended for understanding elder maltreatment (World Health Organization 2011). While still thin, there have been modest empirical gains since the landmark release of the Institute of Medicine's Elder Mistreatment: Abuse, Neglect, and Exploitation in an Aging America (Bonnie and Wallace 2003), depicting the deplorable condition of the elder abuse field.

There is increasing recognition of the importance of distinguishing among types of abuse (Payne 2011), while recognizing that sometimes types of abuse co-occur or that one type of abuse may be a risk factor for experiencing other forms of abuse. However, there is still relatively little research that either increases basic knowledge or guides applied practice (Payne 2011). Furthermore, the research has been uneven, with less empirical attention to caregiver neglect and psychological/verbal abuse compared to other forms of elder abuse.

Detection of elder abuse remains challenging in all countries. In an effort to identify cases, elder abuse screens have been developed, although it is unknown how widely they are administered in any country. The U.S. Preventive Services Task Force recently concluded, however, that there are no valid and reliable elder abuse screens and could not recommend their use (Moyer 2013). Considerably more work is needed to develop psychometrically sound screening instruments for elder abuse. In the meantime, efforts in many countries (e.g., Canada) include public awareness campaigns designed to encourage community members to report suspected elder abuse. However, detection and reporting are related but distinct actions, with the decision to report considerably complex. Regardless, communities implementing public awareness campaigns must be prepared for the possible increase in maltreatment cases coming to the attention of those responsible for responding.

With few exceptions, the field suffers from a lack of forensic markers, which is interesting given the criminalization of elder abuse over the past couple of decades. Lack of forensic markers hampers the ability of geriatricians and other health care providers to differentiate between aging and abusive behavior (Bonnie and Wallace 2003), especially when victims are reluctant to disclose. Furthermore, insufficient knowledge surrounds the differentiation between accidental death and elder homicide. Forensic science also is being applied in the context of financial exploitation, with the utilization of forensic accountants in financial exploitation investigations.

Risk Factors of Elder Abuse

Consistent with a public health approach, much of the elder abuse research has focused on the identification of risk factors (i.e., factors that increase the odds of some phenomenon such as elder abuse). Researchers have identified over 50 risk factors for elder abuse, although only 13 are found consistently across studies (Johannesen and LoGiudice 2013). However, risk factors are differentially associated with types of abuse. Other than co-occurring forms of elder abuse, little is known about the ebb and flow of these risk factors or the interconnectedness among them. Also lacking from this literature is the identification of protective factors that buffer against elder abuse.

One risk factor that seems to cut across all types of elder abuse is dementia (Dong et al. 2014). In 2002, the prevalence of dementia among American individuals ages 71 and older was 13.9%, with another 22.2% having some form of cognitive impairment without dementia. However, it is important to remain cognizant that more people without dementia experience elder abuse. In response to the concern about identifying dementia among older adults, over 100 cognitive screens have been developed and many are in use in every day practice throughout the world. However, the US Preventive Task Force concluded that "...current evidence is insufficient to assess the balance of benefits and harms of screening for cognitive impairment" (Moyer and U.S. Preventive Services Task Force 2014).

The risk factor that consumes the most real estate in this field is social isolation. However, this concept is unrefined in the context of elder abuse, often being conflated with network size, loneliness, and living alone, and yet there are important distinctions among these concepts. The manner in which isolation manifests across types of abuse appears to differ as well. Some studies have found, for example, that while low social support was related to neglect, physical, sexual, and emotional abuse, it was not related to family-perpetrated financial exploitation. In contrast, other studies have found that living alone was related to financial exploitation, but not to

physical abuse (O'Keeffe et al. 2007). Social isolation likely plays an important role in victimization, but requires greater conceptual clarity. It has been proposed, however, that social connectedness may play a prophylactic role in elder maltreatment (World Health Organization 2011).

Gender has also been implicated in elder abuse, although scholars cogently argue that elder abuse is not a gendered phenomenon (Kosberg 2014). While the field awaits the development of victim profiles for each type of abuse, it is important to remember the heterogeneity that exists among older adults generally, and among elder abuse victims specifically. For example, the victimology literature asserts that there is a range of culpability expressed by victims (Doerner and Lab 2015). It may be more difficult for society to perceive an older adult victimized by a family member as a "pure victim" compared to an older adult victimized by a stranger.

Offenders have historically been excluded from elder abuse research as well as the response to elder abuse. Elder abuse offenders can be anyone, but are frequently family members, relatives, friends, neighbors, and professional caregivers, although the predominant type of victim-offender relationship appears to vary by abuse type (Jackson 2014). Furthermore, in Spain the main perpetrators for older people who are dependent or have disabilities were adult offspring, whereas for independent older people the perpetrators appear to be their partners (World Health Organization 2011). There are several offender risk factors that have substantial empirical support across studies from various countries (World Health Organization 2011; Payne 2011; Johannesen and LoGiudice 2013). These include psychopathology (substance abuse, mental illness, and/or criminal history), isolation, and financial dependence upon the victim. As with victims, appreciating the heterogeneity among elder abuse offenders is important. Prosecution has been the primary form of intervention for elder abuse offenders, and even that has been appallingly absent (Payne 2011). Development of offender interventions is urgently needed (Jackson 2014).

To truly understand and predict elder abuse, the ecological model instructs that there are risk factors at levels above and beyond the individual level (Payne 2011). For example, at the relationship level, the quality of the relationship prior to the occurrence of maltreatment may be an important predictive factor (World Health Organization 2011). Although the literature is scant, neighborhood-level factors (unsafe neighborhoods, high unemployment, and negligible social cohesion) have also been shown to be associated with elder abuse. At the societal level, elder abuse may be impacted by social policy and public attitudes such as ageism (i.e., stereotyping and discriminating against individuals or groups on the basis of their age).

Intervention

The field of elder abuse has placed very little effort into intervention development and even less on the evaluation of interventions. Studies find little encouragement in this domain, with some scholars questioning the underlying assumptions of protective services legislation (Payne 2011). It is becoming increasingly recognized that elder abuse cases range in complexity, with implications for interventions. Some cases are easily resolved, but many are not. It is clear that cases involving older parents and their abusive adult children are often particularly challenging cases in which to intervene due in part to parent's fierce protection of their offspring and entrenched patterns of behavior. Efforts are underway to identify and address high-risk victims.

Newer interventions have incorporated known risk factors such as social isolation (World Health Organization 2011), conceding, however, that this type of intervention is time consuming. Some offenders suffer from caregiver burden syndrome, with programs developed to address this condition. However, a systematic review of respite care concluded that, although some evidence supports a positive effect on burden and depression among caregivers, the evidence was limited and weak (World Health Organization 2011).

In the United States and throughout Europe there are examples of shelters offering support for women who have left an abusive relationship. In the USA, the Weinberg Center for Elder Abuse Prevention has gained considerable prominence. However, little is known about the effectiveness of emergency shelters in reducing elder maltreatment. In general, there are insufficient evaluation studies exploring the effectiveness of interventions on elder maltreatment, both locally and globally. One approach may be to identify strategies for preventing violence in general as there may be some underlying risk factors that cut across both of these fields.

In the American context and in some European countries, even less is known about the practice of APS caseworkers and the effectiveness of the services they employ (Payne 2011). There is evidence that a report of abuse to APS increases the likelihood of institutionalization as well as mortality. However, APS caseworkers tend to perceive their interventions (e.g., institutionalization) as effective. The field has yet to identify and define successful outcomes beyond the cessation of abuse. APS caseworkers and older adults sometimes hold different views of the underlying causes of abuse (Payne 2011), suggesting they might perceive outcomes differently. Victim satisfaction with an APS intervention is largely unknown. However, one study found that the services most frequently offered (social services) were not the type of service that had the greatest impact (legal) on the abusive situation (Alon and Berg-Warman 2014). In this evidence-based driven world, APS is going to have to go under the microscope.

One practice that is growing in prominence across countries is responding to elder abuse cases through multidisciplinary teams (MDTs) (Brandl et al. 2007). Rooted in the biopsychosocial model, an MDT simply refers to a group of people bound by a common purpose, typically comprised of five features: sharing, partnership, interdependency, power, and process. MDTs promote the inclusion of professionals historically absent from society's formal response to elder abuse, for example, psychologists to conduct neuropsychological evaluations. Although the concept has existed since the 1950s, demonstration projects in the USA were funded in the early 2000s which served to raise awareness of the model. This model is expected to proliferate in the coming years, although very few states have adopted this practice legislatively. Unfortunately, the empirical validation of MDTs is woefully small.

Conclusion

Elder abuse is a pervasive problem that affects all societies and countries. Considerable gains have been made in the field of elder abuse (research, practice, and policy) since it was first recognized in the 1970s. Although the knowledge base is growing, it remains underdeveloped. Very few interventions have been established, and far fewer have been evaluated. Practice continues to be based on experience rather than empirical evidence. And while there are now governmental policies of some kind in many countries (World Health Organization 2011), they are fragmentary and largely unfunded. It is sometimes easy for those in the field to become discouraged. And yet a look back over the past 35 years finds reason to be optimistic. For example, in 2002, the Toronto Declaration on the Global Prevention of Elder Abuse called on *all* countries to take action to prevent and ameliorate elder abuse. Many countries recognize the plight of abused older adults and are taking steps to respond. In the USA, for example, the Elder Justice Act (Pub. L. 111–148, 124 Stat. 119) was passed in 2009, the first federal legislation devoted exclusively to elder abuse.

As recommended by the World Health Organization, the adoption of a public health approach can facilitate a country's ability to prevent and ameliorate elder abuse. However, in the absence of a substantial investment in resources this fledging field will continue to falter. Whether elder abuse has reached the level of a social problem in any country worthy of such investment remains dubious. However, in time society may look back and characterize this period as the turning point for many countries in the development of the field of elder abuse.

Cross-References

- ▶ Behavioral and Psychological Symptoms of Dementia
- ▶ Caregiving and Carer Stress
- ▶ Social Support and Aging, Theories of

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Eldercare and Work

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Synonyms

Elder care; Informal care; Parent care

Definition

Eldercare is informal and unpaid care provided by family and friends that includes meeting a variety of physical, emotional, household, and financial needs. Caregiving can be divided into two broad

categories: hands-on activities, such as feeding, transporting, and dispensing medication, and managerial activities, such as planning, coordinating, and supervising formal care provided by others (Rosenthal et al. 2007). Care recipients may live in their own homes with their families or in residential facilities such as assisted living communities, nursing homes, or sheltered housing schemes.

Introduction

As populations age around the world, an increasing number of adults are working and caring for elders at the same time. In England and Wales, 11.9% of the female population and 9% of the male population provide some level of unpaid care with as many as 1.2% of the female population and 1% of the male population providing 50 h or more while working full time (Office for National Statistics 2013). In the United States, approximately 17% of the population takes care of older family members or friends while working full or part time (National Alliance for Caregiving 2015). Data from Australia, Canada, Israel, and the European Union show similar patterns of caregiving and employment (Cranswick and Dosman 2008; Fine 2012; Katz et al. 2011; Viitanen 2010). Overall, three times more people of working age are expected to care for two billion aging family members worldwide by 2050 (Carers UK 2013).

In most parts of the world, elders traditionally lived with their families in multigenerational households and were cared for by female relatives who did not work outside the home (Gross 2011). While women are still the primary caregivers in most families, eldercare arrangements are changing due to social, economic, and public policy trends. These trends include more women in the workforce, an increasing number of dual career households, delayed retirements, greater geographic mobility, shrinking family sizes, reduction of public spending on healthcare and social services, fragmented delivery of care to the aging, and a growing desire on the part of the elderly to remain in their own homes for as long as possible (Bookman and Kimbrel 2011; Fine 2012; Kossek et al. 2010; Meng 2013; Yang and Gimm 2013).

With a growing number of women and men providing informal care worldwide and careers and caregiving responsibilities peaking at roughly the same time, eldercare has emerged as an important issue for employers. Although balancing caregiving and work can be stressful, employment may provide a psychological buffer. Thus, employers have a positive role to play by creating supportive work climates and offering workplace-based eldercare assistance. The following sections will highlight recent research on the relationship between eldercare and work with a special focus on two of the most challenging caregiving situations – end of life care and dementia. The general impact of caregiving on caregiver health and well-being, caregiver employment outcomes, and workplace-based eldercare assistance will be discussed.

Impact on Caregiver Health and Well-Being

From a theoretical perspective, caregiver health and psychological outcomes can be understood through the lens of a "social determinants of health" model. This model suggests that a range of individual and organizational factors, as well as wider societal and cultural factors, influence health and psychological outcomes for caregivers (Mikkonen and Raphael 2010). Salient factors include gender, income, and social status; working conditions; health and social services; social support networks; culture; and personal health practices and coping strategies. One example of a culture factor is gendered expectations of who provides care (Williams et al. 2011).

On a practical level, caregivers tend to develop more health problems than non-caregivers, but the effect is generally minimal (Pinquart and Sörenson 2003; Vitaliano et al. 2003). However, they are much more likely to experience increased psychological strain (Duxbury et al. 2011) and higher rates of depression (Pinquart and Sörenson 2003). Some possible explanations for the negative impact of eldercare on well-being include the

role reversal of children caring for parents, caregivers confronting their own mortality, and the emergence of unresolved family issues (Smith 2004). In addition, strong negative emotions such as anger, helplessness, confusion, and guilt may surface when eldercare responsibilities occur because of an emergency or escalate over time as the health of the care recipient declines (Gross 2011).

Research demonstrates that certain types of eldercare produce more stress and strain than others, including caring for a spouse and/or co-residing with a care recipient (Duxbury et al. 2011; Pinquart and Sörenson 2003). Moreover, women and individuals with fewer financial resources experience poorer outcomes no matter where they live or for whom they care (Austen and Ong 2014; Carers UK 2013; Feinberg and Choula 2012; Lee et al. 2001; Schroeder et al. 2012). In addition, caregivers who live in countries with weak social safety nets experience more stress and strain (Hansen et al. 2013).

The most physically and emotionally demanding caregiving situations entail caring for someone with dementia or at the end of life. Dementia patients require high levels of care and supervision, particularly when the syndrome is in the moderate to severe stages (Wimo et al. 2013). People with dementia may also develop neuropsychiatric ailments, including personality changes and mood disorders, as well as associated problem behaviors. These are symptoms that are particularly associated with burden in dementia caregivers (van der Lee et al. 2014; Chiao et al. 2015; Ornstein and Gaugler 2012). Given the significant and cumulative losses associated with the dementia disease trajectory, dementia caregivers may also experience anticipatory and "pre-death grief" (Lindaur and Harvath 2014). Furthermore, dementia caregivers tend to provide more care each month and over a longer period (Kasper et al. 2014). As a result of these multiple pressures, dementia caregivers experience high rates of burden, depression and anxiety, social isolation, physical ill health, and feelings of guilt and frustration (van der Lee et al. 2014; Chiao et al. 2015; Springate and Tremont 2014), although some authors have also documented gains such as spiritual and personal growth and skills acquisition (Zarit et al. 2012; Sanders et al. 2005).

End of life care is also physically and emotionally demanding because caregivers undertake physical tasks, manage complex symptoms, and provide emotional support to a dying person while simultaneously managing their own, sometimes complicated, feelings of loss and grief (Williams et al. 2011; James et al. 2009; Mangan et al. 2003). As a result, end of life care is associated with a wide range of negative health and psychological impacts (Funk et al. 2010; Stajduhar et al. 2010). For example, a cross-country European survey estimates that between 28% (Belgium) and 71% (Italy) of end of life caregivers were physically and/or emotionally overburdened during the last 3 months of the care recipient's life (Pivodic et al. 2014).

Caregiver Employment Outcomes

Employed caregivers report higher levels of stress and work-family conflict than non-caregivers, and employers perceive that caregivers are less productive (Keene and Prokos 2007; Zuba and Schneider 2013). While caregivers are more likely to experience disruption in their labor force participation than non-caregivers, it is debatable whether the stress of eldercare results in negative work outcomes for individuals who remain in the workforce (Zacher et al. 2012). Moreover, caregivers who continue to work may receive a psychological boost from combining the two roles.

Labor force participation. Research from around the world shows that caregiving impacts labor force participation, especially for women (e.g., Austen and Ong 2014; Feinberg and Choula 2012; Kotsadam 2011; Liu et al. 2010). Typical responses to the demands of caregiving include dropping out of the workforce permanently, reducing work hours, taking leave without pay, or retiring early (Dembe et al. 2008). Women are more likely than men to leave the workforce permanently. Other factors that increase the likelihood of exit include age, poor health, and lower socioeconomic status (Austen and Ong 2014;

Lilly et al. 2007; Meng 2013). There is also evidence that employment status is a risk factor for unpaid caring. Individuals not working or working part time are more likely to be the ones to provide care compared to those working full time (Hutton and Hirst 2000).

Intensity of caregiving is another factor that affects labor force participation for both women and men. Research in the United Kingdom shows that there is a "threshold effect" at 10 h a week, such that becoming an unpaid caregiver for 10 or more hours a week is associated with increased odds of leaving employment (King and Pickard 2013). Similarly, a Canadian study shows that higher intensity caregiving is associated with being fully retired for men and women aged 55–69. For women, high-intensity caregiving is also associated with working part time and being a labor force nonparticipant (Jacobs et al. 2014).

Type of caregiving also affects labor force participation. A large-scale nationally representative survey conducted by the Alzheimer's Association (2014) found significant impacts on employment for dementia caregivers in the United States. Seventeen percent of workers gave up their jobs before or after assuming caring responsibilities, 8% took early retirement, and 13% moved from full- to part-time employment. Parallel research in the United Kingdom estimates that 21% of people caring for someone with dementia leave their jobs and 29% reduce their working hours (Centre for Economic and Business Research 2014). End of life caregivers are nearly 5% more likely to reduce their work hours than individuals caring for elders with a long-term, chronic condition (Williams et al. 2014).

Caregivers who reduce their hours or leave the workforce entirely incur long-term financial penalties in terms of lost wages and benefits and reduced retirement savings (Feinberg and Choula 2012). In addition, employers can incur costs because they will have invested resources to train and develop these employees. Many caregivers who leave the labor market will have valuable skills and experience because they are concentrated in the 45–64 age range (Carers UK 2013). Finally, there are public expenditure implications. For example, Pickard (2012) estimated that the UK public expenditure cost of caregivers leaving employment is £1.3 billion per annum, covering £1 billion of lost tax revenues and £300 million in Carer's Allowance.

Work-family conflict. While research consistently shows that eldercare affects labor force participation, there is less evidence to support assertions that the stress of eldercare causes negative work outcomes for those who remain in the workforce (Zacher et al. 2012). For example, employers perceive that eldercare causes employees to miss work (Katz et al. 2011). All caregivers are absent more frequently than non-caregivers, but employees with children miss more days than those taking care of elders (Boise and Neal 1996). Moreover, all caregivers experience higher levels of time- and strain-based conflict than non-caregivers, but there is no difference between those caring for children and those caring for elders (Lee et al. 2010). However, workers who take care of elders are likely to experience more frequent interruptions during the workday, most typically to make phone calls and accompany care recipients to appointments. This phenomenon is known as presenteeism and is a consequence of the fragmented delivery of services to the elderly, which require caregivers to coordinate care from multiple providers (Smith 2004). As with gendered outcomes for labor force participation, the impact of eldercare on absenteeism and presenteeism is greater for women, as well as workers in low-skill and low-status jobs (Austen and Ong 2014; Katz et al. 2011; Lee 1997; Zuba and Schneider 2013).

Employees with the most challenging caregiving responsibilities experience the most work-family conflict and work disruptions. For example, in the United States 54% of employees taking care of dementia patients reported unplanned absences from work, 15% took planned leave, and 8% saw their work performance suffer to point of being worried about dismissal (Alzheimer's Association 2014). In the United Kingdom, as many as 6.6% end of life caregivers missed full days at work compared those caring for someone with a long-term, chronic condition (Williams et al. 2014).

Work as a buffer. Employed caregivers generally report better health than unemployed caregivers. This phenomenon may occur because employment is a protective factor or because the caregivers with the poorest health are those least able to work (Cannuscio et al. 2004). Nevertheless, research indicates that work may be a protective factor because it bolsters a caregiver's sense of efficacy, provides a sense of accomplishment, increases financial resources, and expands support networks and opportunities for respite (Utz et al. 2012; Zuba and Schneider 2013).

Two contrasting theories from the work-family literature explain how successfully (or not) individuals balance eldercare and work. Scarcity theory posits that an individual has a limited amount of time and energy for which caregiving and work compete (Marks 1977). On the other hand, role enhancement theory says that the benefits of one role spillover into the other, creating a net gain (Greenhaus and Powell 2006). Reid et al. (2010) studied which of these theories more accurately predicts employee behavior and found that the results vary greatly from individual to individual with some employed caregivers indicating that work enhances their well-being while others saying that it adds to their stress. Reid et al. (2010) conclude that an individual's subjective perception of the degree to which eldercare interferes with work is more predictive of role conflict and other negative outcomes than more objective measures.

Workplace-Based Eldercare Assistance

Although employer support has been shown to reduce work-family conflict and caregiver burden (Zacher and Winter 2011), research on the availability and effectiveness of workplace-based eldercare assistance is sparse (Kelly et al. 2014). In general, a country's public policy context is a major determinant of how active private employers are in this area. In countries with weaker family leave laws and welfare policies, private employers are more likely to provide assistance, but it is usually limited to the largest companies and certain employees (Dembe et al. 2008; Yang and Gimm 2013). Employers cite the cost of benefits and the difficulty measuring effectiveness as hindrances to providing assistance (Katz et al. 2011).

Workplace-based eldercare assistance can be divided into three broad categories: compliance with family leave laws, formal employer-sponsored services and benefits, and informal support from managers and supervisors. Legal compliance is the most basic level of assistance that employers provide. If employers offer formal benefits, they usually take the form of information, education, and referral programs. In the United States, these would typically be available through Employee Assistance Programs (EAPs). Some employers may go as far as offering flexible hours and paid leave, as well as subsidies for respite and emergency care (Dembe 2008). Flexibility is both the most desired benefit and most beneficial in terms of reducing caregiver burden, but access varies greatly across countries, industries, organizations, and job categories. For example, in the United States flexible work hours are available primarily to professional and managerial employees (Sweet et al. 2014).

Even when employers offer eldercare benefits, employees frequently do not utilize them either because they are not aware of their existence or they worry about being stigmatized if they disclose their care duties (Dembe et al. 2008). Fear of stigmatization is a particular concern for employees with the greatest caregiver burden. For example, the lack of understanding that still exists around dementia means that people may feel uncomfortable about mentioning their care responsibilities at work. This may prevent them from seeking the support they need. Therefore, employers need to take active steps to ensure that all employees are made aware of workplace-based assistance. Employers may also participate in "dementia-friendly" initiatives designed to reduce the stigma of dementia, including the UK's dementia-friendly workplace initiative (Alzheimer's Society 2015).

End of life caregivers may require compassionate or family-friendly leave, in addition to bereavement leave due to the intensity and trajectory of care (Vuksan et al. 2012). Psychoeducational interventions for end of life caregivers

may improve coping and help to reduce distress and burden (Hudson et al. 2013). In turn, reducing caregiver burden and distress can support death at home rather than in hospital (Visser et al. 2004).

Conclusion

With populations aging around the world, more and more adults will find themselves juggling eldercare and work responsibilities. In order to minimize stress, maximize well-being, and ensure that caregivers can continue working as long as they want, forward-thinking employers – with the help of governments and the voluntary sector – should take the lead in developing creative and effective eldercare policies and programs to assist all employees. In order to create "aging-friendly societies" and workplaces, Bookman and Kimbrel (2011) argue that a "large-scale, cross-sector initiative is needed to coordinate efforts. . .to support all citizens from diverse cultures and incomes as they age" (p. 132).

Cross-References

- Dementia and Neurocognitive Disorders
- End of Life Care
- Flexible Work Arrangements
- Human Resource Management and Aging
- Organizational Climates and Age
- Palliative Care
- Stress and Well-being: Its Relationship to Work and Retirement for Older Workers

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Electroconvulsive Therapy

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Synonyms

Convulsive therapy; Electroconvulsive therapy (ECT); Neurostimulation therapy; Somatic therapy

Definition

Electroconvulsive therapy (ECT) is a neurostimulation intervention used to treat severe neuropsychiatric diseases, such as major depressive disorder, bipolar disorder, and schizophrenia. To perform ECT, while the patient is under anesthesia, controlled electrical stimuli are applied to the brain via two electrodes that are placed on select areas of the scalp to generate a therapeutic tonic-clonic seizure. The generated seizure tends to be time limited and results in both motoric (typically the foot) and electroencephalographic manifestations. To result in therapeutic efficacy, a typical ECT course includes on average between eight

and fourteen sessions that are administered either two to three times per week. There are no absolute contraindications to ECT, but patients undergo comprehensive medical and neuropsychiatric examinations before undergoing treatment and are monitored by an interdisciplinary care team during and immediately after the treatment. Though ECT tends to be medically safe, it can result in transient adverse effects including headaches, body aches, and importantly cognitive difficulties. Regarding the latter, the cognitive difficulties include disorientation, decreased processing speed, anterograde amnesia, retrograde amnesia, verbal dysfluency, and executive dysfunction. Despite these transient adverse effects, ECT has been found to be one of the most effective neuropsychiatric treatments, particularly for major depressive disorder. Due to its usefulness when other neuropsychiatric treatments fail, modern neuropsychiatric practice continues to employ ECT.

Introduction

Introduced in the late 1930s, electroconvulsive therapy (ECT) is one of the oldest, most durable, and effective neurostimulation therapies in the neuropsychiatric armamentarium (American Psychiatric Association 2008). Initially developed for schizophrenia or other psychotic disorders based on the false assumption that seizures and psychosis were unable to coexist, ECT has since been found to be highly effective for major depressive disorder (MDD). Over the past two decades, numerous clinical investigations sponsored by the National Institute of Mental Health have informed the development and refinement of ECT (Fink 2014; Lisanby 2007). Such refinements have helped to minimize the side effects of ECT while maximizing the clinical benefits (McClintock et al. 2014). Indeed, despite the introduction of other neuropsychiatric treatments including pharmacotherapeutics, psychotherapy, and transcranial magnetic stimulation, ECT continues to be used in psychiatric practice as it tends to be relatively safe and effective in cases where other treatments fail.

Practice of Electroconvulsive Therapy

Neuropsychiatric practices across the globe, including the United States, employ ECT (American Psychiatric Association 2008). Though there have been no formal epidemiologic studies on the use of ECT, it is estimated that approximately one million people worldwide are treated with ECT. In the United States, the number of people treated with ECT is estimated to be approximately 100,000 annually. Across the United States, the practice of ECT varies due to various mental health laws, as in certain states its use is restricted to certain patients (e.g., patients aged 17 and older). A main factor that limits the use of ECT is the negative stigma associated with it secondary to its associated side effects (e.g., retrograde amnesia, anterograde amnesia). Also, after the publication of the National Institute for Health and Care Excellence (NICE) guidelines (National Institute for Health and Care Excellence 2003), which resulted in more stringent practice parameters, the use of ECT has decreased in the United Kingdom. Nonetheless, ECT has a global presence and its use may increase as more people are diagnosed with neuropsychiatric diseases, particularly when they are nonresponsive to other treatments.

Clinical indications (see Table 1) for ECT include MDD, bipolar disorder, schizophrenia, and catatonia (Mankad et al. 2010). For MDD, ECT tends to be reserved when other treatments fail, and the illness is chronic, severe, and life-threatening. For bipolar disorder, ECT is useful for both the manic and depressive episodes and is indicated when other treatments fail to abate the

Electroconvulsive Therapy, Table 1 Neuropsychiatric indications for electroconvulsive therapy

Behavioral disturbances of dementia (intractable to other treatments)
Bipolar disorder
Catatonia
Epilepsy (intractable to other treatments)
Major depressive disorder
Parkinson's disease (intractable to other treatments)
Schizoaffective disorder
Schizophrenia

bipolar symptoms. For schizophrenia, ECT is indicated when other treatments are ineffective and may be useful for both the positive and negative symptoms. For catatonia, ECT is indicated as a first-line treatment, though it tends to be reserved until other treatments are determined to be ineffective. Among these four clinical indications, ECT has been found most useful for MDD and catatonia.

Administration of Electroconvulsive Therapy

An interdisciplinary healthcare team is needed to administer ECT (American Psychiatric Association 2008; Mankad et al. 2010). Such disciplines include (in alphabetical order) anesthesiology, clinical neuropsychology, clinical psychology, nursing, psychiatry, and social work. Before patients commence with ECT, they must undergo a comprehensive medical and neuropsychiatric examination to ensure that ECT is appropriate and safe. Components of the examination include a general medical and physical work-up, anesthesiology work-up, neuropsychiatric history including prior and current treatments, and global cognitive status examination. As needed, other medical work-ups may be recommended including electrocardiogram (EKG), x-ray (such as chest, spine, and head magnetic resonance imaging (MRI) or computerized tomography (CT)), and neurological examination.

Once a patient is cleared for ECT, the treatment team will provide education to the patient (and his/her care partner) about the ECT treatment process, perform informed consent procedures that will occur before the first ECT session and continue throughout the ECT course, and establish the ECT protocol to be used for the patient. During the provision of ECT, safety is a top priority. Before initiation of each ECT session, the patient is administered anesthetic agents to cause muscle relaxation (minimizes motoric seizure expression) and sedation (minimizes the treatment experience), a bite block is placed in the mouth to protect the teeth and tongue, and the patient is closely and continuously monitored (including pulse, blood pressure, respiration, EKG, and electroencephalography (EEG)) by the treatment team (American Psychiatric Association 2008; Mankad et al. 2010).

Electroconvulsive Therapy, Table 2 Electroconvulsive therapy parameters

Domain	Specific parameter
Stimulus waveform	Sine wave[a] Brief pulse Ultra brief pulse
Electrode configuration	Bitemporal Bifrontal Right unilateral Left unilateral[a]
Electrical dosage strategy	Empirical dose titration Age method Half-age method
Pulse amplitude	500 mA 600 mA 700 mA 800 mA 900 mA

mA milliamperes

[a]Sine wave pulse width is no longer used in modern ECT practice due to its associated adverse cognitive effects, and left unilateral electrode configuration is rarely used in modern ECT practice

To administer ECT, four treatment parameters (Table 2) can be adjusted to provide maximum clinical outcome and minimize adverse effects. These parameters include stimulus waveform, electrode configuration, electrical dosage (American Psychiatric Association 2008), and pulse amplitude (Peterchev et al. 2015). Although the initial stimulus waveform was sinusoidal (sine wave), that waveform is no longer used and modern-day ECT devices no longer carry this option due to its adverse cognitive effects. Both brief and ultra-brief pulse waveforms have been found to be efficacious, and research suggests that the latter may have a more benign cognitive adverse effect profile (Tor et al. 2015). The initial application of ECT employed bitemporal electrode configuration, and thus, it is sometimes called the "gold standard." However, research has suggested that electrode placement along with bifrontal and right unilateral electrode configuration when properly dosed is equivalent with regard to clinical outcome but that the latter two

placements may have less cognitive adverse effects (Kellner et al. 2010). In another electrode configuration, left unilateral has rarely been employed in clinical ECT practice due its adverse cognitive effects particularly with verbal cognitive functions.

When providing the stimulus for the ECT session, two stimulus dosing methods are used including the age and empirical dose titration methods. For the age method, dose is adjusted based on the age of the patient, with younger and older patients treated with lower and higher doses, respectively. For the empirical dose titration method, a stimulus is applied at the lowest dose necessary to produce a tonic-clonic seizure. While the age method tends to generalize the stimulus dose across age groups and the empirical dose titration method individualizes the dosage, both have been found to be safe and efficacious (Mankad et al. 2010). An ECT parameter that has received more recent attention is the pulse amplitude. Current ECT devices usually have the pulse amplitude automatically set at 800 or 900 mA, and many clinics rarely adjust the amplitude. Some computational and pilot evidence suggested that decreasing the pulse amplitude down to 500 mA could result in an efficacious treatment with benign cognitive adverse effects (Peterchev et al. 2015). However, the current evidence base is lacking to justify altering pulse amplitude in clinical practice.

Efficacy

While published rates of ECT antidepressant efficacy have been found to vary with as low as 20% and as high as 80% remission rates due to variability in ECT practice and patient populations, when judiciously employed following evidenced-based practices, ECT is a highly safe and efficacious treatment (Fink 2014; Trevino et al. 2010). Indeed, among all neuropsychiatric antidepressant strategies and in cases where antidepressant treatments have been ineffective, ECT has the highest efficacy rate with concordant large remission rates. Relative to psychotherapeutic and pharmacotherapeutic strategies that can at times take up to 8 or 12 weeks to achieve remission, ECT results in a rapid onset of action with remission on average being achieved in approximately 3–4 weeks (Spaans et al. 2015). Such rapid rate of response and remission is critical for patients, particularly when the MDD is life-threatening such as in cases of MDD with catatonia.

The antidepressant effects of ECT apply to a broad range of depressive symptoms including melancholic and atypical features, psychosis, suicidal ideation, and catatonia. Importantly, ECT is safe and efficacious for populations in which medications may prove to be harmful. For instance, ECT is useful in elderly adults with MDD as there are no medication-medication adverse interactions. Also, ECT can be useful for women with perinatal depression as research has found it to be safe for both the woman and the developing fetus.

Unfortunately, relapse after acute treatment can be high, especially in cases where there is no continuation or maintenance treatment protocol (Fink 2014; Lisanby 2007). Research continues to be ongoing to find optimal strategies to prolong remission post the acute course including continuation ECT, continuation pharmacotherapy, continuation combined ECT and pharmacotherapy, continuation cognitive behavior therapy, and continuation depressive symptom-titrated ECT.

Efficacy in Elderly Adults

Electroconvulsive therapy is considered an important treatment in elderly patients with depression. This is the case as elderly adults frequently require treatment with a rapid onset as they may present with greater depressive symptom severity (e.g., agitation, psychosis) and higher suicide risk and potentially may respond more slowly to antidepressant medication. Research has found that elderly adults with depression show rapid response and remission with ECT. For example, a study that compared outcomes from elderly patients who participated in a randomized controlled trial (RCT) for different antidepressant medications with outcomes from another RCT conducted in patients who received different forms of ECT found that both speed of remission

(mean time to remission for ECT group 3 weeks vs. 4 weeks for medication) and remission rates (63% ECT group vs. 33% in the medication group) were superior with ECT. After adjustment for clinical and demographic differences, the ECT group was also eight times more likely to achieve remission compared to the medication group after 5 weeks of treatment (Spaans et al. 2015).

Adverse Effects

Electroconvulsive therapy is considered a safe procedure in the elderly, although not unlike any other medical procedure, there is the potential risk for adverse effects (Table 3). These risks, however, can be minimized through careful medical work-up, optimally by a multidisciplinary team composed of different specialists (e.g., anesthetist, cardiologists, psychiatrist, etc.). This is particularly important for the elderly, who frequently have medical comorbidities. Of these, preexisting cardiac conditions pose the most significant risk for adverse effects, including death. During ECT, the cardiovascular system is placed under increased stress due to activation of the sympathetic autonomic system that results in tachycardia, hypertension, and increased oxygen consumption. In modern ECT practice, with appropriate anesthetic and cardiovascular management, evidence suggests that ECT can be administered safely even in elderly adults with premorbid cardiovascular conditions when appropriate precautions are put in place. For example, a retrospective review of the medical records of 35 elderly patients with a history of heart failure and reduced ventricular heart function found that ECT was safe, with no reported adverse effects (Rivera et al. 2011). Similarly, a case report of the oldest person (100 years old) to receive ECT who had severe aortic stenosis reported no cardiac complications over an extended period of ECT treatment that spanned 5 years (O'Reardon et al. 2011).

Electroconvulsive Therapy, Table 3 Adverse effects associated with electroconvulsive therapy[a]

Medical adverse effects	Neurocognitive adverse effects
Headache	Decreased processing speed
Migraine	Disorientation
Myalgia (e.g., body aches)	Executive dysfunction
	Inattention
	Memory disruption Anterograde amnesia Retrograde amnesia
	Verbal dysfluency

[a]Most adverse effects associated with electroconvulsive therapy (ECT) tend to be transient. The medical adverse effects tend to dissipate 24–48 h after treatment and can be managed with over-the-counter medication. The neurocognitive adverse effects tend to dissipate within 1 week after the last ECT session, though some effects have been found to persist up to 6 months

An additional adverse effect relevant to the elderly is increased risk of falls from ECT. However, it is important to note that falls are common in psychiatric settings, particularly among patients considered the older-old and those with medical comorbidities (e.g., motor dysfunction and cognitive impairment). A retrospective analysis of records from 1834 admissions to a psychogeriatric inpatient unit identified ECT as a significant risk factor after controlling for other confounders, including age, medication use, Parkinson's disease, and dementia (de Carle et al. 2001). Falls were additionally found to be more common during the day, which was considered to be potentially associated with short-term cognitive side effects. As such, it is recommended to use select ECT parameters to minimize cognitive side effects in elderly patients, as well as implementation of other precautions, such as increased surveillance.

A less common adverse effect is dental and oral injury due to clenching of the jaw from direct stimulation of the masseter muscles. These types of adverse events are rare and typically mild. Risk is increased with dental pathology prior to treatment, which can be identified and potentially mitigated via pretreatment medical work-up.

Medical Effects

Other common medical effects associated with ECT include somatic discomfort (e.g., headache,

muscle soreness, nausea) and postictal delirium. The most common medical side effect of ECT is headache, which commonly occurs during and following postictal recovery. An audit of subjective side effects reported by 70 patients who received ECT found that 11% of patients reported experiencing a severe headache, while 44% reported a mild or moderate headache (Benbow et al. 2004). Somatic complaints, including headache, are however common in depressed patients prior to ECT, which therefore makes it difficult to determine their etiology. For example, a study conducted in elderly patients found that approximately 20% of patients reported headache prior to treatment and that this proportion showed a nonsignificant increase following ECT treatment (Brodaty et al. 2001). Headaches during ECT are typically managed through prophylaxis with analgesic medications, or treated symptomatically. Muscle soreness/pain and nausea are also common. Muscle pain due to ECT is considered to be caused by the actions of the muscle relaxant (succinylcholine) or alternatively through excessive convulsive movements during treatment. In the case of the former, this is managed with prophylaxis using analgesic medications, while the latter can be addressed through an increased dose of muscle relaxant. Nausea in contrast may occur as a side effect of general anesthesia and is typically managed with antiemetics.

Postictal delirium is also known to occur in a minority of patients and is characterized by motor agitation, disorientation, and sometimes erratic behavior. Correspondingly, it poses a risk for injury for both patient and staff. A retrospective case-controlled study of 24 patients who experienced postictal delirium and 24 controls failed to identify any relevant clinical or treatment differences between groups, including age (Devanand et al. 1989). A more recent study similarly was unable to identify any predictors, other than a potential association with seizure length (Reti et al. 2014). Thus, while older age is considered a risk factor for delirium in other settings, it remains unclear whether elderly patients are similarly at increased risk for delirium after treatment with ECT.

Neurocognitive Effects

Cognitive side effects from ECT are frequently the most significant concern for patients and typically manifest in short-term deficits in orientation during postictal recovery immediately following ECT, memory (anterograde and retrograde), executive function, and processing speed. Elderly patients treated with ECT may have poorer baseline cognitive functioning due to age and illness, which potentially may confound the interpretation of cognitive side effects in this population (McClintock et al. 2011). In contrast to research on the cognitive side effects of ECT in relatively younger adult populations, research findings to date have been mixed in regard to the extent in which elderly patients experience cognitive side effects.

Recovery of orientation immediately following ECT, typically assessed at regular intervals during recovery, has been identified as a predictor of retrograde memory side effects from ECT (Sobin et al. 1995). Monitoring of recovery of orientation during the ECT course has therefore been recommended to assist ECT practitioners with identifying patients at increased risk for these side effects. Importantly, increased age has been associated with longer time to reorientate midway during the ECT course (Martin et al. 2015). Older age, therefore, may be a vulnerability factor for increased memory side effects with increased number of ECT treatments.

Research into other ECT-related cognitive side effects in elderly patients, however, has been mixed and shown stability, impairment, or improvement in cognitive performance on measures including tests of global cognitive functioning, memory, and executive function (Tielkes et al. 2008). For example, a recent study conducted in 62 elderly patients (aged 60–85 years) found no significant changes in performance on measures of anterograde and retrograde memory, processing speed, and executive function following ECT compared to healthy elderly controls, although the ECT patients were found to perform poorer on a test of verbal fluency at post treatment compared to controls (Dybedal et al. 2014). In contrast, another recent study in 42 patients aged 58–91 years found significant

improvements in global cognitive function and anterograde memory but no changes on measures of attention and executive function following ECT (Verwijk et al. 2014).

Potential reasons for these mixed results may include heterogeneity in ECT treatment methodologies (e.g., electrode montage, dosing method, pulse width, frequency of treatment, and choice of anesthesia), cognitive assessment methods (i.e., brief screening compared to more detailed neuropsychological assessment), and time of cognitive testing in relation to the last ECT treatment. The latter is potentially important as cognitive side effects tend to resolve within a few weeks following treatment (Semkovska et al. 2010). It is also possible that reported cognitive findings in the elderly may be unduly biased due to the study cohorts. For example, elderly cohorts tend to have relatively higher proportion of involuntary patients who may be unable to participate in cognitive testing. Moreover, research studies often exclude patients who are at greater risk for delirium (i.e., who are cognitively impaired at baseline), which in turn may underestimate overall cognitive side effects. This is potentially important, as patients with higher educational and occupational attainment (i.e., increased cognitive reserve) are less likely to show cognitive side effects following ECT (Legendre et al. 2003).

Thus, while the extent to which elderly patients experience cognitive side effects from ECT remains unclear, given the vulnerabilities in this patient population (e.g., increased prevalence of cardiac comorbidities, cognitive impairment, severe illness), it is recommended to implement careful patient monitoring of cognitive side effects during ECT treatment. Also, use of ECT treatment methods associated with lesser cognitive side effects (e.g., ultra-brief pulse width, lesser frequency treatment) should also be considered for elderly patients who at potential increased risk.

US Food and Drug Administration Recommendations

As ECT was grandfathered in and never formally approved or cleared by the US Food and Drug Administration (FDA), it convened an advisory panel hearing in January 2011 to discuss the reclassification of ECT. Following that advisory panel meeting, the FDA released a draft of a guidance document (Center for Devices and Radiological Health document number 1823) in December 2015 that outlined their recommendations for ECT reclassification (US Food and Drug Administration, 2015). Per the document, the FDA suggested that ECT should be reclassified into Class II for patients age 18 and older with a diagnosis of MDD or bipolar disorder. A device classified into Class II represents a *high-risk* device that requires special controls to ensure device safety and utility. While such reclassification will allow greater access to ECT for patients age 18 and older with MDD or bipolar disorder, it by default suggests that ECT will be reclassified into Class III for all patients with other diagnoses. A Class III device is considered to be of the *highest risk* and has the greatest level of regulatory control. As such, patients younger than age 18 or those with neuropsychiatric diagnoses other than MDD or bipolar disorder in whom ECT has been found to be safe and useful may find it more difficult to be prescribed ECT.

The FDA also provided other recommendations in the guidance document. Regarding the practice of ECT, the document suggested the use of brief pulse waveform, unilateral electrode configuration on the non-dominant hemisphere (e.g., right unilateral), decreased stimulus intensity particularly with bitemporal electrode configuration, and two ECT sessions or less per week. As current ECT clinical practice has no mandated clinical neuropsychological assessment, the FDA recommended that clinicians monitor cognitive function before the initiation of and during the ECT course. The clinical neuropsychological assessment should include both patient self-report and observer-report of cognitive function. As ECT has been found to produce transient adverse cognitive effects, the FDA proposed that the label for ECT devices include the following warning: "Warning: ECT device use may be associated with: disorientation, confusion, and memory problems."

As the guidance document is in review at this time and the FDA has invited comments from the

US community, it is unclear at this time which recommendations, if any, in the guidance document will be put into clinical practice. Given the safety and utility of ECT in patient populations where other treatments are intolerable or ineffective, the restriction of its use could prove problematic for the medical and neuropsychiatric communities.

Future Directions

Being one of the oldest, though with modern technical and practice updates, most efficacious, and relatively safe neurostimulation interventions, ECT has earned its place in the neuropsychiatric armamentarium. With the recent recommendations from the US FDA, the practice of ECT may change with new practice guidelines. Regardless of the final US FDA recommendations, future research is warranted to understand the mechanisms of action underlying the efficacy and side effects of ECT. Further, research is warranted to integrate ECT with other neuropsychiatric interventions (e.g., psychotherapy, transcranial direct current stimulation) to minimize adverse effects and maximize clinical, functional, and quality-of-life outcomes.

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Emotional Development in Old Age

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Synonyms

Emotion and emotional reactivity; Emotion regulation and emotion control; Emotional competence and emotional intelligence; Emotional understanding and cognitive-affective complexity

Definition

Affective well-being requires the frequent experience of positive emotions and the infrequent experience of negative emotions in daily life. Emotions denote fast and short-lived reactions to events that are important to an individual's well-being; these reactions can be described on different levels (physiological, subjective-experiential, and behavioral). Emotional competence includes several distinct facets, including the ability to regulate emotions, the ability to understand and make sense of own emotions, and the ability to infer and share others' emotions.

The Stability-Despite-Loss Paradox of Affective Well-Being

Affective well-being, the frequent experience of positive affect and the infrequent experience of negative affect in daily life, is a key aspect of individuals' general subjective well-being and prominent indicator of successful aging, increasingly thought to play a central role throughout the life span in a wide range of areas involved in human functioning (Kahneman et al. 1999). Perhaps one of the most important findings in psychological aging research has been that affective well-being remains relatively stable during most of the adult life span and early old age, although many individuals experience an increasing number of losses in cognitive, physical, and social domains. Prominent theories of emotional aging have suggested that this discrepancy results from older adults' high emotional competence, particularly the effectiveness of their emotion regulatory strategies (Scheibe and Carstensen 2010). In recent years, however, at least three qualifications to what has been called the stability-despite-loss paradox of subjective well-being have been reported. First, many aspects of subjective well-being, including affective components, become increasingly likely to decline during very old age beginning around age 80 (Baird et al. 2010; Kunzmann et al. 2000) and show normative decline several months or even years before individuals die (Gerstorf et al. 2010). Second, the

stability found in overall subjective well-being is not necessarily evident for all its dimensions (e.g., the frequency of sadness remains stable and even increases in very old age; Kunzmann et al. 2013). Third, certain subgroups of older individuals are at risk for low subjective well-being (e.g., individuals who have been burdened by losses that affect many life domains; Lucas 2007). These qualifications point to potential limits of emotion regulatory processes in old age and the need for theories of emotional aging that paint a balanced picture about older adults' strengths and vulnerabilities in maintaining long-term affective well-being. Before discussing relevant theoretical and empirical work on emotional aging, it might be useful to present definitions of the terms emotion and emotional competence.

Defining Emotion and Emotional Competence

Emotions have been defined as fast and short-lived reactions to events that are important to our personal goals and well-being. Emotions are manifested on different levels and typically characterized by certain cognitive appraisals, specific action tendencies, patterns of physiological activity, configurations of facial expressions, and inner feelings (Levenson 2000). Many researchers have acknowledged the importance of both positive and negative emotions for optimal functioning (Levenson 2000; Wrosch and Miller 2009). Although negative emotions may be unpleasant, they signal the individual that there is something wrong and motivate cognitive and behavioral processes that help regain a balance between the person and the environment. Seen in this light, the capacity to spontaneously react to significant and negative events with the appropriate emotion (e.g., fear to threat, anger to injustice) is an important contributor to longer-term emotional well-being. However, negative emotions may also be signs of or contributors to low affective well-being if they become chronic and decoupled from concrete and immediate causes.

Although emotions are often our best allies, helping us to respond effectively to the opportunities and difficulties we encounter, occasionally, it is necessary to regulate our spontaneous impulses and reactions. The ability to regulate positive and negative emotions has been thought to be one central aspect of emotional competence (e.g., Scheibe and Carstensen 2010). In the broadest sense, emotional competence can be understood as "work" with emotions in ways that help us to keep on track and make progress with our immediate and longer-term goals. Moreover, three different dimensions of emotional competence can be differentiated: (a) regulating emotions so that they fit situational affordances and facilitate our goals; (b) understanding and sense making of emotions, including their causes, temporal dynamics, and consequences; and (c) responding empathically to fellow humans (i.e., being able to accurately infer others' emotions, share their feelings, and experience sympathy with them). These three dimensions of emotional competence have been thought to facilitate long-term affective subjective well-being, particularly in old and very old age (Kunzmann and von Salisch 2009).

Theories of Emotional Aging

Socioemotional selectivity theory. Socioemotional selectivity theory (SST; Scheibe and Carstensen 2010; Carstensen et al. 1999) is a motivational theory of social and emotional aging that has portrayed old age as a period during which individuals are particularly motivated to shape their lives so as to maximize the occurrence of emotionally satisfying moments. More specifically, according to SST, advancing age is naturally associated with endings and a limited lifetime. As a consequence, older adults have a strong present orientation involving goals related to current feeling states, emotional meaningfulness, and satisfaction. By contrast, younger adults, who typically have an extended future time perspective, prioritize longer-term goals aimed at expanding breadth of knowledge and optimizing future resources. Thus, SST predicts that people of different ages prioritize different types of goals. As people age and increasingly perceive time as finite, they attach less importance to goals that expand their horizons and greater importance to goals from which they derive immediate emotional meaning. Obviously, younger people also sometimes pursue goals related to

meaning, just as older people pursue goals related to knowledge acquisition. However, the relative importance placed on these two types of goals is thought to change with increasing age.

In support of SST's main predictions, a large body of evidence suggests that, in comparison with their younger counterparts, older adults are more selective in their choice of social partners and prioritize familiar and close social partners over unfamiliar and emotionally less important persons (Carstensen et al. 1999). In addition, older adults report greater satisfaction and more positive experiences with members of their social networks than do younger adults. When conflicts occur, older adults typically respond with fewer negative emotions than young adults (Luong et al. 2011). Such age-related decreases in negative feelings and facial expressions during unpleasant social interactions concern particularly relationship-damaging emotions such as anger, aggression, or disgust, but not necessarily sadness (Blanchard-Fields and Coats 2008; Charles and Carstensen 2008). Also consistent with SST, in comparison to young adults, older adults seem to be more likely to appraise their partner positively during a conflict and to engage in deescalating conflict management strategies (Luong et al. 2011).

There is also substantial evidence for systematic age differences in basic affective information processing. Older adults appear to be generally more sensitive to positive information and less sensitive to negative information than young adults, a phenomenon termed the "positivity effect" (Reed and Carstensen 2012). SST states that this positivity effect results from an age-related shift in motivational states (i.e., a shift from goals related to knowledge acquisition to goals related to emotional meaning) that causes an age-related increase in the allocation of cognitive resources toward emotion regulation (Mather 2012). Given that the majority of studies interested in affective information processing have not elicited emotions or systematically manipulated emotion regulation strategies, however, the idea that "positivity effects" serve emotion regulation goals and lead to better emotional outcomes is still in need of further investigation (Isaacowitz and Blanchard-Fields 2012).

Dynamic integration theory. According to dynamic integration theory (DIT; Labouvie-Vief 2003), high longer-term subjective well-being encompasses processes of affect optimization but also processes of affect differentiation. Affect differentiation involves tolerance for and sense making of negative and ambivalent experiences and, thus, ideally results in a deeper and more complex understanding of the self, others, and situations. DIT poses that diminishing cognitive resources, particularly those referring to basic information processing functions (e.g., logical reasoning, processing speed, or inhibition), will cause a decline in cognitive-affective complexity with age. As a consequence of their increasing difficulty to make sense of negative feelings, older adults are thought to increasingly favor affect optimization over affect complexity. Indeed, cognitive-affective complexity and affect optimization may mutually inhibit one another. On the one hand, in circumstances that involve reduced cognitive resources and, thus, cognitive-affective complexity, relatively effortless processes of affect optimization may prevail. On the other hand, the more individuals "use" affect optimization and, thus, avoid or quickly downregulate negative experiences, the less likely will they be able to acquire and maintain a complex and differentiated understanding of emotionally significant phenomena that inherently encompass both positive and negative aspects. Consistent with this idea is evidence from an age-comparative study that simultaneously assessed how individuals typically deal with marital conflict and what they know about marital conflict. In comparison with their younger counterparts, older adults were more likely to avoid conflicts with their partner and, at the same time, possessed less complex and elaborated knowledge about marital conflict; age differences in conflict avoidance were negatively associated with age differences in the complexity of knowledge about marital conflict (Thomas and Kunzmann 2013). The age-related diminution in the complexity of knowledge about marital conflict is further consistent with a large number of

studies interested in cognitive-affective complexity more generally (Labouvie-Vief 2003).

According to DIT, optimal functioning involves an integration and flexible coordination of affect optimization and affect complexity (Labouvie-Vief and Medler 2002). Seen in this light, the age-related increase in affect optimization, as, for example, manifested in older adults' positivity effects or avoidance of social conflicts, is a double-edged sword: it promotes a positive affect balance in the moment, but this effect is caused by age-related decline in basic cognitive functions and, ultimately, comes at the cost of an increasingly less differentiated understanding of emotionally significant phenomena. In the long run, a one-sided strategy to optimize affect may result in lower rather than higher levels of affective well-being.

The strength and vulnerability integration model. The strength and vulnerability integration model (SAVI; Charles and Luong 2013) states that understanding age-related stability and change in affective well-being requires considering interactions between older adults' improved emotional competence on the one hand and their decreased physical reserves on the other hand. Consistent with SST, the model poses that older adults' strengths lie in their high motivation and expertise to engage in effective emotion regulation. As an extension of SST, SAVI draws attention to older adults' physiological vulnerabilities and states that these vulnerabilities may render regulating distress and other negative emotions difficult and costly. For example, age-related changes in cardiovascular and neuroendocrine systems can lead to greater blood pressure and cortisol reactions to stressors among older adults relative to younger adults. Heightened and prolonged physiological reactivity most likely impairs older adults' ability to use those emotion regulation strategies that typically would help them lower distress and regain their typical level of affective well-being. Put differently, according to SAVI, because of their physiological vulnerabilities, some older adults may not be able to successfully use their motivation- and experience-based strengths. Particularly if exposed to chronic and complex stressors with implications for multiple life domains, older adults may be at a greater risk for dysregulation and, thus, lower subjective well-being than young adults. Findings from Wrzus and colleagues (2013) are consistent with this idea. The authors found that older adults reacted with greater unpleasantness to complex and demanding stressors than their younger counterparts, but this age difference was not evident when the stressors were more circumscribed. In addition, in comparison with their younger counterparts, older adults showed reduced heart rate variability, a sign of poor physiological regulation, when they encountered complex stressors, but there were no age differences in heart rate variability when stressors were circumscribed. According to SAVI, in complex and taxing situations, age-related biological vulnerabilities come to the foreground and make it difficult for older adults to mitigate negative reactivity. Also consistent with this idea is work suggesting that older adults react to highly arousing negative stimuli with greater unpleasantness than their younger counterparts, whereas this age difference is reversed or nonsignificant if the stimuli are not particularly arousing (Streubel and Kunzmann 2011). Finally, recent research demonstrated that older adults who exhibited high levels of chronic illness were at a greater risk of experiencing sharp increases in feeling of loneliness over 8 years of study, particularly if they were unable to cope effectively with their health problems (Barlow et al. 2015). Together, the ideas put forward in the SAVI model could imply that older adults have the least benefit from their strengths when they need them most, namely, when age-related stressors and critical life events are serious and long lasting rather than mild and circumscribed.

The discrete emotion approach to affective aging. The discrete emotion approach to affective aging (DEA; Kunzmann et al. 2014) is based on a program of research conducted over the past decade (Kunzmann et al. 2013; Kunzmann and Grühn 2005; Kunzmann and Richter 2009; Kunzmann and Thomas 2014). DEA builds on the assumption that each stage in the life cycle (e.g., young adulthood, midlife, or old age) is

characterized by a specific configuration of constraints and opportunities, each residing in the environment, the person, or both (Baltes 1987; Freund 2007; Heckhausen and Schulz 1995). DEA states that these age-specific configurations can change the salience and adaptive value of particular positive and negative emotions. So far, DEA has focused on two stages in the adult life span, that is, young adulthood and old age, and posed that these two life stages are differentially associated with the salience and adaptive value of anger and sadness.

Young adulthood has been described as a phase of growth during which individuals have great opportunities to develop their potentials. Thus, processes of optimization rather than maintenance or compensation have priority in this life phase (Baltes and Baltes 1990). Young adults typically pursue many long-term goals focused on acquiring new resources, such as knowledge, information, or competencies (Carstensen et al. 1999). In young adulthood, individuals have a strong need to accomplish their goals, and perceptions of high personal control as well as a tenacious pursuit of goals are highly prevalent and closely tied to well-being (Wrosch and Heckhausen 1999). As compared to older adults, young adults also tend to be more assertive and willing to engage in social conflicts to accomplish their social goals (Luong et al. 2011).

In marked contrast, old age has been characterized as a phase during which social, cognitive, and physical resources become increasingly limited and processes of maintenance and compensation gain importance (Heckhausen and Schulz 1995; Baltes and Baltes 1990). Given the limited resources in old age, perceptions of low personal control and goal adjustment processes become increasingly frequent and adaptive in this phase of life (Wrosch and Heckhausen 1999). In addition, the awareness of a limited lifetime and the fragility of life seem to promote a tendency among older adults to relate to others in intimate and caring ways (Luong et al. 2011).

According to DEA, discrete emotions that indicate and promote individuals' progress in dealing with age-typical challenges are particularly salient, that is, easily elicited and frequently experienced. Thus, discrete emotions that indicate young individuals' progress in developing their potential and that promote tenacious and assertive behaviors in the face of obstacles should be particularly salient. Anger serves as a prototypical example: it is elicited by the appraisal that one's goals are blocked by others, triggers a reactant "moving against" state of action readiness, promotes goal persistence, and facilitates assertive behaviors (Kunzmann et al. 2014).

In old age, by contrast, discrete emotions that indicate the individual's progress in dealing with losses (including the awareness of life's finitude) and that promote disengagement from unattainable goals in socially responsible ways should be particularly salient. Sadness is a prototypical example: it is elicited by the appraisal of a situation as an irreversible loss, triggers processes of adaptive goal disengagement, and is compatible with social closeness (Kunzmann et al. 2014).

Corroborating evidence for DEA's assumptions stems from a growing body of research on multidirectional age differences in sadness and anger reactivity. Research has documented that older adults tend to react with less anger-related emotions to social conflicts than their younger counterparts (Blanchard-Fields and Coats 2008; Charles and Carstensen 2008). Age differences in sadness reactions to social conflicts, by contrast, have been shown to be reversed (i.e., higher among older adults) or nonsignificant (Blanchard-Fields and Coats 2008; Charles and Carstensen 2008). Other studies have investigated age differences in emotional reactions to nonsocial stimuli. In this line of work, older, as compared with younger, adults reported less anger in response to anger-eliciting stimuli, but equal or higher sadness in response to sadness-eliciting stimuli (Kunzmann and Grühn 2005; Kunzmann and Richter 2009; Labouvie-Vief et al. 2003; Seider et al. 2011; Haase et al. 2012). Although most of the evidence refers to age differences in subjective reactivity, at least two studies, using sad films as stimuli, reported that the often observed age-related diminution in physiological activity (Levenson 2000) was not evident in their research; that is, older adults showed similar (Kunzmann and Grühn 2005) or greater

physiological reactivity (Seider et al. 2011) than young adults. It also deserves to note that similar age differences in the experience of anger and sadness were reported in two studies measuring the frequency of emotions during the past month (Kunzmann et al. 2013) and on a typical day using the day reconstruction method (Kunzmann and Thomas 2014). Finally, there is preliminary support for possible adaptive consequences of an age-related experience of anger and sadness. A laboratory study assessing affective responses to neutral films showed that anger predicted higher long-term subjective well-being in young adulthood, but not in old age. Conversely, sadness was related to high subjective well-being in old age, but not in young adulthood (Haase et al. 2012).

Taken together, DEA addresses the role of discrete emotions in young adulthood and old age, which are two stages in the life cycle that differ markedly in terms of their profiles on at least two psychologically influential dimensions: power control (high in young adulthood and low on old age) and affiliation communion (high in old age and low in young adulthood). To the extent that discrete emotions are differentially compatible with these age-typical profiles and promote adaptive ways in dealing with the challenges and opportunities that emerge, they should also differ in their age-related salience and potential adaptive value. Anger and sadness appear to be two negative emotions that clearly differ in both power control and affiliation communion; additional discrete negative and positive emotions that could serve age-related functions most likely include fear, disgust, pride, regret, and compassion.

Age Differences in Three Facets of Emotional Competence

The remaining part of this review will focus on studies that have assessed emotional competence in vivo by using performance-based tasks. Much of what is known about age and emotional competence has been based on self-report measures. Although these measures have their strengths (e.g., they reveal people's beliefs and judgments about how they deal with emotions), they are likely influenced by impression management strategies (people may be hesitant to describe themselves as emotionally incompetent), introspective limits (do we know how emotionally competent we are?), and implicit aging theories (if older people believe that individuals should become better at regulating their emotions as they age, they are likely to say that they do so). This is why we consider approaches that study emotional competence under standardized conditions and use performance-based tasks.

Emotion regulation. Relatively few laboratory studies have investigated age differences in emotion regulation in vivo. In these studies, younger and older adults have been instructed to regulate their emotional reactions (e.g., subjective feelings or facial expressions) before or while they were presented with emotion-evoking stimuli. The effectiveness of emotion regulatory attempts was operationalized as the difference in emotion reactivity during no-regulation versus regulation conditions. The theoretical framework for most of these studies has been provided by Gross and colleagues' process model of emotion regulation (Gross 1998). This model describes how different types of strategies aimed at regulating one's emotions are used before, during, and after exposure to a negative event. Anticipatory strategies such as attentional deployment or cognitive reappraisal have been shown to be more effective than response-focused strategies (e.g., behavioral suppression). In fact, the latter strategies have more circumscribed effects and may even be associated with physiological costs.

With respect to age differences in emotion regulation, several studies have shown that older and younger adults are similarly successful at reducing outward expressions of emotion (Kunzmann et al. 2005; Phillips et al. 2008). As to cognitive forms of emotion regulation, a growing number of studies indicate that older adults' regulatory strengths are associated with their use of strategies that are relatively effortless. For example, older adults are more successful at using positive reappraisal compared to younger adults, but are less successful at using detached reappraisal (Shiota and Levenson 2009). In positive reappraisal the individual attends to the emotional aspects of a situation and attaches a positive

meaning to these aspects; in detached reappraisal the individual thinks of the situation in a neutral or rational manner. Given that positive reappraisals keep one's focus on the emotional aspects of the situation, it arguably is less cognitively demanding than detached reappraisal that requires a person to ignore all emotional aspects. Consistent with this assumption, research has demonstrated that detached reappraisals have higher cognitive costs than other major emotion regulation strategies, such as distraction (diverting attention from an emotional situation; Sheppes and Meiran 2008). Corroborating the idea of age-related gains in cognitively undemanding emotion regulation strategies, older adults were better at using distraction (think about a positive memory) while watching negative film clips than young adults (Phillips et al. 2008). Studies interested in age-related positivity effects in attention to positive and negative stimuli also deserve note. Evidence from these studies suggests that temporarily decreasing cognitive resources through dual-task paradigms eliminates older adults' tendency to focus on positive stimuli and/or avoid negative stimuli. Although these studies have not elicited emotional reactions or instructed certain emotion regulation strategies, they provide evidence for the idea that even age-related gains in arguably less effortful processes of emotion regulation require a certain amount of cognitive resources (Mather 2012).

In sum, the reviewed evidence suggests multidirectional age differences in emotion regulation. While the effectiveness of some strategies may increase with age (positive reappraisal, attentional deployment), the effectiveness of other strategies remains stable (behavioral suppression) or declines (detached reappraisal). At first sight, this performance-based evidence is at odds with results from self-report studies, indicating that older adults believe that they are generally more effective in regulating their emotions than younger adults (Kunzmann et al. 2005). However, to the extent that older adults use strategies that work for them and avoid strategies that are more effective for young adults, overall gains in emotion regulation competence could be observed among older adults. Future research is needed to investigate the idea that age is associated with an increasingly selective choice of those emotion regulation strategies that rely on intact resources (Urry and Gross 2010).

Empathy. Empathy is fundamental to building and maintaining satisfying social relationships and an important source of prosocial behavior (Davis 1994). Given the importance of social and emotional goals among older adults (Carstensen et al. 1999), empathy may also be among the most influential predictors of successful aging and particularly affective well-being.

There is broad agreement that empathy is a multidimensional concept that involves both cognitive (e.g., the ability to accurately infer another's emotions) and affective (e.g., the ability share another's feeling and to feel sympathy for him or her) dimensions (Davis 1994). Age-comparative work on empathy underscores the usefulness of this distinction, by showing that cognitive and affective facets of empathy exert multidirectional age differences: while the ability to accurately infer others' emotions seem to decline with age (Ruffman et al. 2008), affective facets have been shown to remain stable or to increase with age (Richter and Kunzmann 2011; Sze et al. 2012b). Although the underlying mechanisms for these multidirectional age differences have to be further investigated, it is likely that the age-related decline in empathic accuracy is due to parallel age-related declines in basic cognitive resources, such as logical reasoning, processing speed, or inhibition (e.g., Richter et al. 2010; Wieck and Kunzmann 2015). Emotional congruence and sympathy arguably rely less on such cognitive resources and are more dependent on age-friendly automatic and effortless processes related to certain forms of emotion regulation.

Much of the work interested in age differences in the cognitive facets of empathy relied on tasks that require individuals to recognize emotions depicted in decontextualized facial, vocal, or written material. Isaacowitz and Stanley (2011) considered it possible that such tasks systematically underestimate older adults' empathic accuracy, which may be particularly dependent on the contextual richness of a task. For example, Sze and colleagues (2012a) reported that age-related

decline in emotion recognition was less visible if the tasks were based on dynamic, genuine, and contextualized stimuli. A problem with this interpretation is, however, that the authors' contextualized tasks required participants to make overall judgments of valence rather than specific judgments pertaining to the intensity of discrete emotions. Thus, the absence of age deficits may be due to the lower difficulty level rather than the contextual richness and ecological validity of the task. In fact, an earlier study, manipulating contextual richness and keeping the rating part of the task constant across conditions, suggested that contextual richness does not moderate age differences in empathic accuracy (Richter et al. 2010). In addition, there is evidence suggesting that the negative effect of emotionally incongruent contextual information on empathic accuracy becomes greater with age (Noh and Isaacowitz 2013). Thus, the current evidence speaks against the idea that age deficits in empathic accuracy vanish in ecologically valid tasks. In order to demonstrate what older adults can do under ideal conditions, additional factors need to be taken into consideration. Recent work suggests that task motivation is a promising candidate. With the presence of a strong task motivation, older adults have been shown to perform equally well in empathic accuracy tasks as young adults (Richter et al. 2010; Wieck and Kunzmann 2015). This evidence is consistent with the selective cognitive engagement model, stating that older adults become increasingly selective as their cognitive resources decline and that selective resource allocation is a key to maintaining performance in situations that are particularly meaningful and relevant (Hess 2014).

In sum, the current evidence for age and empathy suggests multidirectional age differences. Overall, older adults appear to have greater difficulty in inferring other people's emotions, but emotional congruence and sympathy remain stable or even increase. Several researchers have discussed the question of whether older adults' deficits in empathic accuracy have implications for the quality of their social relationships and ultimately their long-term affective well-being (Isaacowitz and Stanley 2011). Although this may be the case, two findings may contradict this possibility and deserve note: (a) age deficits in empathic accuracy seem to not occur in contexts that are personally relevant to older adults and (b) relatively stable and high levels of emotional congruence and sympathy may compensate for potential weaknesses in empathic accuracy.

Emotional understanding. Evidence for age differences in emotional understanding primarily stems from research by Labouvie-Vief and her colleagues. More specifically, the authors repeatedly investigated cognitive-affective complexity in several studies with individuals aged 10–80 (and older) using cross-sectional and longitudinal designs (Labouvie-Vief 2003). In some of these studies, the authors asked their participants to think aloud about situations in which they felt particular emotions (e.g., anger, fear, happiness) or about their self and relations to significant others. The answers were transcribed and later evaluated by independent raters with a coding scheme based on four levels of cognitive-affective complexity (Labouvie-Vief et al. 1989). In this scheme, a high level of cognitive-affective complexity is represented by a tolerance for negative and conflicting feelings, a clear differentiation between own and others' feelings, a deep understanding of the dynamics and causes of emotions, and an appreciation of the uniqueness of individual experiences. Findings consistently suggest that cognitive-affective complexity increases during adolescence and young adulthood, peaks in early midlife, and begins to decline during late middle adulthood (Labouvie-Vief 2003; Labouvie-Vief and Medler 2002; Labouvie-Vief et al. 1989). To the extent that cognitive-affective complexity contributes to individuals' optimal functioning, its age-related decline needs to be considered a risk factor for low long-term affective well-being.

Conclusions

Empirical and theoretical work interested in emotional aging documents a complex picture of the

nature of emotion in old age. Older adults' strengths seem to lie in their ability to proactively shape their lives so as to avoid a great number of stressors and negative events. If such events cannot be avoided, older adults appear to be particularly motivated to downregulate the negative implications of problematic circumstances. As long as these events are relatively circumscribed and mild, older adults can take full advantage of their motivation and expertise-based strengths. However, regulatory problems may occur if the stakes are high or when older adults experience the onset of severe age-associated cognitive and physiological vulnerabilities. It is also evident that age differences in emotional reactivity are multidirectional – even if older adults typically experience a variety of negative emotion less often and with less intensity, certain negative emotions, such as sadness, directly relate to the age-relevant theme of loss and increase with age in salience. The functional implications of this enhanced emotional reactivity in particularly taxing and/or loss-related situations are largely unknown and need further investigation.

Across three domains of emotional competence, it became evident that those abilities that require cognitive resources (certain strategies of cognitive emotion regulation, empathic accuracy, or cognitive-affective complexity) cannot be considered a particular strength among older adults. By contrast, age-related gains have been documented in emotional competencies that rely on relatively effortless and automatic processes, such as positivity effects in attention and memory, the sharing of others' feelings, positive reappraisals of stressful events, or behavioral strategies to avoid certain negative experiences preemptively. To the extent that older adults can selectively optimize those competencies that rely on available and relatively intact resources, we can expect to observe age-related gains in emotional competence and ultimately long-term affective well-being. However, as of yet, whether the predominant theme of emotional aging is one of gain or loss cannot easily be determined, and multi-sided views of emotional aging are needed as they are most useful in reaching an accurate and comprehensive answer.

Cross-References

- ▶ Emotion–Cognition Interactions
- ▶ Life Span Developmental Psychology
- ▶ Motivational Theory of Lifespan Development
- ▶ Positive Emotion Processing, Theoretical Perspectives
- ▶ Selection, Optimization, and Compensation at Work in Relation to Age
- ▶ Social Cognition and Aging
- ▶ Socioemotional Selectivity Theory
- ▶ Strength and Vulnerability Integration

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Emotion–Cognition Interactions

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Synonyms

Cognition = thinking, reasoning, memory; Emotion = affect, mood, feelings; Emotion–cognition interplays; Emotion–cognition links

Definition

Emotions influence cognitive processes such as memory and reasoning, but also cognitive appraisals and control processes are important in our experience of emotions. Emotion–cognition interactions are the interface between these different aspects of mental experience.

While cognitive and affective psychology have long been considered as two relatively independent subareas in aging research, there has been a recent surge of interest in investigating the interaction between cognition and emotion. While many cognitive functions decline with age, emotional abilities remain intact and may even improve across adulthood. These different developmental trajectories raise a number of important questions. Does intact emotional processing enhance aspects of cognitive processing in older adults? Is age a potential moderator of cognition–emotion interactions? Do emotional processes place different loads on cognitive function in younger and older adults? The present essay will present research on emotion–cognition interactions in aging from different perspectives. First, the socioemotional selectivity theory (Carstensen 2006) will be introduced, and it will be described how valenced task material and current mood states influence cognitive performance in younger and older adults. Second, age differences in the involvement of cognitive control in dealing with emotional challenges are discussed. Finally, age differences in specific functions combining cognitive and affective processes will be considered. The essay ends with a conclusion and brief outlook.

Socioemotional Selectivity Theory and Effects of Emotional Task Material on Cognition in Younger and Older Adults

The idea that cognition–emotion interactions may be influenced by adult aging has been suggested by theories from lifespan developmental psychologists, providing the conceptual framework for the majority of empirical work. The most

prominent framework is the *socioemotional selectivity theory*, a lifespan theory of motivation, which assumes that the subjective sense of remaining time has profound effects on basic human processes, including cognition and emotion (Carstensen 2006). More precisely, when time is perceived as open ended as in youth, gathering information, experiencing novelty, and expanding breadth of knowledge are prioritized goals. When time is perceived as constrained, as in old age, goals tend to emphasize current feelings and emotion states, particularly regulating emotional states to optimize psychological well-being in the moment. As people age and increasingly perceive time as finite, the theory predicts that they ascribe greater importance to goals from which they derive emotional meaning. The age-related shift in goal priorities should effect cognitive functioning, as it changes the focus of attention and memory.

Socioemotional selectivity theory predicts that older adults should favor processing of information likely to maintain or enhance well-being, which will often mean a bias toward positive information. This hypothesis motivated many studies manipulating the emotional valence of cognitive task material. Results often showed an age-related increase in the preference for positive over negative information in attention and memory, the so-called positivity effect. A clear age-related shift in emotion–cognition interactions was confirmed by a recent meta-analysis (Reed et al. 2014), which showed that younger adults tend to show a negativity bias: that is preferential processing of negative over positive material, while older adults show instead a positivity bias. The majority of the studies reported look at age differences in memory for positive and negative information, finding that older adults remembered more positive information than negative, while younger adults showed the opposite pattern of bias. However, this review combined studies which varied substantially in the tasks used to look at emotional biases, and the authors point out the importance of testing for possible moderators. They found that age-related positivity biases are strongest when the memory task does not impose specific instructions on encoding, for example, in incidental learning tasks where participants do not know that their memory will subsequently be tested.

Another moderator of age changes in emotional biases suggested by a second meta-analysis (Murphy and Isaacowitz 2008) is type of cognitive task assessed. Specifically, memory paradigms yielded overall stronger effects than attention paradigms, and within memory measurements, emotional effects in older adults were stronger in recall paradigms compared to recognition paradigms. While most studies examined emotion effects on retrospective memory for past events, some recent studies have looked at whether emotion influences age-related differences in prospective memory, which is the creation and enactment of an intention, such as remembering to attend an appointment at a specific time. For example, age differences in the influence of positive and negative compared to neutral target cues indicating the right moment to initiate an intended action on its correct fulfillment have been examined (Schnitzspahn et al. 2012). Results did not support a specific positivity bias in old age but instead indicated an age-related emotional salience effect: older adults were better at carrying out the intention in response to both negative and positive words compared to neutral. Similar findings from other studies of age–emotion interactions in prospective memory, using different tasks and materials, support the idea of enhanced emotional salience for both positive and negative material in remembering intentions in old age.

These findings underline the importance of examining valence effects across different cognitive abilities to test the generalizability of the positivity effect. Information processing and encoding may be influenced differently by emotion valence depending on the specific requirements of the examined cognitive function. Besides task type, general cognitive resources seem to play a critical role in the positivity effect (Reed and Carstensen 2012). The positivity effect emerges when resources are relatively available and undivided but is absent when resources are rather poor or divided. Further, positivity emerges during controlled stages of information

processing, but not for relatively automatic processing. These findings led to the conclusion that positivity reflects top-down motivational controlled cognition in older adults that can be influenced by situational and contextual factors (Reed and Carstensen 2012).

The Influence of Mood States on Cognition in Younger and Older Adults

Research motivated by the socioemotional selectivity theory examined emotion–cognition interactions by experimentally manipulating the valence of the task material and its influence on cognitive performance in the respective task, while the participants' mood is assumed to be neutral. A second line of research addresses emotion–cognition links by using neutral cognitive task material after inducing a positive or negative mood and compares subsequent performance to a neutral mood condition. Thus, the emotional state of the participant instead of the valence of the task material is varied. These manipulations are of interest because it is known that mood states can influence cognitive performance in younger adults: for example, being induced into a positive or negative mood may cause more heuristic processing, which can improve performance on some creative tasks but impair performance on constrained tasks which demand concentration and detailed processing. Only very few studies examined age-by-mood interactions in influencing cognitive performance. In general, two possible but contradictory outcomes can be predicted. On the one hand, age effects in cognition may be exacerbated when participants have to deal with a cognitive task and an acute mood state in parallel. As suggested by the socioemotional selectivity theory, older adults are assumed to focus on the regulation of their emotional state which may compete with the ongoing cognitive activity and requires processing resources which are already limited in older adults. On the other hand, dealing with emotions may be a better practiced, more streamlined process in old age. Accordingly, older adults may automatically and more effectively regulate their emotions during mood induction than the young, resulting in less impairment in a cognitive task following a mood induction. This could lead to reduced age effects in positive/negative mood conditions compared to neutral ones. Also, in line with widely reported positivity biases, there might be different effects of positive and negative mood states in old age.

Results to date have been mixed and indicate that age differences in the effect of mood on cognition may be influenced by task demands. It has been found that negative mood disrupts older, but not younger, adults' planning performance (Phillips et al. 2002) but fails to influence either age groups recall memory performance (Emery et al. 2012) or working memory (Scheibe and Blanchard-Fields 2009). In contrast, negative mood impaired the performance of delayed intentions in younger but not older adults (Schnitzspahn et al. 2014). Concerning positive mood, an impairing effect on planning in younger adults was found (Phillips et al. 2002), which was even more pronounced in older adults. Furthermore, positive mood exacerbated false memories in older but not younger adults, whereas correct recall was not influenced (Emery et al. 2012). In contrast, the performance of delayed intentions was impaired under positive compared to neutral mood in younger but not older adults (Schnitzspahn et al. 2014). Thus, results range from reduced age effects of mood state on cognition to no age differences in mood–cognition interactions and to exacerbated age-related mood effects on cognitive performance.

The studies outlined above differed in the nature of mood manipulations used and cognitive tasks investigated. Clearly the understanding of how mood and cognitive functioning interact in aging is still in its infancy, and more research is needed to better understand age differences in mood effects on cognitive performance. More information is needed, through specific task manipulations on the pattern of age differences in mood–cognition interactions. It is possible that the interaction is similarly moderated by measurement type and cognitive resources as the positivity effect. Depending on the brain areas

associated with different cognitive functions and their overlap with the brain regions required during emotion regulation, cognitive performance in tasks measuring the respective functions may be more or less influenced. Besides qualitative differences between cognitive tasks, quantitative differences in their difficulty and hence requirement of cognitive resources may also influence mood effects. Relatively easy cognitive tasks may still be performed well under certain mood states, while performance in difficult tasks should be disturbed. However, task type and difficulty cannot explain the differential age effects observed in some of the studies described above. The most promising candidate here may be age benefits in emotion regulation processes which will be presented in more detail in the following section.

Aging, Cognition, and Emotional Skills

The first part of this review focused on the influence of emotional factors (i.e., valence of the task material and mood) on cognitive performance and thus considered emotions as one possible factor influencing cognition in general and age differences in cognitive performance in particular. However, emotion–cognition interactions have also been examined in the field of emotional aging. The main research questions in this area are the lifespan development of emotional skills and the involvement or necessity of cognitive resources. The following paragraphs will focus on emotion regulation and emotion recognition, their development in aging, and the role of cognition.

Emotion regulation skills are involved in monitoring and controlling our inner experience of emotional states. There is substantial evidence of age-related improvements in emotion regulation skills to downregulate negative affect and promote positive affect (Kryla-Lighthall and Mather 2009). As already briefly mentioned above, successful emotion regulation requires active use of cognitive control strategies or executive functioning and leads to an attentional shift toward one's emotional state and away from other ongoing activities. Given reported age benefits in emotion control, it has been suggested that emotion regulation could be less costly in a cognitive sense in older adults compared to younger ones as they have more experience, and therefore emotion regulation may become more effectively and automatized. This prediction was tested (Scheibe and Blanchard-Fields 2009) by asking younger and older adults to perform a working memory task after a neutral or a negative mood induction. Importantly, instructions were varied between participants in the negative mood group. Some participants were asked to try to maintain the intensity of their negative feelings, while others were asked to change the negative feelings as fast as possible into positive ones. While the instruction to regulate the negative mood after its induction did not affect older adults' performance in the subsequent working memory task, it impaired the performance among the young. This occurred despite evidence of a strong mood induction in both age groups and successful ability to follow emotion regulation instructions in both groups. This finding indicates that intentional downregulation of negative emotions may be less costly in older age. Indeed, the allocation of cognitive resources needed to effectively regulate emotions seems to vary by age.

Another research question that has attracted attention concerns cognitive mechanisms underlying differences between younger and older adults' emotion regulation and their predictive value for mood outcomes. Specifically, it has been suggested that age-related positivity effects in attention and memory that has been described above actually reflect motivated cognition operating in the service of emotion regulation (Isaacowitz 2012). Focusing on positive information while paying less attention to or remembering fewer negative aspects of stimuli could plausibly help to achieve or maintain well-being. This hypothesis has been addressed in several studies using eye tracking in order to examine differences between younger and older adults in visual attention to emotional material. Their findings show a greater preference for "positive looking" in older adults, resulting in a viewing behavior toward positive and away from negative material (Isaacowitz 2012). These age differences in

preferences have been replicated using different materials and seem strongest when participants are in negative mood state or are explicitly instructed to regulate their emotions. Positive looking has been found to help some older adults regulate their mood, but these effects were moderated by individual differences in attentional abilities. Thus, older adults with good attentional abilities were able to use attentional deployment in the form of positive looking to successfully regulate their mood. These findings confirm that positivity effects reflect top-down processes requiring cognitive resources when used to regulate their emotions by older adults.

Another important emotional skill is the ability to recognize the emotions of others. We use nonverbal cues from facial expressions, vocal tone, and body posture to decide whether other people are angry, sad, or happy. Meta-analyses on age effects in emotion recognition suggest an overall age-related decline (Ruffman et al. 2008). This finding is true across modalities (faces, voices, bodies/contexts, matching of faces to voices) and different basic emotions (anger, sadness, fear, surprise, happiness). Some emotions (anger and sadness) and some modalities (face–voice matching) create particular difficulties, while a trend for older adults to be better than younger adults at recognizing disgusted facial expressions was reported. It has been suggested that general cognitive decline might account for the age-related changes in emotion recognition. However, this seems unlikely because the pattern of age effects did not match the difficulty levels of the emotions, as younger and older adults showed difficulties in different emotions.

Reviewing the literature, the authors (Ruffman et al. 2008) conclude that there is no consistent evidence that general cognitive decline accounts for older adults' pattern of emotion recognition difficulties. Instead, it is suggested that specific neuropsychological changes in frontal and temporal volume and neurotransmitters may cause the observed age-related impairments (Ruffman et al. 2008). Interestingly, a positivity effect in terms of absent or reduced age effects in labeling positive emotions and clear age impairments when recognizing negative emotions could not be confirmed in emotion recognition. It seems that older adults do not profit from their benefits in emotion control and their strong motivational focus on emotions and well-being in this specific domain. Recent studies indicate that older adults' poorer performance in recognizing emotions may be ameliorated by manipulations which improve the ecological validity, personal relevance, or motivational context of emotion recognition tasks. For example, it has been reported (Sze et al. 2012) that age-related declines in recognizing emotions from traditional stimuli such as photographs of facial expressions are reversed to result in age-related improvements when rating emotions online using more naturalistic stimuli, in this case videos of dyadic interactions which included contextual information.

Functions Combining Cognitive and Emotional Aspects and Their Development in Aging

After considering the influence of emotional factors on cognition and the involvement of cognitive factors in emotional abilities, the final section will present the development of empathy and wisdom in aging. Both constructs involve cognitive and affective processes and thereby allow the study of emotion–cognition interactions and possible age differences within the same ability.

Empathy requires the cognitive understanding of another person's feelings as well as an appropriate affective response. The latter concerns the affective facet of empathy that comprises the degree to which one shares the feelings of another person and the capacity to experience and express sympathy or emotional concern. Results concerning age differences in empathy are mixed but suggest differential age effects for the different components. As reviewed above, older adults are often reported to perform worse than young on tasks of emotion recognition, which can be considered part of cognitive empathy. However, these age effects may depend on the motivational nature of the task. In one of the few experimental studies to directly look at age differences in cognitive and affective aspects of empathy within the same

paradigm (Richter and Kunzmann 2011), age effects in understanding another person's emotional state (cognitive empathy) were no longer observed when the person was talking about a topic of high relevance to older adults. Concerning the affective facets of empathy, older adults' competencies remain stable or even improve across adulthood: older adults report and express greater sympathy for others than younger adults (Richter and Kunzmann 2011). Taken together, cognitive facets of empathy may be more vulnerable to age-related decline than emotional facets. Accordingly, age differences in empathy may vary between studies depending on the type of measurement used and in how far it focuses more on the cognitive or affective facet.

Wisdom integrates several facets in terms of psychological functioning. The deep insight into self, others, and the world comprises the cognitive facet. Complex emotion regulation allowing the tolerance of ambiguity represents the emotional facet. The assumption of a positive association between wisdom and age is very common in the general population as experience cumulates with age, although most people consider old age as neither necessary nor sufficient for wisdom (Staudinger and Glück 2011). Empirical findings can be distinguished according to the type of wisdom measured. *Personal wisdom* refers to individuals' insight into their selves and their own lives and describes an ideal end point of personality growth. This approach is based in the tradition of personality research and mostly uses self-report measures. Studies do not report a linear positive relationship between personal wisdom and age and sometimes even observed negative relations (Mickler and Staudinger 2008). Declining cognitive resources may make abstract thinking, which is required to satisfy some wisdom criteria such as self-relativism, more difficult for older adults. In addition, lower levels of openness to experience and societal restrictions of growth opportunities in old age may hinder the further development of self-insight.

General wisdom describes individuals' insights into life in general. Approaches to the empirical study originated from cognitive research and are performance based. They have a strong connection with an expertise approach but expand classical cognitive ability measures by including emotional and motivational aspects. In a typical paradigm, participants are presented with difficult and existential life problems and are asked to give advice. Responses are recorded and evaluated according to prespecified wisdom criteria. In general, older adults perform as well as younger adults in such tasks. Age benefits were observed on typical dilemmas of old age and when age has been combined with wisdom-related experiential contexts (e.g., professional training as clinical psychologist), while younger adults performed better on typical dilemmas of young adulthood (see Staudinger and Glück 2011 for an overview). Performance is best predicted by measures located at the interface of cognition and personality, such as a judicial creativity and moral reasoning, but not by fluid and crystallized intelligence or personality alone. The different age effects found depending on the measurement type assessing wisdom suggest that required cognitive resources may play an important role. Negative age effects may arise when measures heavily relying on complex cognition are used, while no age effects or even benefits can be expected in tasks allowing older adults to make use of knowledge and heuristics about life problems acquired through experience and practice.

Conclusion and Outlook

Younger and older adults differ in the way that emotion and cognition combine. The empirical findings summarized above all seem to support the claim that age moderates emotion–cognition interactions as age differences were the rule rather than the exception. Importantly, many studies observed age benefits which may seem surprising given the general cognitive decline accompanying aging. Better emotion control and a strong focus on emotional well-being in older adults seem to make it easier for older adults to work on tasks requiring cognitive and emotional processes. Older adults seem to profit more than young from valenced task material, are generally cognitively less impaired by current mood states, and

are superior in emotion regulation skills: indeed emotion regulation seems less cognitively demanding for older people than young. Other age-related benefits include good performance in tasks requiring complex abilities such as empathy or wisdom, when the tasks allow them to use their emotional strengths and knowledge. These findings are very encouraging, as they show how motivational and emotional strengths can be used to compensate for age-related cognitive decline. However, there is clearly a limit for compensation, and as mentioned in several examples above, age benefits diminish or turn into age-related impairments when the (cognitive and emotional) tasks get too difficult or older adults do not have sufficient cognitive resources available. This pattern is predicted by the *dynamic integration theory* (e.g., Labouvie-Vief et al. 2014), which emphasizes that emotional gains in old age may be reversed where the demand on available information processing is exceeded. For example, older adults show greater interference between mood states and cognition where the cognitive task is very demanding, and older adults perform worse than young when decoding other people's emotions in situations devoid of context. Accordingly, recent conceptual developments build on the socioemotional selectivity theory and expand it by defining the limits of age benefits. Two of them will be outlined in the following.

The *cognitive control framework of aging and emotional well-being* (Kryla-Lighthall and Mather 2009) posits that older adults will experience emotional enhancement to the extent that they are capable of exerting cognitive control to direct attention and memory in ways that help satisfy emotional needs. Thus, cognitive control is suggested as the key mechanism underlying the transformation of age differences in goals into differences in emotional well-being. In line with the socioemotional selectivity theory, it is argued that cognitive control as an emotion regulation tool becomes increasingly useful with advancing age as emotional well-being becomes more important. However, the theoretical framework also describes limitations of age-related changes caused by neural structures. While the amygdala, considered as the primary affective appraisal structure, remains stable with age, emotion and cognitive control regions of the brain including the prefrontal cortex deteriorate significantly. First findings suggest that healthy older adults can still maintain their emotional well-being to some extent by recruiting additional cognitive resources and thereby compensate for their losses by exerting more cognitive effort (Kryla-Lighthall and Mather 2009).

The theoretical *model of strength and vulnerability integration* (Charles and Luong 2013) adopts a broader, more applied perspective. In line with the socioemotional selectivity theory, it suggests that across adulthood, expertise and motivation to regulate one's emotions increase. However, it is further suggested that certain situations that increase in prevalence with age (i.e., social isolation, neurological dysregulation, and chronic stress) preclude the use of these emotion regulation strategies on a daily level. It is further argued that these situations will lead to equal or even lower levels of emotional well-being and greater physical consequences in the cardiovascular and the neuroendocrine systems in older compared to younger adults as a result of their physiological vulnerabilities.

To sum up, while old age is often characterized as a period of cognitive decline, there are also emotional gains during this time of life. Older adults are better at using their emotions to focus cognitive resources on the key aspects of a situation which will enhance mood. Older adults are also good at effectively and efficiently regulating their emotions in a way which might mean less impact of mood fluctuations on cognitive performance. These skills of managing emotions and cognition likely have positive impact on well-being in old age.

Cross-References

- ▶ Age-Related Positivity Effect and Its Implications for Social and Health Gerontology
- ▶ Cognitive Control and Self-Regulation
- ▶ Cognition
- ▶ Emotional Development in Old Age
- ▶ Memory, Episodic

- ▶ Positive Emotion Processing, Theoretical Perspectives
- ▶ Prospective Memory, New Perspectives for Geropsychological Research
- ▶ Socioemotional Selectivity Theory
- ▶ Psychology of Wisdom

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Employee Green Behavior and Aging

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Synonyms

Organizational citizenship behavior toward the environment; Organizational environmental sustainability; Proenvironmental behavior

Definition

Older employee behavior performed at work, either voluntarily or as required by an organization, that contributes to the preservation of the natural environment by reducing harm to, or strengthening, the ecosystem.

Employee Green Behavior at Work and Aging

Environmental sustainability is emerging as a driver of human activity in the twenty-first century. Evidence of this can be seen in global emissions targets and the investment in technology intended to enable societies to grow without compromising the natural environment or jeopardizing the livelihood of future generations (World Commission on Environment and Development 1987). It is likely, however, that to forestall or avoid the worst effects of human activity (anthropogenic climate change), human activity itself will need to change (Ones and Dilchert 2012).

Scientific evidence points to human economic activity as the key driver of environmental degradation (Ones and Dilchert 2012). Many organizations and industries have therefore taken it upon themselves to address their role and to attenuate their negative environmental impact while at the same time accentuating their positive impact (Robertson and Barling 2015). When we consider the amount of time many people spend at work throughout their lives (Terkel 1974), organizational efforts to increase employee activity that contributes to environmental sustainability (i.e., employee green behavior; Ones and Dilchert 2012) might well be a vital cog in the machinery of a sustainable society.

Environmental sustainability is one of several significant issues with implications for organizations. In addition to economic activity, climate change is also being driven by changes in global population (Intergovernmental Panel on Climate Change: 2014). In this regard, a contemporaneous issue facing many countries is an aging population, caused by increased longevity, a decline in fertility, and the procession of the baby boomer bulge into old age (McDaniel and Zimmer 2013). According to the Bureau of Labor Statistics (2015), over 67 million employees in the United States are aged 55 or over, representing approximately 43% of the total labor force. Looking to the future from a more global perspective, Kuenen et al. (2011) estimate that the dependency rate (number of people over 65 per 100 workers) will double from 12% in 2010 to 25% in 2050 as the baby boomers exit the workforce. Organizational success in the twenty-first century will be determined in part by the ability of organizations to respond effectively to significant issues (Ones and Dilchert 2012), such as environmental sustainability and an aging population. The focus of this entry is to integrate research on aging and employee green behavior and provide insights into whether or not employees become greener as they gray.

How Are Aging and Environmental Sustainability Interrelated?

As should be expected with concurrent issues of such magnitude, the issues of an aging population and environmental sustainability are interrelated. On the one hand, climatic changes pose health risks for older people – who are more vulnerable to changes in the environment. For example, research has shown that periods of extreme heat are associated with increased mortality rates among the elderly (Åström et al. 2011). Moreover, and as the Intergovernmental Panel on Climate Change (2014) has now established, periods of extreme heat are likely to become both more frequent and more extreme in future years.

At the same time, the members of an aging population and workforce have evolving needs (e.g., mobility, health; Klein et al. 2012) that place increased demands on natural resources, thereby incurring environmental costs. Although there is reason to believe that an individual's overall CO_2 emissions should decrease slightly above the age of 65 (Zagheni 2011), there are three additional important considerations that need to be appraised and that bring into question these presumptions.

First, the business sector uses considerably more energy and produces vastly more waste than the domestic sector (Davis and Challenger 2011). As a consequence, workplace activity is going to be the largest contributor to global emissions and a significant contributor to employees' carbon footprints (Goodall 2010). Second, governments are raising retirement ages to cope with the financial burden of supporting such a large cohort (Hertel and Zacher 2016). Third, while

overall emissions may trend downward, they are still expected to remain well above the minimum threshold (5.5 t per person) that MacKay (2009) suggests is necessary to avoid a worst-case scenario (i.e., concentration of CO_2 in the atmosphere exceeding 450 parts per million, which is associated with a 2 °C increase in average global temperature; Intergovernmental Panel on Climate Change: 2014).

With these issues in mind, and taking into account that many employees today work beyond what was once accepted as the traditional retirement age (65 years; Hertel and Zacher 2016), it seems reasonable to conclude that estimates of individuals' emissions decreasing after age 65 might not be as robust as currently thought. Moreover, even in the event that estimates of declining emissions after the age of 65 turn out to be correct, any decreases (while nominally positive) would be superficial because it would still exceed the proposed per person threshold for emissions by some 200% (Mackay 2009). In acknowledgment of the contribution of workplace activity to greenhouse emissions, and assuming that the longer a person works, the larger their own carbon footprint, the question of how an aging workforce engages with environmental sustainability becomes vitally important. We next provide an overview of the current state of research in relation to this question.

Employee Green Behavior

Employee green behavior refers to individual actions in the workplace that contribute to environmental sustainability (Ones and Dilchert 2012). The need to define these behaviors in the context of the workplace arises because of the extent to which an individual has autonomy over his or her behavior. Whereas the decision to be environmentally friendly at home is largely volitional and driven by psychological (i.e., person) factors (Bamberg and Möser 2007), in the workplace it may be either encouraged or discouraged by social norms, expectations, and task demands (Ones and Dilchert 2012). Ones and Dilchert (2012) indicate that as much as 29% of green behavior at work is required by the organization. Considering the normalization of organizational environmental sustainability through increased social, regulatory, and normative pressure (Klein et al. 2012), it is likely that companies will increasingly embed green behaviors into employees' required tasks. Accordingly, reviews on green behavior at work have a focus on constructs and processes unique to the workplace.

In response to an increase in organizational and academic interest in environmental sustainability (Ones and Dilchert 2012), several researchers have conducted reviews of employee green behavior (e.g., Norton et al. 2015). These reviews document the role of contextual factors such as policies and goals and person factors such as environmental attitudes and perceived green organizational climate in the green behavior of workers in general.

Employee Green Behavior Among Older Workers

Although our understanding of aging and workplace behavior in general is relatively mature (Hertel and Zacher 2016), the impact of aging on employee green behaviors is in its infancy. Although the aforementioned reviews on employee green behavior have not investigated age specifically, subsequent analysis of the studies included in the largest and most recent review (Norton et al. 2015) does serve to highlight relationships between age and employee green behavior. Broadly, these studies form four categories: (1) report the effects of age, (2) control for age but do not report any effects, (3) report age as a demographic variable, and (4) do not measure age. Of the 69 studies included in the review, the majority (37) fell into the fourth category, while 13 fell into the third category and 3 are included in the second. Moreover, of the 16 studies that did report effects, findings were mixed. Nine studies reported no relationship between age and employee green behavior, two reported negative effects, and five reported positive findings. It should be noted, however, that most studies report bivariate correlations only. In short, there seems to be a lack of evidence regarding the specific relationship between age and green behavior in the workplace.

Why Employees Might/Might Not Become More Green as They Gray

In light of a paucity of data from which to draw conclusions about aging and employee green behavior, it is necessary to consider explanations for how these two constructs might relate based on data from related areas. The following positions are drawn from the broader literatures on aging, general work behavior, and green behavior at home.

Arguments for a Positive Relationship

On the one hand, there is evidence that environmental values strengthen as people age, and green behaviors at home therefore become more prevalent (Whitmarsh and O'Neill 2010). In this regard, stronger environmental attitudes in older people may be explained from a cohort perspective. Research suggests that environmental attitudes (as a predictor of employee green behavior; Norton et al. 2015) are relatively stable after early adulthood (Inglehart 1990). Thus, the predisposition to green behavior among contemporary older employees might be explained by the emergence of an environmental discourse during their early adulthood (Wiernik et al. 2013).

Conversely, there is also evidence of a U-shaped relationship between environmental behavior at home and age (Klein et al. 2012), suggesting that the effect might not necessarily be straightforward. Specifically, green behavior at home is more prevalent in early and late adulthood, but less common during middle adulthood. This effect may be attributed to the prioritization of family-oriented rather than environmental values as people raise their children in middle adulthood (Hertel and Zacher in press).

In this regard, a life span perspective may be particularly helpful. Consider, for example, the concept of generativity, which refers to one of the motivations in Erikson's (1950) stages of psychosocial development. In this respect, generativity describes an individual's desire to help guide the next generation. From this perspective, and in light of omnipresent environmental issues, there might be justification to hypothesize that individuals should engage in more green behavior as they age. In doing so, older employees might be seen to be attempting to limit their environmental impact, the costs of which future generations would incur. This also taps into a central belief at the heart of most definitions of environmental sustainability – which is to preserve the ecosystem for the benefit of future generations (World Commission on Environment and Development: 1987).

Another argument for why employees might become greener as they gray draws on positive relationships of age with conscientiousness and agreeableness (Hertel and Zacher 2016; Wiernik et al. 2013). First, conscientious employees are more likely to engage in citizenship behavior (Hertel and Zacher 2016; Wiernik et al. 2013), which encompasses approximately two-thirds of employee green behavior (Ones and Dilchert 2012). Second, and relatedly, older workers might be more agreeable to the idea of environmental sustainability if the organization demonstrates a value toward it (e.g., by announcing a shift to purchasing renewable energy). Both of these arguments implicate the important role of organizational values toward the natural environment. These establish a need within the organization for environmental initiatives, to which older adults might be more agreeable, and provide cues toward areas where citizenship behavior might be appreciated. For example, older employees in organizations with prominent environmental values might be more inclined to align their behavior to these values, including performing citizenship behaviors that contribute to the organization's environmental mission.

Finally, older adults are more inclined to value frugality by being economical and avoiding waste (Wiernik et al. 2013). This is relevant to environmental sustainability as environmental initiatives often focus on recycling, avoiding waste, and conserving resources (Ones and Dilchert 2012). Curtailing the consumption of resources is often an early step toward environmental sustainability, as reducing costs associated with waste provides direct financial benefits to organizations (Kane 2015). Pursuing frugal environmental behavior may also be a source of intrinsic satisfaction

(Lee et al. 1995). Thus, for older employees who value frugality, engaging in green behavior at work may have beneficial outcomes and contribute to overall job satisfaction.

A positive relationship between aging and green behavior would also provide organizations with three additional opportunities to benefit simultaneously from an aging workforce and move toward environmental sustainability. First, a positive effect of aging on environmental values might be effectively utilized by having older employees lead the way in communicating and championing green initiatives (Wiernik et al. 2013). Second, if older adults are in fact more conscientious than their younger colleagues, they might be more predisposed to prosocial activity such as making environmentally friendly suggestions or leading green teams. Third, older employees possessing a greater appreciation for frugality might in effect serve as environmental advisors to purchasing officers, emphasizing a need to resupply resources only when necessary and suggesting environmentally friendly alternatives. Such roles may have positive outcomes for older employees as well, such as intrinsic satisfaction derived from frugality (Lee et al. 1995). Alternatively, organizations might find that campaigns that emphasize the financial cost of leaving lights on are especially effective for older employees, who have a heightened appreciation for being economical. Thus, a positive relationship between aging and green behavior could make older employees valuable assets for organizations seeking to engage with environmental sustainability.

Arguments for a Negative Relationship

On the other hand, the idea that green behavior at home decreases with age is supported by the argument that, as people age, they have greater disposable income and therefore become less willing to sacrifice comfort and convenience (Wiernik et al. 2013). For example, whereas younger individuals might be more willing to open a window on a hot day, older adults may be more inclined to use air conditioning (Klein et al. 2012). Applied to the workplace, older workers might prefer to engage in behavior that prioritizes convenience above environmental interests (e.g., printing documents to read instead of reading them on the screen). Alternatively, older employees may engage in non-green behavior out of necessity to optimize declining personal resources such as physical ability (Baltes and Baltes 1990). For example, an older employee might print a document to review with one page to a sheet because s/he wants a larger size print.

A life span perspective also supports a negative relationship between age and green behavior. According to this perspective, older adults might be less motivated by future consequences. Given that climate change is an intergenerational issue (Intergovernmental Panel on Climate Change: 2014), reduced sensitivity toward long-term consequences removes a significant motivation to behave in an environmentally conscious way (Klein et al. 2012). Accordingly, older employees might be less affected by environmental campaigns in the workplace that focus on future consequences of their behavior. This may be particularly relevant for initiatives with goals that extend into the future – beyond the expected retirement age of older employees.

Another argument for a negative relationship draws on the hypothesis that habits crystallize over a person's life span, and accordingly individuals become more resistant to change, including efforts to move to more environmentally sustainable ways of work. According to this argument, older employees would be less likely to replace old practices (e.g., traveling for meetings) with new practices that incorporate environmental interests (such as teleconferencing). The empirical evidence does not support this stereotype, however. In fact, there is evidence that resistance to change can even decrease with age (Hertel and Zacher 2016). In this regard, evidence that people become more agreeable and conscientious as they age suggests that people become *more* open to change as they age (Hertel and Zacher 2016). Nonetheless, there are valid reasons to conclude that people become less likely to engage in green behavior as they age and that older employees may demonstrate fewer green behaviors at work.

If in fact employees become less likely to engage in employee green behaviors as they age, organizations might need to install contingencies to mitigate such an effect. First, organizations could address the issue of convenience by (a) making green behavior more convenient and (b) reducing the impact of non-green behavior. An example of making green behavior more convenient is for managers to provide information and/or training on how to schedule computers to turn off and start up in order to avoid drawing power overnight and during weekends. Another example would be for organizations to provide tablet computers with styluses to allow people to make handwritten notes on documents without having to print them first. An example of a mitigating tactic would be to dedicate a printer for draft documents that uses recycled paper and ink cartridges and a default setting that saves ink and prints double-sided.

To address issues from a life span perspective, organizations might consider reframing environmental goals and messages to be more inclusive of older employees who see themselves close to retirement. Options for this strategy include creating short-term goals for projects that are likely to extend beyond older employees' tenure. Alternatively, listed companies could offer stock options as part of retirement packages so that older employees can maintain a vested interest in the company's performance beyond their employment. Another intervention targeting the life span perspective is to tailor environmental messages to encompass the broader effects of environmental sustainability for the general community and future generations.

Where environmental sustainability will require the adoption of new behaviors, organizations will likely need to implement interventions to change non-green habits. This could manifest in training programs that challenge assumptions about habitual behavior (e.g., that shutting down and powering up a computer uses more electricity than leaving it on or is bad for the device) and explain and demonstrate green alternatives. Such a strategy could be integrated with organizational values and norms for innovation and continuous improvement, as messages utilizing social norms are particularly effective for older employees (Wiernik et al. 2013).

Research Recommendations

With the emerging significance of an aging population and the need for organizations to become environmentally sustainable, there is a real need for research on how older employees might better engage with green behaviors. At the very least, researchers should report employee age as a variable in research on employee green behavior. Beyond this, it would be interesting to investigate the potential for cohort effects on environmental attitudes and behavior. In this case, the effect of aging on employee green behavior may be moderated by an individual's experience of the prevailing social attitudes during early adulthood, which have changed over time (Wiernik et al. 2013). In this regard, the environmental message individuals receive in early adulthood might be more important than the effects of aging. Alternatively the effects of aging might be moderated by personality traits (e.g., conscientiousness, agreeableness) or the degree of concern for future generations (i.e., generativity). In effect, the effects of aging on employee green behavior may vary from one person to the next.

In this entry, we have outlined theoretically grounded arguments for why aging might have positive and/or negative effects on employee green behavior. Only empirical evidence can elucidate the extent to which, and under what circumstances, these positions are true. Research providing insights in this area is likely to have significant practical implications for how organizations respond to the challenges of an aging working force and environmental sustainability. Should evidence support the argument for a positive effect of aging on employee green behavior, a next step might be to investigate the effects of such behavior on older employees' job satisfaction and work motivation. Conversely, evidence for a negative effect of aging on employee green behavior would shift the focus of research toward interventions designed to overcome an emerging resistance in older adulthood to employee green behavior.

Conclusion

Aging and environmental sustainability are significant and contemporaneous issues with implications for organizations. In spite of the reality of an aging workforce and the need for organizations to operate in environmentally sustainable ways, there is practically no research to date that has studied the effect of age on employee green behavior. What empirical evidence does exist is insufficient in both quantity and consistency to infer any conclusions. From a broader perspective, there appear to be valid arguments for both positive and negative relationships between age and employee green behavior. When interpreting existing research on aging and environmental behavior more generally, it is important to acknowledge the possibility for cohort effects. Specifically, our current understanding is derived using data from a cohort who may not have been exposed to the same environmental messages as generations that will be entering older adulthood in coming decades. Nonetheless, from our understanding of aging and workplace behavior more generally, older employees may be particularly useful to organizational initiatives that promote green behavior.

Cross-References

► Age, Organizational Citizenship Behaviors, and Counterproductive Work Behaviors

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Employment of Older Workers

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Synonyms

Aging labor force; Mature employees

Older Workers

The growing number of men and women who are working longer and the aging of many labor markets are global phenomena without precedent. More older people are working, despite large country differences (OECD 2014). Many people in the world will live an additional 30 years after they have reached the traditional age of retirement from paid work, and this is forcing a reenvisioning of the future of work and what "retirement" means. A complex array of factors, such as increasing longevity, declining fertility rates, changing labor market dynamics, and retirement policies and practices, are creating a new demography of work.

Many countries are carrying out reforms to encourage longer working lives, to incentivize worker retention, and to respond to the looming challenges of rapid population aging (Sonnet et al. 2014). In some countries this is a reversal of earlier policy aimed at early exit of older people from the labor force, when developed countries responded to recessionary times in the 1980s by pushing older workers out of the labor market through redundancies and early retirement.

Definition

The definition of an older worker varies from country to country and from context to context. For example, to take chronological age as a start point, the OECD older workers scorecard uses the ages of 55 years to 64 years. Others use the age of 50 to begin discussions about "older workers," and in some cases older workers are deemed to start from 45 years old. In the USA the Age Discrimination in Employment Act (ADEA) forbids age discrimination against people from the age of 40 years, which many might regard as the start point of middle age.

Whatever the chronological definition used, it is clear, however, that in many countries there is now a difference between the "young old" (those up to 65 years of age) and the "old old" those who may be in their seventies, eighties or even nineties and still in paid employment. It is startling to note the projection that in 35 years' time, Japan is likely to have 550,000 people over the age of 100.

Clearly, too, thousands of older people are involved in work that is unpaid, particularly women who are often caring for older partners and other dependents. In some cases women are caring for both children and dependents. However, whether older workers are paid for their labor or not, responses to older workers are impacted globally by social attitudes and economic growth and stability. For example, policy in developed countries relating to the category of "older worker" is often indexed to a nominal age of retirement where individuals receive universal state or privately funded pension payments.

Looking at the markers of age for older workers, it is clear that some regard workers as old when their physical capacities decline and their stamina retreats impacting on job

productivity. Others suggest an older worker is marked by declines in cognitive or intellectual capacities impacting on performance. For others chronological age alone marks out an individual as an older worker particularly if that is linked to incentives for early exit from the labor market. There is evidence, too, that perceptions of age differ by gender.

Population Aging and Work

The number of people worldwide aged 60 years and older is expected to triple by 2050, according to projections by the United Nations Population Division. Not only that, the share of the population in older age groups is increasing. At least four trends are apparent in population aging that impact on the employment of older workers in general. First, population aging is not confined to some countries only but is everywhere, including the youngest countries and developing nations. For example, the six Gulf countries, which have traditionally relied on expatriate workforces, acknowledge that their two main demographic challenges by 2050 will be population aging and a slowdown of the increase in national workforces. Second, population aging is a major life force and impacts not only on employment in terms of job demands but also health, economic security, and social cohesion. Third, population aging is occurring quickly and the pace is accelerating, and, fourth, it is taking place at different rates around the world. For example, in Asia, while Japan was the first country to face the "age wave," South Korea and China follow and then India and Pakistan (Hayutin 2009).

The supply and demand of jobs in a global labor market is characterized increasingly by job mobility and migration to find work. Older workers are not immune from these trends. They are also crucial to vital sectors where worker shortages are profound. The World Health Organization in 2013 estimated that there would be a shortage of 12.9 million healthcare workers by 2035. In areas of great need like sub-Saharan Africa, shortages are particularly acute. Nursing, for example, is an occupation which is aging rapidly (Graham and Duffield 2010).

The Diversity of Older Workers

While extending working lives will maximize older adults' income security, not all older people want to work or can access jobs. There are many reasons why people work longer including both positive and negative factors, often referred to as either "push" or "pull" elements or supply- and demand-side factors. It is a mistake to assume that older workers are a homogeneous group and therefore one policy size will fit all.

Many women, in particular, are more likely to be forced to work longer because they have earned less over their working lives and they are living longer. Their earning potential may be influenced by women's traditional occupational segregation in lesser-paid work (such as cleaning, clerical, and caring work) and/or because of work interruption when bearing and raising children and having primary or sole responsibility for family and domestic life. The global financial crisis also disproportionally impacted on older adults and saw many lose significant portions of their retirement assets at a time of intensified competition for jobs and resources. However, it has been shown that irrespective of age, women usually face dimmer job prospects than men.

Older workers are a multifaceted and diverse group. Categories of older workers include those who are retained in paid employment beyond the conventional retirement age when an employer needs their skills, older people who reenter the labor market for job satisfaction and feelings of self-esteem that the structure of work gives them, and those who downscale to different, lesser-paid jobs. The majority of older workers are part-time by choice or by demand, and many are employed on temporary contracts only because that is all that is available to them. Increasingly, too, there are thousands of older people who are self-employed including farmers in agricultural sectors and in small businesses around the world, including some older workers who "buy" themselves a job through self-employment.

The different types of older work have prompted new terms such as "job shifting," which can mean moving from a highly paid and full-time position to a lesser-paid, part-time job as

an older worker, and "encore career," a term covering thousands of Americans in particular who have shifted in the second half of their lives to second careers in areas like the environment, nonprofit sectors which blend income and social impact (Freedman 2007).

Motivations for Working Longer

Some people want to work longer at an older age. In some cases this aspiration is made easier by the general shift over time from manufacturing and service industry jobs, which required sustained physical labor and took a toll on older bodies, to the knowledge economy where physical body demands are less onerous. It is no surprise, for example, that in many countries, such as South Africa, Australia, Canada, and the United Kingdom, the education sector is one area which older workers find attractive in terms of retention of their skills and labor.

Others are compelled to work longer at an older age than their parents, for example, to increase their financial security. There is less certainty that some countries can absorb the full costs of their aging populations especially where there are limited existing retirement income schemes or state pensions.

It is clear that education matters. Across OECD countries, well-educated people are more likely to work longer than the less skilled. This gap, though, probably cannot be separated from the deepening inequality divide between those who are well educated and better-off and those who are poor and unskilled with low educational attainment, irrespective of age.

Perspectives About Working Longer

It is clear that there are both challenges and opportunities associated with older workers. Two perspectives have traditionally dominated discussion about working longer. First, there is the perspective that sees working longer as beneficial to individuals, families, communities, and society. This is reflected in the title of a major OECD report published in 2006 *Live Longer*, *Work Longer* (OECD 2006) which implicitly suggests that extending a working life will increase life span. Often this perspective is referred to as positive aging or active aging, and it is a policy framework used by Western governments in particular to place working longer in a favorable social context. In the positive aging context, older workers are seen as "productive," contributing economically (Butler 2009) and increasing their own self-esteem and self-efficacy through the structure of work. In this optimistic scenario, the choice to continue on working as an older person is characterized by individual autonomy and the human rights of older people (Office of the Human Commissioner for Human Rights 2012). Humorist and writer George Bernard Shaw once said, "A perpetual holiday is a good working definition of hell."

The second perspective suggests that older people may be more likely to be in "precarious work" (International Labour Organization 2012) as opposed to "decent work." Precarious work is characterized as uncertain, risky, and unpredictable, sometimes without employment protections in the law, often casual work without certainty of hours from day to day or week to week, and mostly low paid and contingent (Sargeant and Frazer 2009). The idea has been popularized by Guy Standing's work in which he describes the "precariat" as "the new dangerous class" (Standing 2011). He states that "old agers have become a source of cheap labour, paid low wages, given few benefits, easily sacked." This is undoubtedly true of some older workers only, particularly women, ethnic minorities, and migrant workers, who are often in "precarious work" that creates greater economic inequality, insecurity, and instability.

Social Attitudes, Discrimination, and Older Workers

Ageism, which constitutes negative societal attitudes about age, and age discrimination at work are of concern throughout the world. Age discrimination means older people are disadvantaged in

individual or cumulative aspects of work such as job hiring, pay and reward systems, promotions, job assignments, training opportunities, and fringe benefits. This is despite different cultural contexts in which older people are revered for their wisdom and knowledge and regarded as "elders" with dignity and respect in family structures and communities.

Age discrimination is often invisible and covert and often not easy to prove despite statutory prohibition in many countries. The emphasis on age discrimination is not necessarily because of a new appreciation of the need for fairness. Fredman (2011) says it gains its chief impetus from macroeconomic imperatives, but this should not obscure the fact that it is unjust. The impacts of exclusion from the labor market of older people on the basis of age should not be underestimated in terms of poverty, ill-health, and depression, as well as self-esteem and social isolation.

Experiments in Spain, Sweden, Scotland, Germany, Norway, New Zealand, and Australia, among other countries, have shown that if matching applications from job candidates with equal qualifications are presented to employers, the younger applicant will be preferred. Older applicants were not preferred, not on the basis of merit or competencies, but simply on the discriminatory basis of their age (Wilson et al. 2007). However, employers seldom identify chronological age as the criterion on which they have preferred one candidate over another. It is often very difficult for a mature job seeker to establish that old age was the grounds on which they did not get a job.

Age discrimination laws usually include the whole employment cycle starting from job advertisements which are expected not to refer to the age of applicants through to exiting from the labor market through retirement or redundancy. Laws prohibiting age discrimination have been used by specific occupational groups such as airline pilots, judges, and university teachers, among others, to challenge mandatory retirement ages in various countries with mixed success. In the European Union, for example, the courts can say that an objective justification for not employing older people is the need for intergenerational fairness or to balance the age structure of an organization, or the need for health and safety considerations, or the need to recruit and appoint young people.

The mass media, and the news media in particular, have been criticized for promoting the cult of youth as celebrities in sport, leisure, and fashion and in the world of work. This led to the comment that the "mass media has powerfully and negatively influenced both public opinion generally, and employers' attitudes specifically, on the subject of older workers" (McGregor 2005). Concern has also been expressed consistently at the way older workers are stereotyped in print advertisements and commercials and online marketing, despite the potential purchasing power of older workers in paid employment (Treguer 2009).

Changing Employer Practices

A variety of human resource strategies are necessary to attract, retain, and accommodate older workers, in addition to labor market and pension policies. Companies need to retain and transfer institutional knowledge, for example. They also need older workers to mentor and coach younger and intermediate workers. Corporates, companies, and small businesses need to manage diverse workforces that are representative of their own client and customer bases, and they need to be able to keep older workers productive.

Many transnational corporations and multinational companies can afford enlightened and progressive employer policies and practices that balance their workforces by age. Companies around the world, such as Singapore Health Services Ltd., with 20% of its 15,000 workforce above 50 years of age, have innovative human resource policies (Tan 2009). These include reemploying retirees, flexible work arrangements such as flexitime, project work and part-time work and customized employment contracts, job sharing, and telecommuting.

However, a challenge for many smaller organizations is that older workers are often the most expensive. Higher pay has often been linked to seniority and job tenure. Some employers wish to rationalize both succession planning and wage costs, without breaching age discrimination

legislation. Whether older workers, especially middle-class baby boomers, would accept or can afford lesser wages as retirees or be attracted to different jobs for less money is a moot point. However, tailoring wage and benefit systems accordingly may become urgent in some sectors.

Employability of Workers

Many older workers, who have choice about whether to work or not, make an individual decision about job retention, on their own personal sense of employability. This could include consideration of their currency in the skills, knowledge, and technology required by their occupational choice. Sometimes this is professional registration, sometimes it is new software, and sometimes it is the inability to be productive and keep up in a factory environment. In some cases the decision is health related. Older workers may develop age-related illnesses or disabilities that curtail working longer and prompt exit from the labor market.

In other cases, inadequate workplace design such as insufficient lighting or inadequate ergonomic support (making computers easier to see, hear, and use) pushes an older worker out of the labor market. An English study showed older workers found it difficult to work in open-plan environments because of noise, light, and cold temperatures and older workers say they want to learn new technology at their own pace, in face-to-face situations rather than in environments where they are expected to either rely on Internet packages or compete with tech-savvy, younger workers (Myerson 2009). Work intensification and "job creep" in areas like aged care, where more is expected in less time along with increasing employer expectations, are other reasons older workers give for exiting.

An issue of increased salience to older workers is lifelong learning to sustain employability. Adult learning for job training either to refresh or renew job-related knowledge and skills and financial incentives to encourage it are not necessarily mainstream policy even in countries where older workforces are impacting on economic growth. Global research shows that older workers often feel they are discriminated against in selection for training opportunities (McGregor and Gray 2002).

Future Trends

There is much research "on" or "about" older workers. Comparatively little is known about the perceptions and experiences of older workers themselves, and their voices have become the "missing voices" in policy frameworks around older workers, aging, and employment. It is critical that future research addresses this omission. It is also essential that older workers are not viewed by legislators, policy makers, and employers as one homogeneous grouping. No other population groupings, such as children, or young people, or the middle aged, span 30–40 years of life. A single description whether it be old age or older worker is insufficient. It is therefore imperative that national statistical collections, censuses, and international data collections allow for disaggregation past the age of 65 years to develop a more sophisticated mapping of older people. This will help governments, policy agencies, employers, and older people themselves plan for the future.

The idea that older workers are taking jobs from young people and that this could provoke or incite intergenerational tensions with younger people has been largely discredited. The idea of a fixed number of jobs with winners and losers is a variation of what economists call the "lump of labor" fallacy. Research shows that there is no evidence that increasing the employment of older persons reduces either the job opportunities or wage rates of younger workers (Munnell and Wu 2013). Global problems of youth unemployment have many patterns and complexities that are different to those influencing older worker unemployment and access to employment. However, an under-researched area requiring future scholarship and debate concerns the intergenerational transfers and accommodations that will have to take place in workplaces of the

future. As the aging population increases and as the labor market gets older, how will older people work? What incentives will they require not to retire? Only some of the answers to these significant questions are known today.

Cross-References

- ▶ Organizational Strategies for Attracting, Utilizing, and Retaining Older Workers
- ▶ Recruitment and Selection of Older Workers
- ▶ Stress and Well-Being: Its Relationship to Work and Retirement for Older Workers
- ▶ Technology and Older Workers

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Encephalopathy

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Synonyms

Autoimmune Disease; Encephalitis; Infections; Neuroinflammation; Prion Disease

Definition

Encephalopathy is a broad term for any brain disease that affects brain functioning.

Encephalopathy refers to a broad category of conditions that disrupt normal brain functioning. Like many broadly defined conditions, etiology and clinical presentation vary extensively. Etiologies can include vascular conditions, autoimmune disorders, infectious and viral agents, cancer, paraneoplastic syndromes, hypoxia, systemic medical illness, neurodegenerative disorders, prion disease, medications, metabolic conditions, traumatic brain injury, and toxins. Symptoms may include delirium, altered mental status, seizures, cognitive deficits, motor impairment (e.g., weakness), psychosis, personality changes, and other psychiatric symptoms (Roos and Brosch 2012).

The average age of onset for these conditions varies somewhat according to etiology; however, older age is almost universally a risk factor for the development of encephalopathy, with the majority of patients presenting over the age of 50 (Paterson et al. 2012). Risk for developing encephalopathy increases with age, such that as adults move into their 40s, 50s, and 60s, risk for onset of these conditions intensifies.

The most common forms of encephalopathies present with clear changes in mental status and/or delirium. For example, hepatic encephalopathy presents in the context of liver failure with confusion, altered consciousness, and ultimately coma and/or death. Similarly, uremic encephalopathy can develop in patients with acute or chronic kidney failure. Subdural hematomas, most often secondary to traumatic brain injury, can cause an encephalopathy marked by headaches and changes in consciousness. Wernicke's encephalopathy (WE), caused by a thiamine deficiency secondary to chronic alcohol use, HIV/AIDS, and malnutrition, is marked by confusion, ataxia, and weakness (Weathers 2013). These acute medical disturbances are typically treated in primary medical settings and are unlikely to be seen by most geropsychologists.

However, several encephalopathies can present with a more insidious onset and with predominant psychiatric and cognitive symptoms. These syndromes are more likely to present with subacute delirium that may not be immediately obvious. Unlike a classic delirium, subacute presentations are marked by cognitive changes over days and weeks rather than a more rapid, 24-h window (Flaherty 2011). As such, these conditions are frequently misdiagnosed as neurodegenerative diseases or psychiatric illnesses. Practitioners who work with older adults must be familiar with these diseases in order to make appropriate referrals for diagnosis and treatment, especially given that so many of these disorders are treatable and reversible.

This entry will give a brief overview of several types of encephalopathies that are more likely to present outside of traditional acute care settings or neurology clinics. First, this entry will review anti-NMDA receptor encephalopathy (ANRE), which presents with predominant psychiatric features. Next, the entry will review voltage gated potassium channel encephalopathy, Hashimoto's encephalopathy, herpes simplex encephalopathy, and spongiform encephalopathy (i.e., prion disease) all of which often present with marked cognitive changes. Notably, both cognitive and psychiatric changes are common among individuals with these encephalopathies and understanding core symptom profiles may be helpful in making appropriate referrals.

Anti-NMDA Receptor Encephalopathy

N-methyl-D-asparate (NMDA) receptors are glutamate receptors found throughout the central nervous system and are thought to be involved in cognitive functioning and psychiatric illness, particularly psychosis. Anti-NMDA receptor encephalopathy (ANRE) is an autoimmune disease, a condition in which the body mounts an immune response against itself. In the case of ANRE, the immune system develops antibodies to attack NMDA receptors in the brain. ANRE is characterized by acute psychiatric and neurological symptoms including psychosis, seizures, fatigue and/or reduced consciousness, breathing difficulty, and abnormal movements (Vitaliani

et al. 2005). While the median age of onset is 24, cases of ANRE have been reported in older adults up to 76 years of age (Dalmau et al. 2008). ANRE is often associated with a type of tumor, an ovarian teratoma, which is found in almost 59% of patients with the disease. In the subset of cases that are associated with malignancies, the immune response to the tumor also attacks parts of the central nervous system, which is known as a paraneoplastic syndrome. In a case series by Dalmau et al. (2008) the median age of onset was 23 and predominantly female (91%). The symptom presentation is often dominated by psychiatric symptoms including psychosis. In a popular book published in 2012, author Susannah Cahalan provides a first-hand account of her experience with this disease. Her initial symptoms included psychosis and emotional lability, and providers diagnosed her with an alcohol use disorder and schizoaffective disorder (Cahalan 2012). This is not uncommon for patients with ANRE; many have gone undiagnosed for months because they were thought to have primary psychiatric disorders. Other features include seizures (76%), reduced alertness or unresponsiveness (86%), autonomic dysfunction, such as difficulty breathing and slowed heart rate (69%). Ultimately, Cahalan (2012) was transferred to an inpatient neurology department in response to onset of seizures. Many patients also exhibit abnormal movements, often orofacial dyskinesias such as grimacing or chewing movements, or limb posturing, which can sometimes be mistaken for seizures (Dalmau et al. 2008). Nonspecific flu-like symptoms (e.g., fever, headache) are also common just before the onset of the acute neurological and psychiatric symptoms (Sansing et al. 2007).

While many patients exhibit seizures as part of the ANRE clinical syndrome, most patients will exhibit abnormalities on electroencephalogram (EEG) monitoring, including slowing without overt epileptic activity (Dalmau et al. 2008). Approximately half of patients exhibit abnormalities on magnetic resonance imaging (MRI), which most commonly consist of hyperintensities observed on T2 and FLAIR images in medial temporal structures and the cerebellum (Sansing et al. 2007). Impairments on cognitive testing are common. Diagnosis is confirmed by testing the cerebrospinal fluid (CSF) for antibodies to the NMDA receptor (Sansing et al. 2007). For Calahan, it took over a month to receive an accurate diagnosis (Cahalan 2012). Accurate diagnosis is critical because ANRE is responsive to treatment, which usually involves immunotherapy, such as corticosteroids or plasma exchange, as well as surgical tumor removal (Dalmau et al. 2008). Many patients achieve full recovery or exhibit only mild lasting deficits; however, some patients experience severe lasting effects and the disease can be fatal (Dalmau et al. 2008).

Voltage Gated Potassium Channel Antibody Associated Encephalopathy

Voltage gated potassium channel encephalopathy (VGKC) is an autoimmune condition that is particularly common in adults over 50 and presents more often in males than females. In healthy adults, voltage gated potassium channels regulate neurotransmitter release but with abnormal expression of these antibodies, an encephalopathy may develop.

The clinical profile of VGKC is marked by acute cognitive changes, seizures, and hyponatremia (Bettcher et al. 2014). Some research suggests that seizure activity may represent the first symptom of VGKC, although they may not be clinically obvious if they are focal temporal seizures that do not generalize and present with tonic-clonic movements. In a comprehensive literature review, Radja and Cavanna (Radja and Cavanna 2013) found that seizures were present in 85% of patients diagnosed with VGKC; seizures often preempted subsequent cognitive changes. Severe episodic memory impairment is a core feature of VGKC; over 97% of patients present with memory impairment (Radja and Cavanna 2013). Changes in executive functioning and language have also been observed. Neuropsychological tests measuring verbal fluency and set-shifting appear to be particularly sensitive to the language and executive functioning changes associated with VGKC (Bettcher et al. 2014). Finally, psychiatric symptoms are

also common in this population, affecting approximately 33% of patients (Radja and Cavanna 2013). Specific symptoms include agitation, insomnia, hallucinations, and depression. In case studies, patients have presented with schizophrenia-like syndromes that progress to delirium, stressing the presence of affective symptoms in this disorder (Parthasarathi et al. 2006).

MRI findings among patients with VGKC are consistent with the neuropsychological profile; in particular, the medial temporal lobes appear to be hyperintense on imaging in approximately 80% of patients (Bettcher et al. 2014; Radja and Cavanna 2013). This is consistent with a limbic encephalopathy in which autoimmune diseases primarily target the limbic system. Phenotypically, limbic encephalopathies are associated with neuropsychiatric symptoms (e.g., psychosis, anxiety), subacute behavioral changes, cognitive decline, seizures, and fluctuating course. Neuroimaging in limbic encephalopathy cases can present with abnormalities in the medial temporal lobes, although this is not identified in all cases (Paterson et al. 2012). These conditions rarely affect the medial temporal lobes in isolation, and for VGKC, additional involvement of the lateral frontal lobes, basal ganglia, and white matter structures has been identified.

VGKC is highly responsive to treatment with immunosuppresants (Radja and Cavanna 2013). Over time, cognition typically improves markedly, and patients report subjective improvements in all cognitive domains and psychological domains, as well as remission of seizures (Radja and Cavanna 2013). However, longitudinal evidence suggests that some patients continue to have cognitive difficulties in one or more domain even after treatment (Bettcher et al. 2014).

Hashimoto's Encephalopathy

Hashimoto's encephalopathy (HE) is a rare condition that was first characterized by Brain et al. (1966) in a 48-year-old male who presented with stroke-like symptoms of aphasia and right hemiplegia (Brain et al. 1966). The causes of HE are not clearly understood, but it is thought to be associated with Hashimoto's thyroiditis (HT), an autoimmune disorder in which antibodies attack the thyroid gland. In rare instances, the autoimmune reaction may cause an inflammatory response in the thyroid receptors of the brain's limbic system. Although the autoimmune reaction is not limited to the limbic system, it is nonetheless referred to as a limbic encephalopathy. Only a small fraction of Hashimoto's thyroiditis patients may develop HE; it is estimated that HE occurs in only 2.1/100,000 people (Ferracci et al. 2004), while HT occurs in approximately 1/1000 people. Hashimoto's encephalopathy may present in patients of all ages, including older adults, with a mean age of onset in the mid 40s (Chong et al. 2003). Approximately 80% of reported cases are female. Due to the heterogeneity of presentation, subtypes have been proposed: steroid-responsive encephalopathy associated with autoimmune thyroiditis (SREAT) (Castillo et al. 2006) and nonvasculitic autoimmune inflammatory meningoencephalitis (NAIM) (Caselli et al. 1999). Regardless of type, a defining trait of HE is that it is steroid-responsive. High serum antithyroid antibody must be present in order to diagnose HE, while other diagnostic tests may vary (Wood-Alum and Shaw 2014).

Patients who present with HE may display a wide range of symptoms, which can make the syndrome difficult to identify. Older adult patients often present with more subtle symptoms, such as anxiety or cognitive impairment, but they may also exhibit other psychiatric symptoms including psychosis, fluctuating states of consciousness and attention. Many patients may present with stroke-like symptoms such as aphasia, hemiparesis, weakness, blindness, headache, gait unsteadiness, and seizures can also occur (Weathers 2013; Chong et al. 2003; Wood-Alum and Shaw 2014). Because of these varying characteristics, patients presenting with these symptoms may be misdiagnosed and thus treated inappropriately. Additionally, elevated antithyroid antibodies may be present with other nonthyroid related autoimmune disorders; therefore, blood labs alone cannot diagnose HE. Other diagnostic tests may include electroencephalography and/or neuroimaging (Wood-Alum and Shaw 2014).

The treatment of HE is varied due to the rarity of the disorder; therefore optimal dosage, duration, and course of treatment is unknown. The initial case identified by Brain and colleagues (1966) reported symptomatic remission with levothyroxine treatment alone (Brain et al. 1966). Subsequent studies have reported an approximate 65% effectiveness with levothyroxine alone, while steroid treatment alone has yielded an estimated 98% effectiveness (Wood-Alum and Shaw 2014). Additional treatments may include a combination of medications and/or intravenous immunoglobulin therapy or plasmapheresis for more resistant cases. Despite the lack of clear diagnostic and treatment criteria, steroidal treatment generally yields good prognoses and remission of symptoms.

Herpes Simplex Virus Encephalitis

Encephalitis caused by the herpes simplex virus (HSE) is the most common form of sporadic and fatal encephalitis in the world (Whitley et al. 1998). Unlike HE, VGKC, and ANRE which are caused by autoimmune disorders, HSE is caused by viral infection. Approximately 1250 cases are diagnosed annually, half of the cases are diagnosed in adults over 50 (Tyler 2004), and HSE affects men and women equally (Berk and Myers 2010). Typically, the herpes simplex virus-type I (HSV-1), commonly known to cause orofacial lesions, causes HSE. The HSV-2 variant associated with genital lesions and neonatal infections is the source of only 10% of documented HSE cases. Patients with compromised immune systems appear to be particularly vulnerable to HSE. Primary HSV-1 infections among individuals with no previous history of HSV-1 antibodies are responsible for approximately 1/3 of HSE cases, while recurrent infections cause the remaining 2/3 of HSE cases (Widener and Whitley 2014).

In HSE, HSV-1 produces inflammation in the CNS that leads to hemorrhage and necrosis of brain tissue (Widener and Whitley 2014). HSE most frequently affects the medial temporal lobes and the orbitofrontal regions of the brain, but cases have been documented with focal lesions in the brain stem rather than the cortex (Tyler et al. 1995). At present, the particular triggers for onset of HSE remain unclear. Researchers hypothesize that HSV-1 targets the cortex through the olfactory bulbs, thereby leaving the orbitofrontal and medial frontal lobes particularly vulnerable to the deleterious effects of the disease (Widener and Whitley 2014). However, others have argued that the trigeminal nerve serves as the primary pathway through which the virus targets the CNS (Tyler et al. 1995).

Initial symptoms associated with HSE include changes with cognition including altered mental status and speech deficits as well as concurrent fever and headache (Berk and Myers 2010). Given the vulnerability of temporal regions in HSE, patients frequently show neuropsychological deficits in language, (e.g., naming and semantic knowledge) as well as episodic memory. As with other types of encephalitis, early symptoms are frequently psychiatric. In cases of HSE, acute personality change and olfactory hallucinations are common. The presence of olfactory hallucinations and nasal field defects are important potential indicators for HSE (Berk and Myers 2010). Additionally, patients with this diagnosis often experience temporal lobe seizures and hemiparesis.

In addition to carefully reviewing symptoms, diagnosis can be confirmed by CSF analysis, EEG, and imaging. Early in infection, CSF will show elevated lymphocytes and red blood cells suggestive of hemorrhage and/or damage to the blood–brain barrier (Berk and Myers 2010; Widener and Whitley 2014). EEG pattern is typically abnormal with slow waves most notable in the temporal lobes; occasional lateralization is also highly suggestive of HSE. Finally, MRI scans are highly sensitive to HSE-related brain changes, particularly in early stages of the disease. Early MRI changes reveal edema and hyperintensities in the orbitofrontal and medial temporal lobes. Additionally, early imaging often identifies changes in the insula and external capsula with later involvement of the cingulate (Widener and Whitley 2014). Although brain biopsy used to be the only definitive diagnostic mechanism of HSE, polymerase chain reaction (PCR) now represents

the gold standard for both assessing the presence of HSV in the CNS and monitoring treatment response in patients with HSE (Widener and Whitley 2014).

Early diagnosis and treatment with acylcovir for HSE is imperative. Without treatment, the mortality rate for HSE is over 70% (Berk and Myers 2010; Widener and Whitley 2014). Even among patients who receive treatment, long-term cognitive consequences are frequent; only 2.5% of patients diagnosed with HSE ultimately recover normal neurological and cognitive status (Ward and Roizman 1994). Prognosis is directly related to prompt treatment as level of consciousness at treatment onset is correlated with outcomes (Berk and Myers 2010). Additionally, worse prognosis is associated with older age at onset and symptom duration longer than 4 days prior to treatment initiation (Widener and Whitley 2014).

Prion Diseases

Prion diseases, also referred to as spongiform encephalopathies, are responsible for a variety of rapidly progressive dementias. Normal prion proteins are found in the membranes of cells. Prion diseases are caused by misfolded prion proteins that propagate throughout the central nervous system. Prion diseases can occur spontaneously, as a result of an inherited genetic mutation, or acquired through infection or other mechanism of transmission. In the USA, the incidence rate of prion disease is about 1 in 1 million, and sporadic Creutzfeldt-Jakob disease (CJD) comprises most of the diagnosed cases. As it represents the most common form of prion disease, and often presents with cognitive, motor, and behavioral symptoms, CJD will be discussed in more detail. Geschwind (Geschwind 2015) described the clinical syndrome and diagnostic considerations in CJD and other prion diseases (Geschwind 2015).

Many dementias caused by neurodegenerative conditions, such as Alzheimer's disease, progress slowly and gradually over many years. In contrast, CJD is characterized by a very rapid course; the median length of survival is 5 months and most patients do not survive past 1 year. The disease most often affects older adults with the typical age of onset falling between 55 and 75. Patients in this age group presenting with a rapid decline in cognitive functioning should raise concern for CJD or another spongiform encephalopathy (Geschwind 2015).

The clinical syndrome for CJD includes behavioral symptoms, gait abnormalities, extrapyramidal symptoms such as dystonia and Parkinsonism, and myoclonus (muscle twitching). Initial symptoms most commonly include cognitive symptoms, characterized by memory loss, language dysfunction, executive functioning difficulties, and confusion. Other early symptoms that occur in about one third of patients include fatigue, headache, dizziness, and changes in appetite and sleep. Almost half of patients experience behavioral symptoms at some point during the disease course, which include agitation, depression, aggression, apathy, or personality change, and are therefore often misdiagnosed with psychiatric disorders. One third of patients experience language dysfunction (aphasia), difficulty with motor planning (apraxia), neglect, and difficulty with arithmetic calculations. CJD affects vast areas of the brain and because of the variability in symptom presentation it can be challenging to accurately diagnose (Geschwind 2015).

Diagnostic tests include EEG, MRI, and CSF. EEG abnormalities may not appear until later in the disease course. MRI, particularly fluid-attenuated inversion recovery (FLAIR) and diffusion-weighted imaging (DWI) sequences, reveals abnormalities in the deep gray matter nuclei as well as hyperintensity in the cortical gyri, known as cortical ribboning. CSF tests may not always reveal abnormalities in patients with CJD but a minority of patients may have elevated proteins found in CSF (Geschwind 2015).

Wernicke's Encephalopathy

Wernicke's encephalopathy (WE) results from thiamine (vitamin B1) deficiency often secondary to poor nutrition and poor vitamin absorption in those who chronically abuse alcohol. In addition

to poor diet and alcohol misuse, other risk factors include bariatric surgery, chronic vomiting or diarrhea, and chemotherapy in those undergoing treatment for cancer (Sechi and Serra 2007; Zahr et al. 2011). Some individuals also have a genetic susceptibility for reduced thiamine affinity (Guerrini et al. 2005). Thiamine is involved in important neurological processes such as the production and maintenance of myelin, communication between neurons, and producing neurotransmitters such as GABA. Lesions in brain areas most vulnerable to thiamine deficiency can be observed after as little as 3 weeks of thiamine depletion (Schenker et al. 1980).

WE is rare with 2% prevalence rates in the USA, and it affects men almost twice as often as women. The classic triad of WE symptoms includes altered mental status, eye movement changes, and unsteady gait, although these symptoms are not universal. Altered mental state secondary to WE includes confusion, slowed thinking, apathy, reduced awareness, and concentration difficulties (Sechi and Serra 2007). Eye movement abnormalities occur in approximately one third of patients and can include gaze palsy and involuntary quick jerking of the eyes known as nystagmus. Motor and gait abnormalities most often present with poor coordination and unsteady gait. Gait ataxia in WE patients is typically characterized by a wide stance with short, unsteady steps (Lough 2012). Psychiatric symptoms such as agitation and hallucinations have also been reported (Zahr et al. 2011).

WE can occur with or without Korsakoff's syndrome, although the majority of patients with untreated WE will develop Korsakoff's syndrome. Patients with Korsakoff's syndrome exhibit profound anterograde amnesia with relatively preserved implicit learning and general intelligence. Confabulation often accompanies the memory impairment, particularly in the earlier stages of the syndrome. Executive functioning deficits are also common (Zahr et al. 2011). Korsakoff's syndrome is associated with atrophy of the thalamus, mammillary bodies, and frontal lobes, which can be observed on imaging. CSF is usually normal in patients with WE/Korsakoff's syndrome, and EEG abnormalities do not appear until later in the disease course (Sechi and Serra 2007). Unfortunately, this syndrome does not improve even with treatment to correct thiamine deficiency (Butters 1980).

WE is important to identify correctly because if untreated, it can lead to coma and death. WE can be differentiated from more commonly seen neurodegenerative disorders in older adults based on the rapid onset. In addition to the clinical signs, blood tests to determine thiamine levels and MRI findings have the most diagnostic utility (Lough 2012). However, the nonspecific nature of the symptoms make it easy to misdiagnose. Early symptoms often include headache, fatigue, and irritability and can present differently across individuals. Furthermore, symptoms can be difficult to differentiate from acute alcohol intoxication when patients present to medical settings (Thomson 2002).

Conclusions

Encephalopathies are varied in etiology and presentation. Despite this variability, there are certain categories of symptoms that are common across these syndromes. Cognitive changes, fluctuations in consciousness, and psychiatric symptoms are highly prevalent in encephalopathies, regardless of specific etiology. With disease progression, seizures are common. Given that patients with these symptoms may present in primary care clinics, geriatric medical clinics, as well as psychiatry and psychology departments, it is important that providers outside the scope of neurology practices are familiar with potential presentations of these disorders. Additionally, older adults are at increased risk for encephalopathy, and it is important for providers to be aware of the varied etiologies and symptoms that are associated with these conditions. Symptoms that indicate any alteration in brain functioning, such as cognitive and psychiatric changes, should raise suspicion for encephalopathy. Notably, onset of encephalopathy symptoms is typically acute rather than gradual. However, the onset of a subacute delirium with more gradual symptom onset (i.e., over days and weeks rather than hours) is common

among the atypical encephalopathies described here. The presence of seizures often triggers a referral to a neurologist, but this symptom often manifests later in disease progression. Patients with encephalopathy, particularly those presenting with cognitive and behavioral changes, may go undiagnosed for many months. Immediate treatment is associated with the best outcomes, therefore recognizing early signs and symptoms of these disorders in older adults is imperative.

Cross-References

- ▶ Cognition
- ▶ Behavioral and Psychological Symptoms of Dementia
- ▶ Delirium
- ▶ Geriatric Neuropsychological Assessment

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End of Life Care

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Synonyms

Death; Dying; Hospice care; Palliative care; Terminal illness

Definition

The end of life can occur at any age, though it most often occurs in later life, when people are most vulnerable to the range of diseases and illnesses that compromise physical health. The end of life is preceded by *dying* and culminates in *death*, a technical distinction of some importance because both dying and death are distinct phenomena about which people have varying expectations, fears, and wishes. In its most clinical definition, dying refers to the process of physiological decline that leads to a complete cessation of vital bodily functions such as respiration and circulation. The dying process can be short or protracted; of a single cause or multifactorial; painful or relatively peaceful; brought about by a person's own hand, by another's hand, or by accident; a result of internal processes or external forces; and wished for or fought against. Clearly, dying is a multifaceted experience, with biological, psychological, and social elements. Death, meanwhile, is the end product of dying. Dying is the process, death the result.

End-of-life care refers to the wide range of services and supports that can be provided not only to an individual who is dying but also to family members and friends. It also involves a variety of professionals who provide the care, but of course have thoughts and feelings about the experience themselves. This care has many facets and attributes, such as its intensity, location, scope, and financing. Those facets and attributes often evolve in response to the specific reasons why a person is dying. For instance, acuity of the situation calls for different interventions: a person who has a sudden, massive heart attack will need different things than someone experiencing gradual decline associated with a slow-growing tumor. The cause of the situation might also demand different interventions: dying as a result of a natural disaster will involve a different experience than dying as a result of a common, age-related disease. Timing also matters: dying while still in early childhood is vastly different from dying past age 100.

Across these facets, the goal of end-of-life care is, in general, to enhance the quality of life near

the end of life for people with a life-limiting illness and their care partners. There are, of course, many ways to achieve that quality, which themselves span biological, psychological, and social strategies. In practice, end-of-life care usually (and optimally) includes a collection of strategies and interventions, designed and implemented by a team of caregivers, all striving to enhance a person's experience in this important, ultimate developmental milestone.

Life Span Developmental and Biopsychosocial Perspective

Dying and death can occur at any point in the life span, and the timing of those events matter. It is useful to consider three different contexts in order to gain a comprehensive understanding of a person's dying and death. The first is to recognize that dying and death occur at a particular time in the development of the *individual*. As a person progresses through life, she grows in many different domains – physiological, psychological, social, and spiritual – and the point of her development influences her experience of dying and death. For example, the psychological resources available to a person who is dying are likely to be different for a younger person than an older person. Not only do basic cognitive functions (e.g., insight, reasoning, judgment) evolve and change across a person's life span, but so too does their perspective on life, based on the accumulation of experiences they have had and their relative place in their own history. Likewise, from a social perspective, death is more expected, more of an "on-time event," for an older adult than it is for an adolescent. Therefore, the death of any 16-year-old, regardless of circumstances, can seem more tragic than the death of a 90-year-old who has had a lengthy life.

The second important context is that of the *family*, the most central social network for most people. When an individual begins to die, she does so within a family network that is itself changing over time, with its own developmental history and milestones. When a parent is dying, the family will experience it differently if the children are very young, if the children are young adults launching their own lives, if the children are middle aged with their own growing family, and if the children are old and might even predecease their parent. In all these scenarios, the parent is still a parent, but the family itself is in a different developmental place. Consequently the parent's dying will affect the family in different ways, just as the family will affect the parent in different ways.

The third important context is the *culture*. This context incorporates specifics about the nation, region, state, province, principality, neighborhood, community, and at the most minute level, perhaps even the building where a person lives. Broadly speaking, the location in which a person is dying influences the experience, with its unique structure, resources, and systems. So too do the set of norms and values that characterize the group of people in which the dying person is situated. This context also incorporates the particular point in history at which a person is dying. Dying and death in the late 1800s were different processes than dying will be in 2050: changing technology, medical advances, mores and values, legislative policies, reimbursement structures, and other features all influence a person's journey through dying.

To return to the original point, dying is a unique experience for that *person*, in that *family*, in that *culture*, and at that place in *time*.

Mental Health at the End of Life

People near the end of life grapple with a variety of challenges that could have an impact on their mental health. These include serious medical conditions that bring a host of symptoms such as pain, fatigue, dyspnea, nausea, and constipation; intrusive treatments that often have side effects as debilitating as the disease they are meant to treat; functional limitations that interfere with activities of daily living and prompt increased dependence on others for assistance; the sheer amount of time spent in organizing and attending appointments with health-care providers, requiring a person to step out of the routine most people follow and live

instead according to other people's schedules and availability; financial obligations related to treatments and short or long stays in institutional settings; and, of course, living with the knowledge of one's foreshortened future and the uncertainty of what that future might bring. It is no wonder, then, that people who are dying are vulnerable to sadness, worry, and dread. Still, not every person who is dying is distressed.

The World Health Organization defines mental health as, "A state of well-being in which every individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (World Health Organization 2001). Note that this definition does not focus on the *absence* of significant psychological distress, but instead the *presence* of activities that promote continued engagement with life, even as death nears. Therefore, psychological assessment and intervention should focus on classic mental health symptoms, such as depression and anxiety, but they should also address ways to enhance psychological well-being more broadly. People who are dying also may benefit from interventions that help them clarify their goals and values, adopt useful coping skills, use effective communication strategies, maximize remaining abilities, and grapple with questions about identity and meaning in the face of mortality.

Moreover, to assume that dying is an entirely negative experience overlooks the varied positive outcomes that some people experience. That includes an incentive, however unintended, to review one's life and to reach a level of understanding and appreciation of what one has accomplished. An enhanced depth of relationship with friends and family is also possible, as is achieving a clarity of purpose necessitated by limited time remaining. Getting one's "house in order" can lead to reconnection, reconciliation, and renewal in unexpected ways.

Significant psychiatric problems do occur as people are dying, however, and their detection and treatment should be pursued with the same diligence as would be the case in any other group. Frank clinical syndromes are common in people with severe illnesses. These include depressive disorders (e.g., major depressive disorder), anxiety disorders (e.g., panic disorder, specific phobias), trauma- and stressor-related disorders (e.g., posttraumatic stress disorder), substance-related disorders (e.g., alcohol-use disorder), sleep-wake disorders (e.g., insomnia disorder), and, perhaps more rarely, eating disorders (e.g., anorexia nervosa, bulimia nervosa). These are the syndromes listed and described in taxonomic systems such as the International Classification of Diseases (ICD) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). Equally influential to quality of life is the presence of subsyndromal symptoms that, though less severe, are nonetheless distressing. Examples of those symptoms include apathy that leads to unhelpful social isolation, restlessness that depletes energy that could be spent on more affirmative activities, and rumination that distracts from important contemplation. Subsyndromal symptoms are common and deserve equal attention and intervention.

Mental health considerations are relevant to family and friends as well. Even before death, symptoms of grief may appear in a caregiver, and that sadness may be a natural response to an impending death. For example, in the case of a patient with advanced dementia, caregivers may begin to grieve as the disease follows its natural course, sometimes years before death. After death, grief is also a natural response. Although some experiences are common during bereavement (disbelief, sadness, longing, guilt), they are not ineluctable in sequence or duration. Variations in the experience are likely depending on the circumstances of the death, nature of the relationship with the person who died, and the time since death, among other factors. However, there is a difference between expected grief and *prolonged grief disorder*. The former is a natural emotional reaction to loss that does not impair a person's functioning to any great extent and typically resolves with time. The latter, on the other hand, is a more severe form of grief with a distinct symptom pattern that can include intense yearning for the deceased, bitterness over the loss, and difficulty accepting the loss. Prolonged grief disorder also appears to have a different response to treatment (Prigerson et al. 2008).

Psychological Assessment

Caring for people at the end of life requires knowing how they are thinking and feeling about their experience. Therefore, astute psychological assessment is the linchpin of care. When learning about a person with serious illness, psychologists will want to investigate traditional mental health symptoms, such as current and past anxiety and depression, but a comprehensive assessment will extend far beyond those symptoms. It is equally important to know about a range of topics covered in a usual clinical interview – a person's educational and work history, social support network, financial concerns, and spiritual philosophy – but also other features of a person's psychology that may matter to their current circumstances, preferred learning style, past coping strategies, and personality. Of course, extensive knowledge about a person's medical circumstances represents an important foundation for many, if not most, conversations. That includes asking patients about their understanding of their disease, prognosis, and current treatment regimen (and comparing that to information provided by the patients' health-care team, noting any discrepancies). A comprehensive psychological assessment involves multiple methods that may include interviews, questionnaires, and observations. Moreover, a comprehensive psychological assessment is multimodal and may involve input from patients themselves but also family, friends, medical records, and an array of health-care providers.

Given that some people who are dying may be quite limited in their ability to provide information themselves, due to cognitive or physical limitations, thought and care need to be given to how and when to obtain assessment details. Clinicians will need to consider the impact of sensory limitations, speech and language abilities, stamina, and consciousness that may fluctuate due to disease, treatments, and the dying process. Maximizing a patient's communication abilities means understanding these factors and managing the assessment, so tools (e.g., reading glasses, large-print materials) and timing (e.g., at the patient's best time of day, when there are few distractions and symptoms are well managed) are to the patient's benefit.

When a person is dying, there are likely urgent or at least proximate medical needs that dominate the situation, but it would be a mistake to overlook the role that frank psychopathology may play in the quality of a person's life at the end of life. The prevalence of psychiatric symptoms is quite high in people with life-limiting illness, and clinicians should investigate their presence as they would in any referral. Although studies vary widely in their estimates, mood and anxiety disorders may be present in more than a third of patients (Solano et al. 2006), and disorders based on DSM-5 or ICD-10 diagnostic criteria should be fully investigated. Self-report questionnaires can be used to assess symptom severity (as well as progress in treatment). Well-validated instruments include the Hospital Anxiety and Depression Scale (HADS), the Patient Health Questionnaire (PHQ-9), the General Health Questionnaire (GHQ-12), the Geriatric Depression Scale (GDS), and the Geriatric Anxiety Inventory (GAI).

One overarching suggestion in any kind of assessment is to remain mindful of the overlap between physical and psychiatric symptoms. It can be difficult, but very important, to tease apart symptoms that are due to a disease or its treatment from symptoms due to a psychological process. Indeed, the two may be interrelated. For instance, low energy may be a symptom of depression or an effect of chemotherapy, or both. Dyspnea may be a symptom of anxiety or related to chronic obstructive pulmonary disease, or both. Consequently, focusing on cognitive symptoms (e.g., hopelessness, worthlessness, guilt, fear, dread, rumination) may be more useful when determining the reason for a patient's symptoms (American Psychological Association 2007).

A final consideration has to do with the challenge of measuring constructs that are manifestly important when talking with patients who have serious illnesses but that defy the tools we have available. Patients (and caregivers) talk about forgiveness, acceptance, peace, dignity, and readiness to die, but scale development and assessment innovation have not been as important to the field as those concepts are to patients.

Psychological Interventions

Psychological challenges appear throughout the experience of living with serious illness. Psychological support can be useful throughout the experience as well. Beginning with the point at which a life-limiting diagnosis is made, psychologists can help patients understand their diagnosis, manage emotional reactions, communicate treatment preferences, and mobilize supports. As illness progresses, psychologists can offer both supportive and change-oriented interventions to promote adaptation to shifting circumstances. Following death, psychologists can provide services to the bereaved. Psychological interventions are relevant not only to patients but also to their informal caregivers and to their health-care providers, who may from time to time seek opportunities to help them cope with the stress of working in end-of-life care.

Selecting a treatment approach depends on the goals of the patient and targets for intervention. Treatments for psychopathology or subsyndromal symptoms that have been validated in other patient populations are reasonable alternatives to consider: evidence-based cognitive-behavioral, interpersonal, and brief psychodynamic approaches may be useful, though those treatments have not been validated in patients with serious illness, and modifications may be needed in end-of-life circumstances (Kasl-Godley 2011). Other approaches may contain elements with obvious face validity for people who are dying. Acceptance and Commitment Therapy (ACT) (Hayes et al. 2012), with its focus on acknowledging symptoms rather than trying to change or dismiss them, may help patients whose symptoms may, in reality, not improve. Likewise, existential therapies that concentrate on meaning making in the face of mortality have obvious application (Spira 2000).

Recently, several new types of psychotherapy have been developed that are specifically designed to address the psychological well-being of patients near the end of life. The two with the most empirical data so far regarding their efficacy are Dignity Therapy and Meaning-Centered Group Therapy. Dignity Therapy (DT) (Chochinov et al. 2005) uses a set of facilitated questions posed by the therapist to help patients identify past accomplishments, values, and goals. Themes that are addressed include generativity, the continuity of self, role preservation, the maintenance of pride, hopefulness, and concerns about the aftermath of one's death. DT sessions can be recorded, and a transcript can be used to create a "legacy document" that captures the patient's life in a form that can be shared and retained by family members. Patients and family member report that DT is helpful, although its impact on anxiety, depression, and quality of life is less clear. Meaning-Centered Group Therapy (MCGT) (Breitbart et al. 2004) combines existential and cognitive-behavioral techniques to help very ill patients restore meaning to their life. MCGT involves eight, weekly group sessions, 90 min in length that include didactics, discussion, and experiential exercises to help patients understand their illness and sustain hope and meaning. Recent evaluations of MCGT have found significant improvement in sense of meaning, faith, and spiritual well-being and significant decline in symptom-related distress and a desire for death.

Competence in Diversity and Inclusion

People arrive at the end of their life having traveled many different paths. Therefore, although dying ends in the same, universal cessation of basic biological functions, how it happens, and how people feel about it, vary widely. Each person has a unique developmental history that shapes his/her experience at the end of life, and health-care providers need to consider how individual differences might matter. Moreover, differences across nations, regions, and cultures can affect how an illness is experienced, how choices are weighed, how the health-care system operates, and the dynamics of personal and professional relationships. Generalizations about how racial or ethnic groups approach end-of-life issues may be a starting point, but only a starting point. It may be more useful to pay attention to cultural scripts, but recognize variability within groups based on socioeconomic status, acculturation, spiritual

beliefs, and other factors likely to vary from person to person (Smith et al. 2009).

In the usual domains of psychological practice – assessment and intervention – several considerations are important. Norms on many common assessment instruments are rarely available for particular groups based on age, gender, race/ethnicity, and socioeconomic status, and they are even more rare for people within those groups who are dying. Consequently, there is relatively little information about what is "normal" at the end of life in terms of psychological constructs in the domains of emotion (e.g., variations in positive and negative affect), cognition (e.g., decision-making processes), and personality (e.g., locus of control). In terms of evidence-based psychological treatments, interventions designed for the end of life are so fledgling that there have been virtually no systematic evaluations of their effectiveness in subgroups of diverse patients. Therefore, providers will have to be flexible and open-minded in their practice, making sure to inquire about the background, experience, beliefs, and preferences of the particular patient and family with whom they are working.

Palliative Care and Hospice

One common point of confusion among the public, and even some health-care professionals, is the relationship between palliative care and hospice. Palliative care is a broad category of care designed to help people coping with serious illness. This type of specialty care is, according to the World Health Organization, "an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual" (http://www.who.int/cancer/palliative/definition/en/). As such, palliative care is provided to people throughout the disease trajectory, from diagnosis to death; in a variety of care settings, from home to outpatient and inpatient; to any type of patient, from children to older adults; and with any type of severe disease. Palliative care generally involves a holistic, interprofessional approach to care that can benefit both patients and family members. A growing body of research suggests that not only does palliative care improve quality of life, but it also extends life for some patients while at the same time reducing costs (Higginson and Evans 2010; Morrison et al. 2011).

Hospice, by contrast, is a particular type of palliative care. This service adopts a palliative care philosophy when supporting patients very near the end of life. Like palliative care, hospice can be offered to any type of patient, with any type of life-limiting illness, and can be provided at home or in a residential or institutional setting. In the United States, hospice has included a suite of services, reimbursed by the Medicare Hospice Benefit, as a complement to other health-care services a patient might receive. Traditionally, patients are eligible to receive hospice care when a physician certifies that a patient has fewer than 6 months to live. In addition, hospice is offered if patients are no longer pursuing curative treatments. In recent years there has been some movement to reduce these restrictions, with some pilot programs testing more relaxed eligibility criteria. In general, however, hospice is reserved for patients very close to death, whereas palliative care is appropriate, and perhaps most beneficial, when initiated early in the course of a disease.

Interprofessional Collaboration

Because end-of-life care aims to enhance quality of life broadly, it addresses patient needs in many domains. A biopsychosocial-spiritual approach to care recognizes the complex interplay among a patient's medical condition and treatments, psychological adaptation to serious illness, the social context in which the experience of illness occurs, and a person's spiritual interpretation of their circumstances. As a result, a team of professionals is typically involved in providing end-of-life care. That team can include a broad range of professionals from many disciplines, all of whom have something important to add to a patient's care.

A typical palliative care team, for instance, includes a physician, nurse, social worker, and chaplain. In some settings, end-of-life care is also provided by psychologists, psychiatrists, occupational therapists, physical therapists, speech-language pathologists, pharmacists, dieticians, aides, and homemakers. Hospice also utilizes volunteers for peer support. Of course the most essential members of the team are the patient and the family, who bring their own perspective, expertise, expectations, and needs.

The concept of collaborative care has evolved in recent years, as the importance of an integrated effort has become more apparent. Teams were first known as "multidisciplinary," with professionals from different disciplines developing their own independent treatment plans for patients that were later shared among team members. The terminology changed to "interdisciplinary teams" when team members from different disciplines were encouraged to assess and develop a treatment plan collaboratively. More recently, the term "interprofessional team" has come into widespread use, with an even greater emphasis on team members understanding and appreciating the contributions of each discipline. Therefore, a true interprofessional team that provides end-of-life care would concentrate its efforts on sharing information and expertise to develop an integrated care plan that involves several disciplines, each contributing unique expertise that dovetails with that of other disciplines. Effective interdisciplinary care depends on several factors, including timely and comprehensive communication among team members, a shared philosophy about care, transparent decision-making, a clear delineation of roles, respect for the competencies each discipline brings to the care plan, and provision of mutual support (Hanks et al. 2009). This model of care is likely to become even more preeminent as its benefits become more widely substantiated.

Supporting Formal Caregivers

Emotions run high in much of end-of-life care because the decisions are complex, time is limited, and the stakes are high. Stress is unavoidable, and a genuine challenge for providers is finding a way to manage it. Without doing so, burnout is likely. Signs of burnout include emotional exhaustion, pessimism, cynicism, and self-doubt (Maslach 2001). Providers who are burned out may find themselves disengaging from patients, maintaining a more safe emotional distance in order to avoid any disappointment or sadness. Risk factors for burnout include occupational time pressure, frequent exposure to suffering, interprofessional team conflicts, and uncertainty about one's professional competence. At the same time, protective factors include having ample time to spend with patients and families, receiving adequate training about communication principles, stable personal and professional relationships, and positive professional appraisal (Pereira et al. 2011). In the face of burnout, effective interventions involve obtaining peer consultation and supervision, seeking continuing education, establishing a satisfying work-life balance, and recognizing when down time is needed and taking it (Vachon 2006).

One role that psychologists can play in end-of-life care is supporting other providers in their work. With expertise in the interplay among thoughts, emotions, and behavior, psychologists are in a unique position to educate and intervene to help individuals and teams manage the challenges of the intensity of end-of-life care. As they educate staff about the mental health needs of their patients, so too can they educate staff about how to promote their own mental and physical health. Psychologists also may be called in to facilitate support or process groups to help teams work more effectively.

Ethical Issues

That so many ethical issues arise in end-of-life care is perhaps an indication of the importance of this moment in a person's life. It brings to a close every other chapter of life that preceded it, and it is therefore invested with great meaning for individuals, families, and cultures. At the same time, ethical issues arise in end-of-life care because it is a nexus for complicated, fast-moving, multifaceted

situations that involve many people and many difficult decisions. Broadly, many of these ethical issues center on autonomy: the extent to which an individual has the opportunity (and ability) to live and die when, where, and how they wish. People have strong preferences regarding the end of their lives, and those preferences intersect with beliefs within the family, proscriptions dictated by faith traditions, and guideposts articulated by legal doctrine and public policy. Ethical quandaries arise when there is tension between opposing beliefs or ideas. For example, ethical principles are in conflict when deciding whether a patient who is in severe pain should be treated with morphine (respecting the ethical principle of beneficence), even though that treatment might lead to the patient's extreme sedation and might even hasten death (the ethical principle of nonmaleficence). Many health-care organizations have in place trained ethics committees to help patients, family, and staff weigh complex decisions, though these decisions are rarely easy.

Conclusion

Dying and death are universal human experiences, yet conversations about them are relatively rare in contemporary society. That is generally true within the field of psychology as well, although there is an obvious role for the discipline in research, education, and practice in this area. Indeed, as science reveals the increasingly interconnected nature of the body and the mind, and as health-care adopts integrated, interprofessional models, psychology has much to add to end-of-life care. Assessments and interventions with patients and families are foundational contributions, even if they are in their fledgling stages of development. There are great opportunities, great challenges, and great satisfactions in this work, present at the zenith of life.

Cross-References

- ▶ Acceptance and Commitment Therapy
- ▶ Anxiety Disorders in Later Life
- ▶ Cognitive Behavioural Therapy
- ▶ Decision Making
- ▶ Distance-to-Death Research in Geropsychology
- ▶ Family Therapy
- ▶ Grief and Bereavement: Theoretical Perspectives
- ▶ Interpersonal Psychotherapy
- ▶ Mental Health and Aging
- ▶ Mindfulness Approaches
- ▶ Palliative Care
- ▶ Psychodynamic and Humanistic Approaches
- ▶ Subsyndromal Psychiatric Disorders

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English Longitudinal Study of Aging (ELSA)

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Synonyms

Aging cohort; Health; Lifestyle; Retirement; Panel studies

Definition

The English Longitudinal Study of Ageing (ELSA) (Steptoe et al. 2013a) is a multidisciplinary panel study that collects a comprehensive array of measures on a representative sample of men and woman aged 50 and over who are living in England. Repeated measures covering health, economics, psychology, lifestyle, and social connections are collected from the same individuals over time, allowing researchers to study the dynamics of the aging process.

The ELSA Sample and Study Design

ELSA is sampled from the Health Survey for England (HSE), a large annual cross-sectional survey on the health of the population of England (Mindell et al. 2012). Sample members recruited at wave 1 (2002/2003) were individuals who had previously taken part in 1 of 3 years of the HSE (1998, 1999, and 2001) and were aged 50 or over at the time of the wave 1 interview. Subsequent ELSA data collection waves have taken place biennially, in 2004/2005 (wave 2), 2006/2007 (wave 3), 2008/2009 (wave 4), 2010/2011 (wave 5), 2012/2013 (wave 6), and 2014/2015 (wave 7). The eighth and ninth waves of data collection are planned for 2016/2017 and 2018/2019, respectively.

New study participants are recruited during some waves in order to compensate for the aging sample population and to refresh the younger age groups. This serves to maintain representation of all ages 50 and over in ELSA. Refreshment sampling to date has recruited members aged 50–52 at wave 3 (HSE 2001–04), aged 50–74 at wave 4 (HSE 2006), aged 50–55 at wave 6 (HSE 2009–11), and aged 50–51 at wave 7 (HSE 2011–12), with plans to continue to recruit new sample members aged 50–51 at future waves.

The "core members" of the ELSA sample are individuals aged 50 and over, living in private residences, who were recruited through HSE at either the first wave of ELSA or at any of the subsequent refreshment samples. The data also includes interviews with "young partners," who are individuals under the age of 50 whose partners are core members and "new partners" in the correct age range who entered relationships with core members after those members were recruited to ELSA.

Mode of Interview

Data are collected from respondents in their own home, every 2 years and by means of a computer-assisted personal interview (CAPI) that is delivered by a trained interviewer. The CAPI includes questions on the respondents' demographics, household membership, work and retirement activities, economic circumstances, health, and behavior. A self-completion questionnaire includes questions on well-being, social participation, quality of life, and social networks, along with questions considered to be sensitive. The main interview takes approximately 85 min to complete for an individual interview and around 2 h when two people within the same household are interviewed concurrently.

At waves 2, 4, and 6, core members who completed a main interview were offered a visit from a qualified nurse, where a blood sample was taken and a series of performance and biomedical tests were conducted. The nurse visits took place soon after the main interviews and were of similar duration to the main interviews.

Unless they expressly ask to leave the study, all participants who decline to be interviewed in a given wave are offered a full interview at each future wave. From wave 3 onward, individuals electing to leave the study, or those who had declined to take part in two consecutive face-to-face interviews, were offered a telephone interview as an alternative to the standard interview. The telephone interviews were approximately 10 min long and respondents were asked a small number of questions about their health, work and benefits, marital status, and accommodation. As well as providing limited information in their own right, these telephone interviews are also a useful strategy for retaining sample members who might otherwise leave the study, with some agreeing to a full interview at future waves.

Individuals at wave 1 were not recruited if they lived in institutions such as retirement homes, elderly care facilities, hospices, or prisons. From wave 3 onward, any respondent who had previously taken part in a main interview at wave 1 but had later transitioned into a care home or other institution was deemed eligible for interview. As a consequence of this, researchers now have the opportunity to study the circumstances that surround a respondent's move from a private residence to an institution. In situations when study participants have been unable to consent to an interview for themselves, because of a physical, mental, or cognitive disability, a proxy informant, usually a close family member or friend, has been asked to complete a 20-min interview on the participant's behalf. The proxy interview focuses mainly on key demographic information and general health status, omitting attitudinal questions that a third person is unlikely to be able to answer. Prior contact with a respondent who later requires or requests interview-by-proxy gives opportunity to researchers to ascertain what factors and mechanisms might contribute to later life disability or impairment.

An end of life (EOL) interview was introduced into ELSA at wave 2. The EOL interview aims to capture important information about how a deceased study member's life might have changed in the years before their death and how their assets were distributed after their death. Like proxy interviews, EOL interviews are generally undertaken with a close family member or friend and include questions on the health of the deceased, any care or support they had received, their mood and memory, problem behavior and financial questions such as funeral expenses, inheritances, and private health care. EOL interviews have taken place at waves 2, 3, 4, and 6 with a response rate of 66% (n=135), 54% (n=375), 58% (n=242), and 74% (n=242) from all issued cases, respectively.

Response Rates

Cross-sectional response rates at a given wave of ELSA are calculated by dividing the total number of respondents by the total number of individuals deemed eligible for that wave. Response rates are based on core members and not on those who have died, who have moved to an institution or care home, or who are living outside the UK. Waves 1, 2, 3, 4, 5, 6, and 7 have achieved response rates of 66%, 82%, 73%, 74%, 80%,

78%, and 77%, respectively. These response rates include both those who were eligible for wave 1 and refreshment sample members who joined the study at later waves. By wave 6, 56% of all eligible wave 1 core members had given an interview at every wave of ELSA.

Much like other panel studies, the success of ELSA is dependent on the retention of respondents for follow-up interviews. Loss to follow-up can occur because respondents are no longer eligible for interview, and for ELSA, this includes those who have died or who have moved outside of the UK. The majority of respondents who are deemed ineligible to participate in ELSA are participants who have died: 23.5% (n=2680) of the core sample members at wave 1 (n=11,391) had died by wave 6. There is strong evidence to suggest that within the ELSA sample, participants with higher numeracy are less likely to drop out of the study compared with their less-numerate counterparts. Higher levels of education also appear to predict lower levels of attrition, but this association appears to be limited to younger respondents (i.e., those aged 50–64) (Banks et al. 2011). Lower retention rates have also been reported in ELSA compared with HRS, but the mobility of respondents, maturity of the study, interviewer quality, and sampling methods were not found to be sufficient to explain the gap in attrition between the two studies; rather it was suggested that higher incentivization in HRS compared with ELSA and cultural differences in the willingness of the two populations to take part and remain in scientific surveys might explain the difference (Banks et al. 2011).

Weighting: Cross-sectional and longitudinal weights are produced to minimize any bias resulting from differential nonresponse and to ensure that the respondent sample is representative of the population of interest (adults aged 50 and over living in private households in England). At wave 1, a weight was derived to minimize any unrepresentativeness of the sample population due to nonresponse at HSE, refusal to be interviewed post-HSE, and nonresponse at wave 1. Derivation of the weight involved calibration of the age-sex profile of core member respondents to that of the population represented by the Census 2001. Wave 2 weights were calculated to adjust for differential nonresponse between waves 1 and 2 and population representativeness. From wave 3, refreshments were added to the main sample, requiring the need for separate cross-sectional and longitudinal weights. Separate weights have been produced to address differential nonresponse for interview completion, completion of the self-completion questionnaire, participating in a nurse visit, and giving a blood sample at waves 2, 4, and 6. A detailed description of the weights can be found in the user guides and technical reports that can be accessed at http://www.elsa-project.ac.uk/.

Linkage to administrative data: Since ELSA's inception, respondents have been asked to give their permission to link their survey data to National Health Service (NHS) Hospital Episode Statistics (HES) data, which contain details of diagnosis, treatment, length of stay, and type of discharge. Respondents have also been asked to give permission to link their records to the NHS Central Register mortality data and cancer registration data. Year and age of death information for deceased respondents is available. Analysts who wish to utilize the detailed mortality data, HES, or cancer data are able to request special permission to access this data. Permission from respondents was also obtained to link survey data to official records of national insurance contributions, welfare and benefit receipt, and details of any tax credits they may be claiming, and these data will be available to analysts shortly.

Data Access

Anonymized archived data from ELSA are available from the UK Data Service (UKDS, https://www.ukdataservice.ac.uk/). The main dataset is made available to *bona fide* researchers on submission of a request to UKDS. The archive data are used primarily by academics and government departments. Requests for restricted data (geographically more detailed and/or relating to administrative data linkages) can be made by

application to the ELSA Linked Data Access Committee; an application form can be found at www.ifs.org.uk/elsa.

International Comparisons of Health at Older Ages

To enable cross-country comparisons, ELSA has been developed with close consideration of its two sister studies, the Health and Retirement Study (HRS; USA) and the Survey of Health, Ageing and Retirement in Europe (SHARE; 20+ European countries and Israel). HRS, ELSA, and SHARE have also been used as models for the development of other aging studies such as the Irish Longitudinal Study on Ageing (TILDA), the Northern Ireland Cohort for the Longitudinal Study of Ageing (NICOLA), the China Health and Retirement Longitudinal Study (CHARLS), the Korean Longitudinal Study on Ageing (KLoSA), the Mexican Health and Aging Study (MHAS), the Japanese Study of Aging and Retirement (JSTAR), and the Brazilian Longitudinal Study of Health, Ageing and Well Being (ELSI-Brasil). Understanding which factors drive national differences in factors such as retirement, chronic disease, and mortality is pivotal for informing policies aimed at improving health and well-being. For example, comparison of disease rates in ELSA and HRS populations revealed that at every wealth level the English population in late middle age has lower levels of diabetes, hypertension, heart disease, myocardial infarction, stroke, lung disease, and cancer and lower mean levels of C-reactive protein, high-density lipoprotein, and cholesterol levels than their US counterparts (Banks et al. 2006). Although older adults in the USA appear to suffer higher burdens of chronic disease, they have been reported as being cognitively healthier than older adults in England (Langa et al. 2009), and when health is operationalized into functional domains that include measures of pain, cognition, disability, depression, and physical performance rather than defined by absence of disease, English adults were found to be only slightly healthier than US adults (Cieza et al. 2015).

Content of Waves 1–7

Respondents are not always subject to the same questions at every wave of ELSA. Instead some questions are rotated on and off successive waves of the study, often to allow time to include new questions. The information in Table 1 provides a broad overview of the content included in ELSA. The primary content of the survey is arranged in separate modules that broadly focus on health, work, financial circumstances, cognitive function, and psychosocial measures. A number of substudies are also ongoing and each primary module and substudy is briefly detailed below.

Health Module

The health module includes self-report measures of general health and physician-diagnosed conditions including mental illnesses, longstanding illness/disability, symptoms indicative of particular health conditions and health behaviors. There are also objective measures relating to gait speed, physical performance, anthropometrics, and biological markers. During wave 6, a module on sexual relationships and activities was introduced to the study. A report covering sexual activity, problems with sexual functioning, and concerns about sexual health has subsequently been published (Lee et al. 2016). Information on drug prescription and adherence data was first collected during the nurse visit at wave 6 and will be repeated at wave 8, with the aim of producing a unique national longitudinal dataset on medication use in an aging population. The name of each prescribed medicine was recorded and allocated a code number corresponding to the British National Formulary (BNF) listing. Collection of polypharmacy data should provide an opportunity for a deeper understanding of the factors that contribute to successful use of prescribed drugs in older people. At wave 7, an objective measure of hearing ability was introduced to the study to further complement the self-reported hearing questions that were already present in the survey. The HearCheck device, developed and produced by Siemens (Munich, Germany), is a handheld device with an ear cup that is held against the respondent's ear (Parving et al. 2008).

English Longitudinal Study of Aging (ELSA), Table 1 Information collected in the ELSA, waves 1–7. For measures not administered at every wave, the brackets denote the wave of data collection

Demographic data	**Consumption**
Household membership	Housing (rent and mortgage)
Living relatives	Vehicle and durables ownership
Marital status	Fuel, leisure, clothing (2–7), food, health insurance
Ethnic group and country of birth	Transfers, charitable giving/child trust funds (2,4–7)
Educational qualifications	**Expectations**
Age completed full-time education	Mortality, employment, inheritances, and bequests
Occupation of main carer when respondent was 14 years old	Income
	Adequacy
Parents age and cause of death	Ability to work
Income and assets	Movement into nursing home (2, 6, 7)
Earnings	Perceived financial position (2–5)
State benefits	Future housing and care needs (6,7)
Sources of income	Paying for care and knowledge of care funding (7)
Financial and physical assets	**Health**
Primary housing wealth and mortgage debt	Self-reported health
Business wealth	Disability and mobility; aids, sources of help, who pays
Debt	Eyesight and hearing (self-report)
Life insurance	Objective HearCheck hearing test (7)
Lifetime receipt of inheritance and gifts (6,7)	Dental health (3,5,7)
Pensions	Physician-diagnosed conditions (self-report)
Current pension plan and past pension details	Falls, fractures, pain and joint replacements
Current contributions	Urinary incontinence and bowel incontinence (6,7)
Accrued pension wealth (self-reported)	Menopause (4–7)
Knowledge of female state pension age (3–7)	Sexual function and attitude (6)
Knowledge of male state pension age (6,7)	Cancer screening (5, 6,7)
State pension deferral (4–7)	Polypharmacy (6)
Employment	Psychiatric and emotional problems
Job details, normal pay and hours	General health questionnaire (GHQ-12)
Health and work disability (2–7)	CES-D depression scale
Age and reasons for retirement if retired	**Health behaviors**
Employer name and permission to contact	Physical activity – in general and at work
Desired, offered, and requested workplace adaptions (2–7)	Alcohol consumption
	Smoking status and history
Social and civic participation	Consumption of fruit and vegetables (3–7)
Provision of unpaid help	Sleep duration and disturbance (4,6)
Informal caregiving and volunteering	**Cognitive function**
Civic, social, and cultural participation	Memory: word list recall, immediate and delayed recall
Accessing local amenities and services (1–2,4–7)	Memory: prospective (1–5)
TV watching (4–6)	Executive function: letter cancelation – accuracy and speed of mental processing (1–5)
Social networks and support	
Social isolation and loneliness	Executive function: word finding (1–5 and 7)
Transport	Numerical ability (1,4,6,7)
Social capital (1, 3,7)	Literacy (2,5,6,7)
Perceived discrimination (5)	Fluid intelligence (6)
Religiosity (5)	Backward counting from 20 (7)
Digital inclusion (6.7)	Serial 7s counting backward from 100 (7)
Psychosocial factors	Naming objects (7)
Control and demand	Quality of cognitive interview (interviewers assessment)
Effort–reward balance (2–7)	Proxy interview of cognitive function – IQCODE scale (2–7)
Subjective social status	
Age at which middle age ends and old age begins (1,3,7)	**Physical examination and performance**
Self-perceived age (2,4,6,7) and desired ages (2,4)	Walking speed (for ages 60 and over)
Experience and perceptions of aging ()	Height and weight; waist and hip circumference (2,4,6)
Sense of collectiveness (4)	Blood pressure
Altruism (4)	Lung function
Pet ownership (5)	Chair stands; balance, leg raises, and grip strength (2,4,6)

(*continued*)

E

English Longitudinal Study of Aging (ELSA), Table 1 (continued)

Psychological and social well-being	**Blood assays**
Quality of life (CASP-19)	DNA extraction and storage (2,4,6)
Satisfaction with life scale – (2–7)	Total LDL and HDL cholesterol and triglycerides (2,4,6)
Ryff well-being scale (2 subsample)	C-reactive protein, fibrinogen (2,4,6)
Positive affect (5) –6?	Glucose, glycated hemoglobin (2,4,6)
Personality (5)	Hemoglobin and ferritin (2,4,6)
Time use and affect (6,7)	White blood cell count (4,6)
ONS well-being questions (6,7)	IGF-1, DHEAS (4)
	Vitamin D (6)
	Biological samples:
	Cortisol – from hair (6), from saliva (2,4)

The participant is asked to indicate when they hear a beep, and a detection threshold is recorded.

Financial Circumstances Module

ELSA captures detailed information on all aspects of the household budget and on economic circumstances including wealth holdings, household income, pensions, consumption, future expectations, employment, and retirement and work disability (see Table 1). In an aging world, where individual pension provision is becoming an increasingly important issue and more complex decisions need to be made at increasingly older ages, it is vital that individuals are able to understand the financial choices available to them in terms of savings, annuitization, insurance, and other related choices. Using these data, it has been shown that numeracy levels are strongly correlated with knowledge and understanding of pension arrangements, perceived financial security, measures of retirement saving, and investment portfolios, even after controlling for factors such as cognitive ability and educational qualifications. This suggests that simple retirement planning information could be beneficial to low-numeracy and low-education adult groups (Banks and Oldfield 2006).

Engagement of older adults in paid work is becoming a policy issue of major importance, in part because of the economic pressures of an aging population. ELSA captures details on many aspects of employment including current work status, types of work performed, and reasons for remaining in or for leaving work. The study also contains questions on whether health problems limit the respondent's ability to carry out paid work and the level of physical activity required to carry out a current job. It is not only through paid work that older adults contribute to society as many partake in productive activities such as volunteering and caring and details of these activities are also captured in ELSA.

In recent years, there has been an increasing focus on the wealth holdings of older people, especially with respect to different types of costs that older adults will face, such as funding their future retirement needs and payment for long-term care. To help understand these issues, a new set of questions on perception of social care were added to the existing social care questions at wave 7 and included questions on whether respondents expect to need formal social care at home, whether they expect to pay for it, and their knowledge of care funding.

Cognitive Function Module

The cognitive measures in ELSA are designed to assess cognitive ability across a number of dimensions, including learning and memory, word-finding ability, executive function, speed of processing, and numerical ability. At wave 7, the cognitive function questions were adapted to temporarily remove a measure of fluid intelligence and to add questions to identify early signs of dementia. New measures of cognitive function, taken from the mini–mental state examination were added at wave 7, which involved asking the respondent to count backward in ones from 20, to count backward in sevens from 100, and to name items and people from a standardized description. Cognitive test scores used in ELSA have been demonstrated to indicate risk of death from a number of chronic diseases (Batty et al. 2016).

Psychosocial Measures Module

ELSA includes a significant number of measures related to psychological well-being, including scales for determining depression (CES-D), satisfaction with life (SWLS), and quality of life (CASP-19). Notably, these scales have been used in conjunction with other markers of health and physical performance in an attempt to understand the complex relationship well-being forms with physical health. High levels of well-being are a significant contributor to healthy aging, but maintaining positive well-being can present a challenge in older adults who are experiencing ill health, caring for a sick or disabled spouse, or suffering from bereavement. Higher levels of happiness and enjoyment have been found to be associated with reduced later life disability and mobility (Steptoe et al. 2014a), and increased pleasure and enjoyment of life have been linked to a reduced risk of incident frailty in ELSA participants (Gale et al. 2014). A sense of purpose and meaning in life has also been linked to increased survival (Steptoe et al. 2014b). It is clear that determinants of well-being in older adults extend beyond health concerns and higher levels of well-being have been reported in respondents who participate in social activities such as volunteering and paid work, providing that they felt adequately appreciated for their contributions (McMunn et al. 2009).

In addition, ELSA contains questions on social activities such as going to the museum, theater, cinema, and eating out and participation in organizations such as social clubs, religious groups, or committees. Data on the emotional closeness and amount of contact with a spouse or partner, children, and friends are also collected. It has been demonstrated that higher levels of social isolation, defined in terms of contact with family and friends and partaking in civic participation, is an independent predictor of survival (Steptoe et al. 2013b). ELSA collects information on the use of the Internet and email, and these measures have been linked to reductions in cognitive decline in older adults (Xavier et al. 2014). Questions on perceived discrimination were introduced to ELSA at wave 5. A recent study using data on perceived age discrimination revealed that individuals who were older, less wealthy, and more educated and who had retired were more vulnerable to this type of perceived discrimination (Rippon et al. 2014).

Substudies

Objective Physical Activity

Self-reported measures of physical activity have been used to demonstrate that taking up physical activity in later life is associated with reduced risk of developing major chronic disease, depressive symptoms, and physical and cognitive impairment (Hamer et al. 2014). Physical activity measures based on self-report are limited because they rely on accurate recall and accurate reporting. Respondents often fail to take into account the totality of their activity throughout the day, thus the need for objective data. During wave 6, a subsample of 330 respondents were given wrist-worn accelerometers for 7 days so that objective measures of physical activity could be recorded. The data are currently being analyzed.

Risk Preferences

A risk module aimed at measuring participants' willingness to take risk and to delay reward was carried out in wave 5 on a subsample of 1060 ELSA respondents. The module involved two incentivized tasks and the chance to win small amounts of real prize money. The risk module was designed as a computer-assisted self-administered interview but with a computer-assisted personal interview (CAPI) for those who wanted, or needed, the interviewer to assist them with operating the laptop.

Dementia

The inclusion of an assessment of dementia in the sample is vital if ELSA is to contribute to the better understanding of cognitive impairment at older ages. ELSA will conduct interviews in 2017 with about 1,000 ELSA participants aged 65 and older who have previously participated in four to eight waves of data collection. Respondents will be asked to complete additional cognitive tests that will provide accurate information about

cognitive abilities applicable to the diagnosis of dementia and the identification of mild cognitive deterioration. The tests will match those administered in HRS and which are themselves derived from the Aging, Demographics, and Memory Study (ADAMS).

Retrospective Life History Interview

At wave 3, data from 7,855 participants were collected on upbringing, early life adversity, family structure, schooling, employment and earnings, parity and reproductive history, living conditions in residences at different stages of life, relationship with parents when they were a child, childhood health, smoking, and other important events in their lives. To aid recall of past events, a "Life History Calendar" was used to help individuals remember past circumstances more accurately. The aim of the interview was to collect data to understand the life course of respondents and to analyze associations between earlier life experiences and well-being, health, and economic circumstances in later life. A recent study that utilized these measures revealed that material poverty in childhood is linked to higher levels of depression, poorer memory, and slower walking speed in later adult life (Tampubolon 2015). A separate study has reported associations between early parenthood, larger family size, and poorer health outcomes in older adults (Grundy & Read 2015).

Anchoring Vignettes

Interpretation of measures across different groups within a population sample, or across national contexts, is problematic because different groups may interpret similar situations differently. To try and circumvent this problem, respondents were asked in wave 3 to complete supplementary self-completion questionnaires on health or work disability that contained anchoring vignettes. Respondents were first asked to rate, on a five-point scale, various aspects of their own circumstance; they were then asked to do the same thing for a hypothetical person with the same background and age as the respondent. Differences between the ways respondents rated hypothetical persons compared with themselves were then examined. Anchoring vignettes have recently been used to show that cultural differences in terms of mental health norms explain some of the differences in self-reported depressive symptoms between respondents in ELSA, SHARE, and HRS (Mojtabai 2015).

ELSA Genome-Wide Association Study: It is seldom that large-scale population studies possess both genome-wide genotyping data as well as a large array of phenotypic data. The inclusion of such information in ELSA has great potential to augment what is already known about how genomic variation is linked to disease risk and how certain characteristics interact to modify genetic susceptibility. In 2013/2014, we used the Illumina Omni 2.5–8 chip (Illumina Inc, San Diego, Ca., USA) to perform genome-wide genotyping of around 2.5 million single nucleotide polymorphisms (SNPs) and related genomic features for approximately 7,400 ELSA participants. The same genotyping chip had previously been used in HRS, enabling direct comparisons of the ELSA and HRS samples to be carried out without the need for imputation-based meta-analysis. The ELSA GWAS data have been deposited in the European Genome-phenome Archive (EGA) and are available to *bona fide* researchers. Data access is regulated by the ELSA Genetic Data Access Committee (EGDAC). Applicants can request access to the ELSA GWAS data with or without linkage to phenotypic information or can apply to commission genotyping, because not all the SNPs have been genotyped.

Ethics: All participants gave written informed consent at the recruitment wave to participate in the study and have given separate written permissions to allow linkage of their data to administrative data sources. At each subsequent wave, the participants' consent to participate was reaffirmed in writing. Telephone interviewees gave verbal consent to participate.

Ethical consent for the study was granted by the NHS-REC and by the University College London Research Ethics Committee.

Management of ELSA

From inception until 2014, the principal investigator of the study was Professor Sir Michael Marmot. In 2014, Professor Andrew Steptoe took over this role and is the current principal investigator and Professors James Banks and James Nazroo have been co-PIs of the study since its inception. Dr Nina Rogers manages the study. ELSA is a collaboration between the Department of Epidemiology and Public Health at University College London, the Institute for Fiscal Studies, the University of Manchester, and NatCen Social Research. The study has been supported in specialist areas by expert groups at the University of East Anglia, the University of Cambridge, the University of Exeter, and the University of Nottingham.

Funding

Around half of ELSA's funding since wave 1 has come from the US National Institute on Ageing (NIA). Various UK government departments have provided substantial amounts of funding to ELSA and current sponsors include the Department for Work and Pensions, the Department of Health, and the Department for Transport. Previous funders of the ELSA include the UK Department of Education and Skills, the Department for the Environment, Food and Rural Affairs (DEFRA), Her Majesty's Treasury, the Department of Trade and Industry, Her Majesty's Revenue and Customs (formerly the Inland Revenue), the Office of the Deputy Prime Minister, and the Office of National Statistics (ONS). The Economic and Social Research Council currently coordinate funding between the UK government funders and ELSA.

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Entrepreneurship and Aging

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Synonyms

Elder entrepreneur; Gray entrepreneur; Second career entrepreneur; Senior entrepreneur; Third age entrepreneur

Definition

Older entrepreneurship is the discovery, evaluation, and exploitation of future goods and services when in age 50 and above.

Introduction

The world's population will age dramatically. Increased life expectancy, declining fertility rates, and the aging baby boom generation lead to a rising proportion of older people. By 2050, people aged 65 and above will constitute over 26% of the population in developed countries (Cohen 2003). The increase in older people will affect how and to what extent older people remain active participants in the workforce. A growing number of older people will stay in their jobs or remain economically active through other means (Kautonen et al. 2011). An interesting aspect of this changing involvement of older people in the economy is the phenomenon of the older entrepreneur (de Bruin and Dupuis 2003), also known as gray entrepreneur, senior entrepreneur, third age entrepreneur, elder entrepreneur, and second career entrepreneur (Weber and Schaper 2004).

Definition of Older Entrepreneurs

Entrepreneurship is defined as the discovery, evaluation, and exploitation of opportunities to create future goods and services (Shane and Venkataraman 2000). This definition implies that entrepreneurship is a process with different phases of discovering, evaluating, and exploiting rather than a single event (Baron and Shane 2008). Outcomes of entrepreneurship include new businesses (i.e., new venture creation) but also business growth and innovations when managing the business. Entrepreneurship can thus be a continuous, lifelong process.

There is no agreement in the literature about what age the term "older" comprises (Weber and Schaper 2004). A possible cutoff point could be the retirement age, which is around 65 in many countries (Weber and Schaper 2004). However, many issues that confront older people in the workforce are also relevant for people in their fifties (de Bruin and Dupuis 2003). Some authors include people as young as 45 years of age, whereas for others the term "older" includes people of 60 years and above (Weber and Schaper 2004). Most scholars opt for a midpoint and define older entrepreneurship as starting a new business or being self-employed with age 50 and above (Ainsworth 2015).

Older entrepreneurship can thus be defined as the discovery, evaluation, and exploitation of future goods and services when in age 50 and above.

It is important to distinguish older entrepreneurs from older business owner. Older entrepreneurs recognize and evaluate business opportunities and then exploit or implement these opportunities to create something new (Shane and Venkataraman 2000). They can do this in the start-up phase to create a new business or within an existing business to grow and develop this business. Older business owners, in contrast, are defined as owning and managing a business, but they do not necessarily act entrepreneurially in the sense of identifying, evaluating, and exploiting new business opportunities. Older business owners own the business because they have either founded the business themselves or gained ownership through purchase or inheritance of the business. When the business owners have founded the business themselves, they have acted entrepreneurially at that time. Business owners who do not continue to identify and exploit new opportunities are not considered to be entrepreneurs. Thus, the tasks of the older entrepreneur differ from the tasks of the older business owner. The older entrepreneur deals with the identification and exploitation of new opportunities, whereas the older business owner manages an operating business. The difference between the concept of older business owner and older entrepreneur is also evident in data on the prevalence of older entrepreneurship.

Prevalence of Older Entrepreneurship

In general, the probability of being a business owner increases with age (Blanchflower 2001). People are gradually more likely to become a business owner through founding, buying, or inheriting a business and thus "flow into entrepreneurship" (Blanchflower 2001). Once being self-employed, many business owners manage their businesses until retirement or at least for a time of several decades.

In contrast, the probability of being an entrepreneur and starting a new business follows an inverse U-shape (Kautonen et al. 2014). Start-up activity gradually increases up to middle age and then decreases (Reynolds et al. 2004). The age group of 25–44 is more likely to start a business than any other age group (Reynolds et al. 2004). Consistently, the interest in becoming an entrepreneur decreases with age (Blanchflower 2001). Even though older people possess more human, social, and financial capital to start a business than younger people (Kautonen et al. 2011; Weber and Schaper 2004; Rogoff 2007; Singh and DeNoble 2003), they are less interested in self-employment (Blanchflower 2001). Hence, older people do not lack the skills or requirements for entrepreneurship but are less interested in entrepreneurship than younger people. Among workers in employment aged 50–75, only 14% would prefer to be self-employed (Curran and Blackburn 2001). The main reasons against self-employment are "no guarantee of income" (65%), "to late/feel to old" (60%), and "no job security" (50%) (Curran and Blackburn 2001).

Research on Motivation and Older Entrepreneurship

It is important to distinguish between research on older entrepreneurship as an outcome and research on older entrepreneurship as a predictor. The first line of research seeks to understand factors that drive or inhibit older people to engage in entrepreneurship. The second line of research examines older entrepreneurship as a predictor for performance measures. This paragraph describes the first line of research on older entrepreneurship as an outcome. The subsequent paragraph describes the second line of research on older entrepreneurship as a predictor.

Time Allocation Model

The time allocation model posits that the decreasing interest in entrepreneurship is the result of an age effect (Zacher and Gielnik 2014). The model suggests that the relative return of a business reduces as people become older. People allocate their time between income generating activities and leisure time to maximize the expected utility.

Waged labor results in an immediate income. In contrast, starting a new firm requires spending a certain number of weeks or months to exploit the opportunity. It takes time before a new firm is established and generates revenue. Consequently, the resulting income is delayed to some point in the future. As people age, the amount of time left is decreasing. As a result, people depreciate the value that is given to delayed income from entrepreneurship. Furthermore, with age the income from waged labor is increasing due to accumulated work experience. Thus, as people age, the opportunity costs to engage in entrepreneurship rise. Taken together, the delayed income from entrepreneurship and high opportunity costs compared to waged labor make it less attractive for older people to start a business.

Opportunity–Necessity Model

The opportunity–necessity model seeks to distinguish between different pathways that lead to entrepreneurship at older age (Rogoff 2007). According to the model, there are two different pathways why older people engage in entrepreneurship. Older people engage in entrepreneurship because they either have to ("necessity") or want to ("opportunity") (Rogoff 2007). The two different pathways are important to understand older people's underlying motivation for entrepreneurship. There are economic and social reasons that make it necessary for older people to engage in entrepreneurship ("necessity pathway"). One of the main economic reasons for older people to engage in entrepreneurship is that retirement funds shrink with negative effects on older people's wealth. To compensate for the shrinking retirement funds, older people remain motivated to earn a salary (de Bruin and Dupuis 2003). Self-employment then becomes an attractive option when older people are not able to stay in their jobs or find a new job. One of the main social reasons is that aging is often seen as a time of decline. Negative stereotypes against older workers are thus common in the population (de Bruin and Dupuis 2003). Age discriminatory practices in recruitment make it difficult for older people to remain in or enter the traditional labor market (Kautonen et al. 2011; Zacher and Gielnik 2014). Thus, starting a business might be a viable option for older people to stay economically active and have an income.

According to the opportunity argumentation, older people have characteristics that are favorable for entrepreneurship (Curran and Blackburn 2001). During their working lives, older people gain experience, acquire knowledge, build professional networks, and accumulate financial assets (Singh and DeNoble 2003). These factors facilitate discovering and exploiting opportunities.

Early Retirement: Self-Employment Model

Scholars describe in a deductive model the motivation of older workers who chose entrepreneurship as a transition into (or out of) retirement (Singh and DeNoble 2003). Entrepreneurship offers flexibility that makes it an attractive form of bridge employment for older workers. Entrepreneurs can more easily vary their hours and conditions of involvement (de Bruin and Dupuis 2003) and thus balance demands from personal life and work (Ainsworth 2015). Three types of early retirees that start a business are differentiated (Singh and DeNoble 2003). The "constrained entrepreneur" always wanted to become self-employed but was not able to follow this dream because of established or perceived constraints (e.g., liquidity, family). The "rational entrepreneur" compares his or her current career options with self-employment. This comparison is often based on financial reasoning but can also include non-monetary aspects (e.g., respect, fulfillment). The "reluctant entrepreneur" becomes self-employed because of a lack of employment opportunities on the traditional labor market.

Contingency Model

The contingency model posits that the assumption of a general decline of entrepreneurial activity with increasing age is too simplistic (Kautonen et al. 2014). Rather, older people's engagement in entrepreneurship is dependent on contingency factors like perceived age norms (Kautonen et al. 2011) and type of business (Kautonen et al. 2014).

Age Norms. Perceived age norms influence entrepreneurial intentions of older people

(Kautonen et al. 2011). These age norms refer to perceiving entrepreneurship as socially acceptable at any age and especially at the third age. Three mechanisms transfer the effect of perceived age norms on entrepreneurial intentions (Kautonen et al. 2011). The effect of perceived age norms influences entrepreneurial intentions via how positive individual's attitudes toward entrepreneurship are, how the individual perceives the amount of support from family and friends, and how the individual perceives their own ability to become an entrepreneur (Kautonen et al. 2011).

Business Type. The relationship between age and the engagement in entrepreneurship depends on the type of business people pursue (Kautonen et al. 2014). Scholars identified three different types of businesses that differ regarding the risk involved and regarding the prevalence in different age groups (Kautonen et al. 2014). First, "owner–managers" are growth-oriented and have ambitions to hire others. Being growth-oriented and ambitious requires having a higher-risk propensity. With age, the risk propensity declines and with it the willingness to engage in entrepreneurship as an owner–manager. In accordance with the model of Lévesque and Minniti (2006), the relationship between age and entrepreneurship follows an inverse U-shape for owner–managers. Second, "self-employers" want employment for themselves but are not intending to invest in the business or hire others. Similar to waged labor, self-employment involves a low-risk propensity and profit is distributed rapidly. The relationship between age and entrepreneurship for self-employers is significantly different from that of owner–managers. The close resemblance to waged labor and the human capital of older people lead to an increase in self-employment with age even for people in their 60s. Third, "reluctant entrepreneurs" are pushed into entrepreneurship because of a shortage of other employment options. They mostly engage in low-risk forms of self-employment and have a shorter investment horizon. Research shows that for reluctant entrepreneurs, the effect on entrepreneurship is relatively unaffected by age. In summary, with increasing age, entrepreneurs shift from growth-oriented businesses to low-risk businesses, such as simple forms of self-employment.

Research on Older Entrepreneurship and Performance

Research on older entrepreneurship as a predictor of performance suggests that the performance of older entrepreneurs differs from the performance of younger entrepreneurs (Weber and Schaper 2004). Being an older entrepreneur might be advantageous but can also be a possible constrain. Whether older entrepreneurs outperform younger entrepreneurs (or vice versa) depends on the performance measure like survival rate, growth, or family succession. It is important to note that in entrepreneurship research, all these performance measures are considered to be relevant.

Survival Rate. In general, survival rates among new businesses are relatively low with 63% of firms surviving after 4 years (Robb et al. 2010). The likelihood of success in the first 4 years significantly increases if the primary business owner is older than age 45 (Robb et al. 2010). Entrepreneurship scholars argue that older people possess human, social, and financial capital favorable for the survival of a business (Weber and Schaper 2004; Ainsworth 2015). During their working lives, older people gained professional knowledge and build up formal and informal networks that can increase the likelihood of survival (Weber and Schaper 2004). In addition, older people are more likely to have accumulated financial assets through prior employment which can be invested into the business (Singh and DeNoble 2003).

Growth. Even though businesses of older entrepreneurs have a higher survival rate (Robb et al. 2010), these businesses are less likely to grow (Autio 2007; Gielnik et al. 2012). The age group of 18–34 years starts 45% of growth-oriented start-ups compared to 22% in the age group of 45–64 years (Autio 2007). Furthermore, age is negatively related to business growth in terms of sales, profit, transaction volume, income, and number of employees (Gielnik et al. 2012). Scholars argue that the negative effect of age on

business growth is a result of a decrease in people's focus on opportunities (Gielnik et al. 2012). Focus on opportunities is a cognitive–motivational construct that describes how many new goals, plans, options, and opportunities people believe to have in their personal future (Gielnik et al. 2012). Research showed that companies with CEOs high in focus on opportunities increased their number of employees on average by 2.24 employees over a period of 4 years, while companies with CEOs low in focus on opportunities remained with the same number of employees over this time period. Similarly, companies with CEOs high in focus on opportunities increased their sales level by 38% percent over 4 years, while companies with CEOs low in focus on opportunities did not change their sales level over this period (Gielnik et al. 2012). With age several individual and contextual factors negatively influence people's focus on opportunities. Individual capabilities (e.g., information processing capabilities), which are important to maintain a focus on opportunities, decrease with age. In addition, contextual factors like age-related norms and environmental constraints may lower people's focus on opportunities. However, the decline in focus on opportunities and venture growth is not inevitable (Gielnik et al. 2012). Mental health buffers the negative effect of age on people's focus on opportunities. This means that for business owners who remain in good mental health, age does not have a negative effect on their focus on opportunities and business growth.

Family Succession. With age, family succession becomes more important for business owners (Zacher et al. 2012). Age is often seen as a general time of decline and withdrawal (de Bruin and Dupuis 2003). According to the socioemotional selectivity theory (Carstensen et al. 1999), age is not simply a matter of decline but can be considered in terms of shifting goal priorities. With increasing age, people are more aware that time is limited. As a consequence, goal priorities shift from advancing one's own career to passing on knowledge and skills to the younger generation (Zacher et al. 2012). With increasing age, family business owners increase in generativity which means that they direct their focus to generative motives (Zacher et al. 2012). Older family business owners focus less on their own career goals, occupational gains, or accomplishments and direct their focus to developing and guiding members of the younger generation (e.g., their children or grandchildren) in the family business (Zacher et al. 2012). Older business owners' generativity is an important mechanism in the family succession process. Generativity explains why older family business owners are more successful in finding a successor and in smoothly managing the succession process (Zacher et al. 2012).

Conclusion

The topic entrepreneurship and aging gains more and more attention because of the ongoing sociodemographic changes in our society. There is no clear-cut relationship between age and entrepreneurship, but people's ontogenetic development has benefits as well as drawbacks for entrepreneurship. Factors that influence whether or not age positively affects entrepreneurship can be found on the cultural/societal level, the firm level, and the individual level. Thus, a comprehensive approach taking into account all levels is necessary to fully understand the relationship between age and entrepreneurship.

Cross-References

- ▶ Age Stereotypes in the Workplace
- ▶ Age Stereotyping and Discrimination
- ▶ Aging, Inequalities, and Health
- ▶ Attitudes and Self-Perceptions of Aging
- ▶ Distance-to-Death Research in Geropsychology
- ▶ Early and Unplanned Retirement
- ▶ Job Attitudes and Age
- ▶ Late Life Transitions

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Environmental Influences on Aging and Behavior, Theories of

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Synonyms

Ecology of aging; Environmental psychology of aging

Definition

Focusing on environmental influences on aging and behavior, this entry particularly addresses theories that help to describe, explain, and modify/optimize the psychological relationship between the aging person and his/her physical environment.

Introduction

More than four decades ago, (Lawton and Nahemow 1973) conceptualized the maintenance and augmentation of positive affect, the avoidance of negative affect, and the adaptation in later life at large as a dynamic that largely depends on the existing competence of an aging individual (person variable, P) and the environment (E) in which the individual is operating. The fundamental idea that contexts (and not merely genes, physical-biological conditions, or personality factors) may drive aging processes and outcomes has a long-standing tradition in social gerontology

and its emphasis on social relations and the social contexts of aging. However, the role of the immediate physical, spatial, and technical environment put forward by Lawton and Nahemow's work has largely been neglected in geropsychological research (e.g., Wahl 2001; Wahl et al. 2012). This is surprising, because in child and adolescent psychology (Bronfenbrenner 1999), as in life span developmental science at large, co-construction, the assumption that developing individuals are shaped by contexts and vice versa, always has been a widely accepted view (Valsiner 1994; Youniss 1987). Going further, it is important to argue that – particularly in its early and late phase – the human life span is highly sensitive if not vulnerable to environmental input and P-E interactions, including the physical component of the environment.

Research targeting the relationship between the environment and the aging individual has had a strong link with psychology from the beginning (e.g., Lawton 1977; Lawton and Nahemow 1973; Wahl 2001), although it has also been seen as an important interdisciplinary area. Therefore, terms such as *environmental gerontology* and *ecology of aging* used in this entry are intended to emphasize the strong behavioral component of the field and its role within geropsychology.

A Case History: When Aging in Place Fails

Ms. A is an 89-year-old woman who lives in her medium-sized house in a small, urban community in Kansas. She had been married for 66 years to her husband Will, who passed away 3 years ago. Ms. A has a daughter living with her family near NYC, which is rather far away; no other relatives live closer than 4 h away by car. However, social support conditions are working well; her neighbors and some friends provide help when needed. Although Ms. A has good health overall, significant cognitive decline started about 2 years ago, during which substantial mobility and vision impairment have occurred. Ms. A increasingly has to struggle with her place and enjoys it as her place in the world. For example, she now experiences her home, neighborhood, and spatial infrastructure for the first time in life as a barrier: She now has anxiety when using the staircase, the bathroom, and the kitchen. The garden no longer is "her" garden and indeed is now unused, and driving the car evokes feelings of insecurity and incompetence, but driving is necessary to maintaining independence. Dealing with her physical-spatial living situation over the next 2 years increasingly impacts her daily routine and negatively affects her well-being and feelings of autonomy, with the latter belonging to the things she always was very proud of in her life. It also becomes increasingly difficult to keep her informal support network going, and due to ongoing cognitive decline, she is now entering a phase in life in which "full control" in some necessary tasks is no longer possible. One question becomes an intrusive one: "How long will I be able to tolerate this struggle with my place and indeed survive the struggle mentally in good shape?" At the age of 93 years, she will have arranged, together with her daughter, relocation to a nursing facility located 20 miles from her hometown. "Her" place and long-standing and highly valued day-to-day social interactions are left behind.

One may ask what would have happened to Ms. A in another physical setup (e.g., no large distance to next shopping mall, staircase, optimal housing modifications, installation of a computer with Skype and e-mail possibilities, etc.). One may also ask what it likely meant to Ms. A to undertake this relocation and spend her last years at a different place than the one in which she lived for decades. These are key questions of an environmental perspective on aging, as well as of late-life development at large. Let's follow these questions based on a treatise of a number of P-E concepts and theories and a selection of empirical findings.

Fundamental Principles of Psychological Aging and the Environment

Three principles build the cornerstones of environmental perspectives on aging: (1) importance of P-E transaction and developmental

co-construction, (2) importance of explicitly considering the environment with a focus on the physical-spatial dimension, and (3) importance of optimizing ecological validity in research. First, the classic formula dating back to German psychologist Kurt Lewin – that behavior is a function of the person's as well as the environment's characteristics (B = f[P,E]) – has found a central place in the social and behavioral sciences; aging is no exception. Environmental gerontology also has close affinity with *environmental psychology*, in which the concept of "person-environment transaction" has been promoted as a key issue (Altman and Rogoff 1987). A major assumption is that it is difficult – if not impossible – to separate P from E and that the understanding of an ongoing complex and mutual shaping of P and E throughout the life span is adequate. Moreover, it may be that this intimate intertwining of P and E grows along the life span and may indeed reach its climax in old and very old age (Zingmark et al. 1995). Furthermore, life span development is seen as a never-ending sequence of ecological transitions in which new P-E territories are continuously conquered, while other P-E territories are left behind. A major transition in late life (see again Ms. A) is the transition to a sheltered environment, such as a nursing home.

Second, Powell M. Lawton (1977), a key figure in the psychology of aging and the inauguration of environmental gerontology, has defined the environment in the first edition of the *Handbook of the Psychology of Aging* very broadly; this definition includes social others and social groups, as well as all its physical components (the natural or man-made ones). However, the predominant contribution of environmental gerontology to geropsychology can be seen in its emphasis on the physical and spatial environment (Wahl 2001; Wahl et al. 2004, 2012) such as features of the objective home environment (e.g., lighting in kitchen, barriers in bathroom) and distance between one's home and public transport. Wahl and Gitlin (2007) have suggested the term *physical-social environment* to address the issue that the physical component of the environment is hard to separate from its social component and vice versa (see also Wahl and Lang 2004). For example, a certain space infrastructure (e.g., distance between rooms) in a nursing home may provoke or hinder social communication (see already Lawton's "environmental docility hypothesis"; Lawton 1977, 1982). Third, environmental gerontology always put much emphasis on the need to enhance ecological validity in psychological aging research (e.g., Wahl 2001). Focusing on issues such as under which conditions older adults are "feeling at home" (Oswald and Wahl 2005) or offering a detailed description of the role of environmental barriers in the home or immediate surrounding directly brings research to the daily ecology of old age. More generally put, environmental gerontology's argument is that older adults always operate in naturally occurring physical-social environments; therefore, reconstructing daily ecologies of aging must have a high priority. It is interesting to mention in this context that the issue of ecological validity seems to have increased in importance at large in geropsychology in the past two decades or so, via event-sampling in situ research strategies and ambulatory-assessment strategies (Hoppmann and Riediger 2009).

Mission of Environmental Gerontology within Geropsychology

In light of the three principles outlined in the previous section, the overarching aim of environmental gerontology is to describe, explain, and modify/optimize the relationship between the aging person and his/her physical-social environment. With regard to *description*, environmental gerontology puts strong emphasis on day-to-day contexts of aging individuals, reinforcing the notion that daily ecology settings deserve strong attention in gerontological research. A major reason for this emphasis is that older people spend most of their time (i.e., about three-quarters of their daytime) in the home and immediate home environment (Baltes et al. 1999; Oswald and Wahl 2005). Furthermore, older individuals tend to live in the same place for a long period of time, typically for decades, not for years (Oswald and Wahl 2005). Such long-term living and aging at the

same location seems to evoke rich cognitive and affective ties to the place one lives, known in German as *Heimat* (homeland) – or, put in scholarly language, addressed as place identity and place attachment to the very specific genius loci of "my place."

The phenomena to be *explained* in environmental gerontology are classic outcomes in aging research and gero-epidemiology, such as positive and negative affect (Lawton 1977), well-being (Oswald et al. 2011), and autonomy (Oswald and Wahl 2005; Oswald et al. 2007). Furthermore, there is a set of specific variables addressed by environmental gerontology theories and empirical studies, such as the emergence of feelings of being at home, place attachment (and detachment) processes, place identity, usefulness of one's physical environment, and housing-related control beliefs (Oswald et al. 2007). Also, explaining the experience and outcome related with enduring change of space/place, such as transitions to long-term institutions and assisted living (but also from home to home), has been a classic area of environmental gerontology (e.g., Wahl and Oswald 2010).

Striving for *optimization* reflects the ambition of environmental gerontology to improve aging by means of "place improvement" or, as it also has been coined, "place therapy" (Wahl and Weisman 2003). Major examples include evidence-driven home modifications, adding to the development of new housing solutions for the diversity of aging individuals, or designing public spaces and "age-friendly" environments at large.

Established Theoretical Accounts and a Selection of Empirical Findings

Impact of Physical Environments

A classic view has been the Ecological Theory of Aging (ETA; Lawton 1982, 1989; Lawton and Nahemow 1973; Scheidt and Norris-Baker 2004). The basic assumption of this theory has been that the capacity to adapt behaviorally to existing physical-social environmental pressure profoundly decreases as people age, due to an increasing number of functional limitations. Thus, older people need to react to environmental pressure in order to remain independent and feel well in terms of high positive affect and low negative affect (Lawton 1982). The ETA was criticized for portraying the role of the aging individual as too passive. Consequently, in a later extension of the ETA (Lawton 1989), the environmental proactivity hypothesis was introduced, which assumes that older adults are not simply "pressured" by their environments but that they also strive to change proactively environmental conditions according to their own needs and goal priorities in order to maintain independence and well-being. For example, new cohorts of older individuals seem to increasingly make goal-directed P-E transitions, such as moving to an assisted-living facility or closer (but not too close) to their families, in order to prevent being overwhelmed by environmental pressure in the foreseeable future.

The ETA has since gained considerable, though not consistent, empirical support (Scheidt and Norris-Baker 2004; Wahl and Oswald 2010). For example, Wahl et al. (2009) provided a literature analysis of all studies published between 1997 and 2006 in peer-reviewed journals, which addressed relationships between the physical home environment and endpoints such as activities of daily living, amount of help and support needed, and falls. A total of 21 studies found supportive or at least partially supportive evidence for substantial linkages between environmental barriers and hazards in the home and disability-related outcomes, while only four did not. The subset of studies also considering the fit or lack of fit between the aging persons' functional limitations and the given physical barriers revealed the strongest relative linkages with disability-related outcomes. The drawback of the available body of empirical work is that most studies have been cross-sectional, thus not allowing any causal interpretation.

Role of Perceived Physical Environments

Major concepts in this area include place attachment, place identity, and the meaning of home. Theories on place attachment and place identity (Altman and Low 1992; Brown and Perkins

1992; Stedman 2002) point to a gamut of processes – operating when people form affective, cognitive, behavioral, and social bonds to the environment (Burholt and Naylor 2005) – transforming by this means "space" into "place" (Altman and Low 1992; Rowles and Watkins 2003). Often, these aspects of physical, social, and personal bonding are assessed by global attachment evaluations – e.g., on indoor versus outdoor place attachment (Oswald et al. 2005) – but there are also efforts using qualitative methodology to empirically approach place attachment and identity (Oswald and Wahl 2005).

Empirical research in this area, for example, supported the age-related increase of place attachment and place identity (Zingmark et al. 1995). Similarly, the work of Burholt and colleagues (e.g., Burholt and Naylor 2005), Scharf and colleagues (2005), and Peace (2005) provided evidence confirming that attachment to place is an important feature of quality of life in old age – particularly in old and very old individuals – underpinning core elements of the aging person such as self, identity, and quality of life. Aspects of meaning of home have gained particularly strong attention in the now-classic work of Rowles (1983) and Rubinstein (1989; see also Oswald and Wahl 2005).

Need for Simultaneous Consideration of Objective and Subjective Person-Physical Environment Relations

At the core of the framework suggested by Wahl et al. (2012) is the assumption that two processes, experience-driven P-E belonging and behavior-driven P-E agency, help to better understand and integrate existing P-E interchanges as people age. P-E belonging reflects a sense of positive connection with the physical-social environment (e.g., Bakan 1966; Baumeister and Leary 1995), while P-E agency refers to the process of becoming a change agent in one's own life by means of intentional and proactive behaviors imposed on the physical-social environment (e.g., Bandura 1991).

In contrast, processes of P-E agency include the full range of goal-directed behaviors related to making use of the objective physical-social environment, such as environment-related cognition and perceived control over the environment. These behaviors include reactive and proactive aspects of using, compensating, adapting, retrofitting, creating, and sustaining places, which is especially important in old age because of decreasing functional and cognitive capacity. The model also assumes that both P-E belonging *and* P-E agency must be considered in any qualification of P-E relations in later life.

Emerging empirical evidence for the model came from the ENABLE-AGE project, in which, for the first time, a maximum of indicators regarding P-E belonging as well as P-E agency have been assessed in parallel in advanced old-age individuals in a range of European countries (Iwarsson et al. 2007). As has been found, for example, P-E fit processes and housing-related control processes speaking to objective constellations of remaining competence and respective objective physical-social home environments – as well as P-E belonging processes – contributed to the prediction of endpoints such as autonomy, well-being, and depression (Oswald et al. 2007).

Most recently, Golant's model of residential normalcy highlights subjective environmental experiences of residential comfort and mastery as well as related adaptive coping strategies to maintain or achieve residential normalcy in existing objective physical environments (Golant 2015). According to the model, if older people feel comfortable and in control of their environment at home, they have achieved residential normalcy and may no longer feel the need to change anything. However, if there is a perceived incongruence on the behavioral or experiential level, they perceive themselves as being out of their mastery and/or comfort zone. Consequently, they will try to re-achieve residential normalcy by ways of assimilative or accommodative coping strategies (Brandtstädter and Greve 1994) with respect to the immediate home environment.

Technology as a Major New Environment of Aging

The Internet, the "automation" of everyday technology (e.g., teller machines, ticket machines,

computer and telephone voice menus, car technology), and sensor- or GPS-based assistance are rapidly changing the way older people organize and experience their everyday life (e.g., Schulz et al. 2014). Future cohorts of older adults will benefit from a full range of technology products designed to support them as they "stay connected" and age well, despite accumulated loss experiences. This requires a full new set of empirical research including outcome studies that are currently only available to a limited extent (see again Schulz et al. 2014).

Reconsidering the Case of Ms. A and an Outlook

Environmental perspectives on aging can be considered a major part of geropsychology, able to add the role of the physical-social environment to the understanding of aging processes and outcomes. Furthermore, there is the need in many areas of geropsychology to pay full attention to technology environments (such as those dealing with social relations (e.g., social interaction via the Internet)), in the experience of vulnerable phases late in life (e.g., care robotics), as well as in developmental regulation at large (i.e., technology as a means to exert control over one's environment; see again Valsiner 1994). Environmental gerontology may become an important helper in order to enrich these key areas of geropsychology.

Returning to Ms. A's case, a sole "personal" view of her situation appears to be too narrow, in light of P-E theories. The place she lived for years had become a major part of her quality of life, and leaving this place late in life – likely close to the end of her life – appears, through the lens of environmental gerontology, to be a major loss and psychological threat. At the same time, making the best use of housing modifications and the installation of technological aids, such as Skype or the use of a robotic system, may have had the potential to prevent or significantly delay her relocation to a nursing home. On the other hand, the progression of her cognitive vulnerabilities may also have undermined the efficiency of even the most optimized environment. In a sense, the situation of many older individuals, particularly those in advanced old age, appears in environmental gerontology terms as an ongoing "struggle with place." In future cohorts, agency and proactive dealing with this struggle may be expected to increase, for example, via increased competencies to use all kinds of technology and accept a smart home environment. This may indeed also allow individuals to stay put, even in the face of major cognitive impairment.

It is a limitation that most ongoing longitudinal studies of aging only measure the physical and technical environment in which aging individuals live to a minor extent. Such a tendency toward "decontextualization" of aging seems problematic and hinders the empirical testing of environmental theories based on longitudinal data.

Cross-References

- ▶ Aging and Psychological Well-Being
- ▶ Contextual Adult Life Span Theory for Adapting Psychotherapy (CALTAP) and Clinical Geropsychology
- ▶ Gerontechnology
- ▶ Stress and Coping Theory in Geropsychology

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Ergonomics and Demographics

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Synonyms

Human factors and ergonomics; Work design and aging; Personnel development in an aging workforce.

Definitions

The implications of the demographic change have long been known. Falling birthrates and a steady increase in life expectancy lead to considerable changes in the age structure of the workforce. Older employees will be more numerous in the future, and they will have to remain in employment for longer.

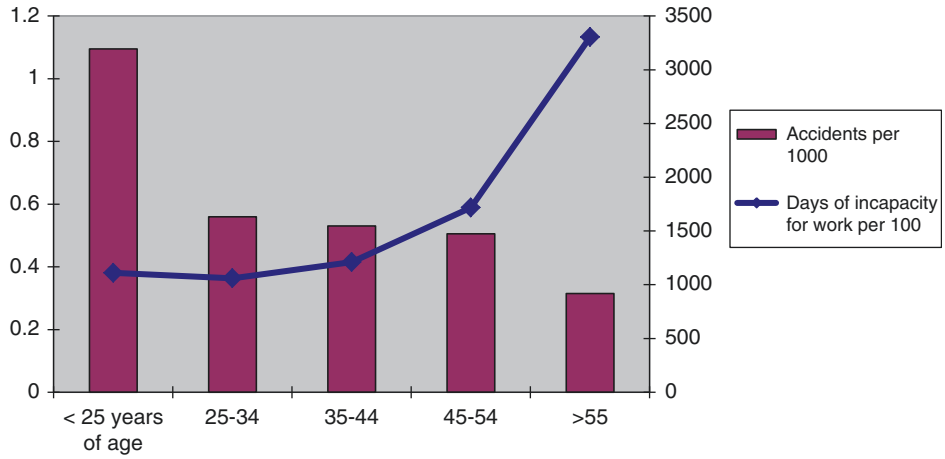
The purpose of designing workplaces for older employees is to give consideration to age-related impairments in their performance, whilst at the same time exploiting and fostering their particular abilities. Following analyses of the physiological changes and identification of the specific hazards faced by older people, design measures for workplaces for older employees were developed and implemented in practice for demonstration purposes at a selection of model workplaces. Work ability of older employees can moreover be retained and enhanced through well-planned personnel development.

In the end it is important not to focus especially on older employees. Each age or generation has its own capabilities and challenges which have to be considered in order to preserve a healthy workforce with high work ability.

Demographics is currently a buzzword, with its impact upon both the private lives of individuals and the world of work. Older people are becoming more numerous as a group, younger people less numerous. Two main trends are driving this development. Firstly, average life expectancy is rising; secondly, the birthrate is falling. For the world of work, this means that the average age of workforces is rising, and younger personnel are becoming increasingly hard to recruit. What are the consequences of this for preventive occupational safety and health activity? How can work be organized such that it can be performed equally well by younger and ageing workforces?

What Changes Can Be Seen in the Performance of Older Workers Over Their Working Lives, and What Are the Impacts of These Changes?

Views of older and ageing workers' performance differ widely. "Old and wise" was a phrase that



Ergonomics and Demographics, Fig. 1 Incapacity for work in days (data from the German Social Accident Insurance Institution for the woodworking industry (Holz-BG), 2006) and accidents per 1,000 equivalent full-time workers (data from the Holz-BG, 2007). The intention here is not to compare the absolute figures (which are from different years), but to illustrate the trends within each of the two curves

reflected the value attached at one time to the wisdom and experience of age. By contrast, modern society is strongly biased towards youth, whether in advertising, in the recruitment of labour, or in the desire to remain young or at least to appear to be so.

Who exactly are these "older workers"? At what age does one become "older": 45, 50, 60? And what actually changes?

Who Exactly Are the "Older" People?

Many publications or studies define older people as persons aged 45 (or 50) and over. By contrast, the gerontologist Andreas Kruse of the University of Heidelberg asserted in 2006 that ageing is a lifelong process beginning at birth and ending at death. Since this process is continual, and changes take a somewhat different form and occur at different times from one person to the next, it is virtually impossible, and also not constructive, to define a calendar age above which one belongs to the older demographic. A definition proposed by the Organisation for Economic Co-operation and Development (OECD) has gained currency, according to which older workers are persons "in the second half of their working lives, not yet in retirement and in good health."

It is evident that "older workers" are an issue for the social insurance systems. The statistics show that although older people are ill less frequently, when they do fall ill they are incapacitated for work for longer periods than their younger counterparts (Fig. 1). This pattern also applies to absences from work owing to illnesses unrelated to work and to occupational accidents. Absences from work by older employees thus give rise to higher costs for both the health and accident insurance institutions.

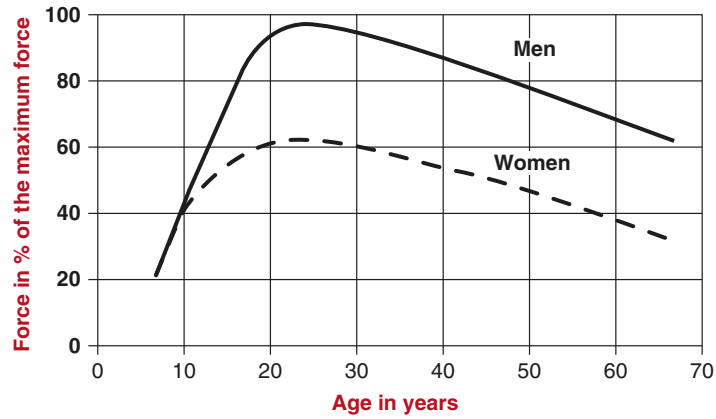
What Changes Occur as People Get Older?

Any individual will notice for themselves that ageing is accompanied by numerous changes. Often, only characteristics or abilities that deteriorate are considered (deficit model; see for example (Landau and Weißert-Horn 2007)):

- *Age-related hearing loss*

  Age-related hearing loss primarily affects the higher frequencies, which older persons are no longer able to discern as clearly as before.
- *Presbyopia*

  Even people with good eyesight typically begin to need glasses when they reach the age of around 45. The useful field of vision that can



Ergonomics and Demographics, Fig. 2 Mean values of the physical forces exerted by men and women, plotted against age. Data from Åstrand, Bengtsson, Burke, Dementjeff, Hettinger, Müller, Lehmann, Quételet, Reindell, Reys, Rodahl, Rutenfranz, and Schochrin. According to (Hettinger and Wobbe 1993), p. 99

be viewed without movement of the head also drops with increasing age (Boyce 2003).

- *Need for more light*

  Generally speaking, it is assumed that at the lower end of the illuminance range, older people require approximately twice the illuminance at their workplaces than younger people.
- *Decrease in physical performance*

  This includes several aspects. Firstly, general agility deteriorates with rising age. Beyond that, muscular performance and maximum physical force also decrease. The cardiovascular system is also no longer as fit as it was in younger years.

  However, Fig. 2 shows clearly that the decrease in physical force is not limited to older age. Human physical force peaks at the age of 20–25. If a person does not then train, their physical force deteriorates continuously. The average force values for women are consistently around 30% lower than those for men. There is therefore no clear point at which a person becomes "old" in terms of physical performance.
- *Increase in recovery time*

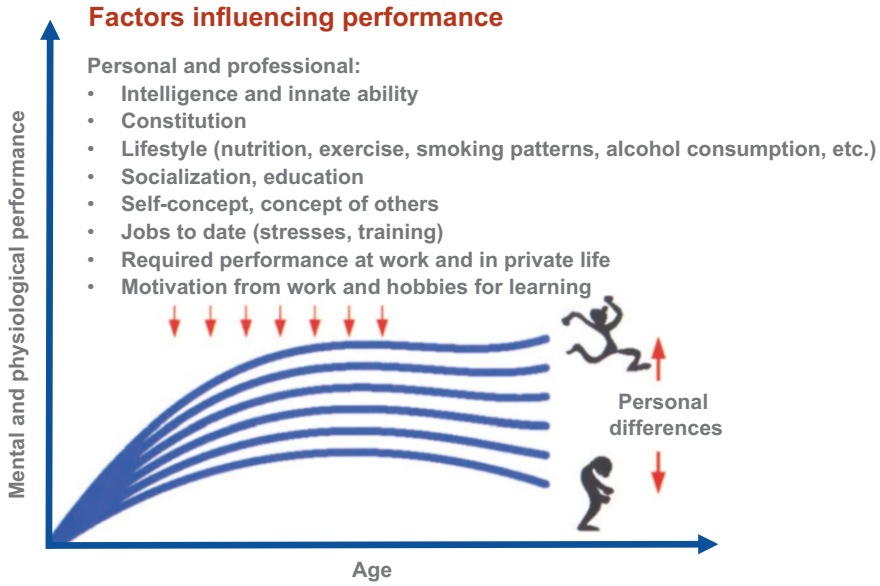
  This increase is a direct consequence of the deterioration in physical performance: when the performance of the cardiovascular system is reduced, the body takes longer to reach the rest state (resting heart rate) following physical exertion.
- *Increase in reaction time*

  Researchers have demonstrated that older people's reactions are slower in certain situations. The differences are, however, in the order of milliseconds. The question therefore arises as to what work situations exist in which the longer reaction time is actually relevant.
- *Deterioration in mental performance*

  Different age groups exhibit differences in terms of memory and the ability to retrieve stored information. However, older people do not always perform less well than their younger counterparts. Older people are often better than younger people at retrieving consolidated knowledge stored in the long-term memory. Other abilities, such as the capacity for coping with stress and confidence in decision-making are also frequently better among older people.

Some of these abilities can be trained. It is known, for example, that regular training of muscles enables their performance to be maintained at a high level even as a person ages. Well-trained male athletes aged between 65 and 70 can still attain peak oxygen uptake values – a measure of the muscle's endurance capacity – that exceed the average values for women across all ages (Hollmann and Hettinger 2000, p. 315).

Not every aspect of deteriorating physical performance can be compensated for by training. Sensory performance in particular is improved only marginally by training. It can, however, be supported by technical aids. In addition, the performance curves differ widely from one person to the next. The values shown in Fig. 2 are average values. A range of factors are at play here that assist in compensating for deficits in old age and



Ergonomics and Demographics, Fig. 3 Changes in the characteristics of human beings as they age occur at different points in time and vary strongly from one individual to the next (Modified in accordance with (Buck et al. 2002))

also in strengthening or developing new abilities. This shows that ageing has a strong biographical component and is also linked to an individual's employment history (Fig. 3).

Abilities that are enhanced in older age or are more and more attained until then include (competence model, refer for example to (Maintz 2003)):

- *Interpersonal skills*
  Older people have more experience in dealing with other people. This includes dealing with customers, as well as colleagues.
- *Effective communication*
  Owing to their greater social competence, older workers are often more successful in discussions with customers. Firstly, they are more familiar with their company's products or services; secondly, their long experience makes them more familiar with frequently recurring customer needs.
- *Experience*
  Older people can deal with vocational challenges better owing not only to their occupational experience but also to their life experience as a whole. Occupational and life experience can often be linked or are mutually beneficial.
- *Regained flexibility in use of time*
  As a rule, older employees no longer have children at home to look after. They can therefore often manage their time more flexibly than young parents. Their commitments to caring for family members can, of course, restrict this flexibility.
- *Company loyalty*
  Surveys have shown this to be a characteristic particularly valued by employers: where employees have had the opportunity to work continuously for a company over a long period of time and to experience recognition within it, their loyalty to their employer is also very strong. This can make them more reliable.

Strategies for Corporate Action Against the Backdrop of Demographic Change

Analysis of the deteriorating and improving abilities of ageing employees reveals key areas in which companies or employers can take measures to support and assist their staff. According to

Ilmarinen and Tempel (2002), companies can address the following four fields of action:

1. Promotion of good health
2. Training and skills development
3. HR management and corporate culture
4. Work design and organization

Design of workplaces suitable for older workers is not sufficient on its own. It is important that ageing be understood as a process. A corporate strategy that merely reacts to deficits as they arise is not effective. Mental and physical fitness in old age is the result of a lifelong process. Both the accident and health insurance institutions are on hand to provide expert advice to companies.

The example below from the field of action of work design and organization addresses the area of workplace design.

Design of Workplaces

In order for the health and performance of older workers to be retained within the work process and beyond, ergonomic measures at the workplace are absolutely essential. Firstly, attention must be paid to the optimum design of tools and work equipment; secondly, however, the proper use of these elements and health-conscious behavior on the part of the workers are relevant.

Constraints and Hazards at the Workplace

Section "What Changes Can Be Seen in the Performance of Older Workers Over Their Working Lives, and What Are the Impacts of These Changes?" showed that human beings change as they age. Many abilities remain virtually unaffected by the ageing process or mature only in the course of an individual's life. Some skills, however, are largely or even completely lost. Examples of changes in old age that tend to make coping with the flow of work more difficult or that can lead to additional health risks include the following:

- Deteriorating vision
- Changes in the perception of noise and deteriorating hearing ability
- Deterioration in general agility
- Reduction in muscle performance, i.e., loss of physical strength
- Reduction in the performance of the cardiovascular system

Should vision deteriorate, poor or uneven lighting, for example, may lead to hazards and a higher accident risk (Zieschang and Freiberg 2006). Should the work require the exertion of substantial muscle force, the worker may be able to perform it only with restrictions, or not at all.

Ergonomic Workplace Design: Model Workplaces

Ergonomically, sound design of workplaces can mitigate or even fully compensate for age-related loss of performance. Good ergonomic design and the necessary adjustments to specific workplaces for the minimization of health risks also benefit younger coworkers at the same workplaces, since they increase occupational safety in general. Special workplaces for older workers, or sheltered workplaces, which are also more likely to be rejected by older workers owing to their special status, then become superfluous.

The workplaces should be designed in the first instance according to the following principles:

- Inherently sound workplace design in accordance with human engineering and ergonomic criteria results in only a small number of additional special measures being required in order for workplaces to be adapted to the needs of older employees.
- Younger employees also benefit from good ergonomic workplace design.
- The aim is not for special "workplaces for old people" or "sheltered workplaces" to be created. Younger workers are also to be able to work at the redesigned workplaces. Social exclusion resulting from age is thus prevented.
- Wherever possible, consideration should be given to the particular abilities of each individual employee.

Good ergonomic design and productivity should not and need not be mutually exclusive (Zieschang and Freiberg 2006). Various design elements are explained below with reference to model assembly and video display unit workplaces.

Model Workplace for an Assembly Task

The workplace was first to be designed according to good human engineering practice and equipped with basic elements. These include:

- An adequately dimensioned and nonreflective work surface
- Assembly trays located appropriately for the task within the worker's reach
- A height-adjustable work chair
- An adjustable footrest
- Adequate lighting

In order for materials and the corresponding tools to be matched more easily, it is advantageous for the assembly trays for the screws and the corresponding screwdriver bits to be color coded.

Various elements were then adapted (Fig. 4) that are geared to the needs of older workers and facilitate performance of the work or indeed make it possible in the first instance (Hoffmann and Zieschang 2005):

- *Design of the lighting*

  Older workers require up to 100% more light. In order to meet this requirement, two lamps were installed for supplementary use as needed. The European standard EN 12464-1 (2003) requires a maintained illuminance value of 300 lx for moderately fine assembly tasks in the metal manufacturing and processing industries and of 500 lx for other industrial sectors. The lamp employed at the model workplace yields an average illuminance of 1,200 lx in the working area on the assembly bench. Switching on an additional lamp of the same type approximately doubles the illuminance to 2,300 lx. Since older workers are more sensitive to glare, it must be ensured that this is not caused by the installation of additional lamps. The combination of two lamps at the model workplace did not give rise to glare.
- *Design of the legibility*

  An illustrated description of the individual assembly steps, with clearly structured diagrams, assists in understanding and learning the procedure and avoiding mistakes. High legibility was attained by means of a sufficiently large font, clear contrast, and large images.
- *Reducing the physical stress*

  In order to relieve the locomotor system, a holding fixture was used for the power screwdriver, and trolleys provided for the delivery of materials to the workplace and roller conveyor belts for dispatch of the assembled workpieces. If possible, the weight of the loads to be manipulated was to be kept low.

  A forearm rest provides relief and improves fine-motor performance. These rests can be fitted to the table and removed from it quickly and easily as required by the individual.

Ergonomics and Demographics, Fig. 4 Model workplace for an assembly task (Source: IAG)

A holder, fitted to the edge of the assembly bench and removable at any time, into which the workpiece subassembly can be inserted during assembly, prevents the parts from slipping out of the worker's hand. Less stress is thereby placed upon the worker's motor functions, and assembly can be performed more quickly. Should no holder be present, a rubber surface can be used as an alternative to assist the worker in gripping small parts. The color selected for the surface should provide a clear contrast to the parts to be handled.

An assembly bench with electrical height adjustment enables each worker to adjust the bench to the working height most suitable for them. Where permitted by the task, the worker should alternate between a seated and standing position, thus preventing imbalanced posture and muscle tension. Should budgetary constraints or other reasons rule out purchase of a height-adjustable bench, other measures must be taken to ensure movement and variation in activity at the workplace.

Further organizational tasks such as collection of the components and transport of the finished subassembly to a location a few meters away also have the function of promoting more movement at the workplace. The worker is forced to stand up in order to put the workpiece aside. Although this entails additional time, the resulting movement at the workplace counters the onset of fatigue, which in turn has a positive influence upon productivity.

Model Workplace for VDU Tasks

This workplace was also designed in the first instance with consideration for ergonomic aspects and equipped with basic elements. These include:

- A nonreflective desktop of adequate area
- An office chair with height adjustment and armrests adjustable for height and width
- An LCD display
- A light-colored keyboard with dark characters
- A standard mouse
- Adequate general lighting

If an ergonomic sitting posture necessitates an adjustable footrest, one must also be provided.

The issue most frequently raised regarding the design of video display unit (VDU) workplaces for older employees is the relationship between age-related deterioration in vision and VDU work. Conditions in the work environment, such as noise, the climate, and the space requirement, must also be considered.

With increasing age, the lens of the eye becomes less elastic, resulting in a deterioration in its accommodative ability. The continual change in focus between screen, keyboard, and documents used for the work increases the strain upon the eyes, consequently leading to premature fatigue. Workers suffering from complaints such as impaired vision may attempt to compensate for them by adopting unfavorable sitting and head postures. Optical aids such as reading glasses, varifocal glasses, or contact lenses often fail to meet the particular requirements posed by a VDU workplace. Under certain circumstances, presbyopia (age-related vision impairments) can be corrected by means of suitable spectacles specially designed for use for work at video display units. In this case, the working conditions and viewing distances for the individual at the workplace must be determined beforehand, in addition to the examination by an eye specialist. The correct relationship between VDU work and recovery time or task alternation can also prevent excess strain upon the eyes.

The model workplace is adapted to the needs of older workers as follows (Fig. 5):

- *Design of the lighting*

  Presbyopia and deteriorating ability to adapt to lighting conditions can be compensated for in part by increased illuminance. The European standard EN 12464-1 requires a maintained illuminance of 500 lx for VDU and office work (EN 12464-1 2003). A mean illuminance of 850 lx was measured at the model workplace with general room lighting. The value was increased to 1,600 lx by means of an additional asymmetrical workplace lamp suitable for VDU work. The glare effects caused by high illuminance values were

Ergonomics and Demographics, Fig. 5 Model workplace for VDU tasks (Source: IAG, Floss)

avoided by suitable design of the display (character display in positive video).

- *Noise abatement*

  Older people are more easily disturbed by background noise than are young people. Where possible, sources of noise (such as printers, photocopiers, and fax machines) should be kept away from the workplace. Where several workplaces are located in a single room, telephone calls and conversations may constitute sources of noise. These can be controlled by sound-absorbing elements such as acoustic ceilings, front panels of cabinets, or suitable partitions.

- *Reducing the physical stress*

  Asymmetric stress and a lack of movement, caused, for example, by a seated work position at a video display unit, accelerate the natural age-related wear of joints, intervertebral disks, and the spine. In order to promote movement, the model workplace was equipped with an electrically powered desk that permits work in either a seated or standing position. Alternatively, a high-level desk, either free-standing or adapted to the existing desk, can be used.

  Organizational measures, such as locating the printer in an adjacent room or placing the telephone at a higher level in the immediate working area, for example on a side table, force the worker to stand up and exercise.

  In order to ensure sufficient movement during sitting, swivel office chairs are recommended that ensure active sitting, i.e., alternation between sitting in forward, middle, and rearward positions.

Preventive Activity for All Age Groups

The purpose of designing workplaces for older workers is to give consideration to age-related impairments in their performance, while at the same time exploiting and fostering their particular abilities. Following analysis of the physiological changes in older people and identification of the specific hazards facing them, the design measures described in section "Ergonomic Workplace Design: Model Workplaces" for workplaces for older employees were developed and implemented in practice for demonstration purposes at various model workplaces. In the process, it was frequently observed that once a workplace had been designed with consideration for good ergonomic practice, only minor further adjustments to the particular needs of older employees were then needed. Workers in all age groups benefit from the preventive health benefits of ergonomic design. That all age groups benefit has also been shown by a study in which persons of different ages performed assembly tasks at a model workplace. The evaluation revealed no significant differences between the older and younger

workers. In other words, the workplace is equally well suited to persons of any age.

The model workplaces illustrate the need for ergonomic design, and can therefore be used for the purpose of training on the subject, and also in the context of consulting with companies.

However, good ergonomic design of workplaces also has its limits. Some occupations present considerable physical or mental stresses when performed over a long period of time and cannot be performed through to the statutory retirement age. How the work ability and health of the affected workers can be retained despite this is described in the next section.

Personnel Development for Occupations of Limited Duration: How Can Employability Be Assured Through a Change in Occupation?

Construction worker, metal production worker, nurse, forester – in many sectors of the economy, occupations are found that can be performed only for a limited duration. According to Behrens (1994), occupations of limited duration are those that, primarily for health reasons, cannot be performed by the majority of workers through to the statutory retirement age and often not even to the age of 50.

In the long term, the high stresses in these occupations lead to premature attrition and high levels of strain upon the workers. Older workers are particularly affected by the cumulative effects of the stresses in occupations of limited duration. They are often unable to work through to the statutory retirement age and must instead leave the occupation prematurely.

Two approaches are conceivable by which the worker's employability can be assured. The first approach involves all measures for extending the time spent working in the occupation in which the individual was trained (see section "Design of Workplaces"). This should always be the preferred approach. These measures may, however, not suffice, in which case the second approach must be taken. The second approach involves the timely provision of advice and training for a change in task or occupation. The consulting concept developed for this purpose is based upon a number of empirical studies (Ulbricht and Jahn 2010; Jahn and Ulbricht 2011; Rahnfeld and Jahn 2012; Seibt and Seidler in press; Saifoulline and Jahn 2015). In these studies, a comprehensive risk analysis was performed for the model occupations of nurse, cleaner, construction worker, teacher, and metal caster. Experts with many years' vocational experience, individuals who had successfully changed vocation, occupational physicians, and managers with responsibility for personnel were interviewed in the course of these studies.

The consulting concept essentially comprises four steps:

1. Identification of early-warning indicators
2. Analysis of the risk factors in the current occupation
3. Requirements for a follow-on occupation
4. Provision of advice on a switch to a suitable occupation

Identification of Early-Warning Indicators

The effects of occupational stresses are often not recognized until an advanced stage and sometimes not until it is already too late. It is important that they be recognized and addressed early in order for retention of employability to be assured. The early-warning indicators are a sign of occupational health hazards and risks that could lead to the employee leaving his or her occupation prematurely.

Early Warnings from Superiors

Often, it is direct superiors who realize at an early stage that a worker's health and performance are suffering. A drop in work performance or more frequent absences from work may be indicators. The task of the worker's superior is to discuss with the worker what the reasons could be for the impaired work performance and health. Together with the worker, the superior examines whether the impairments could be counteracted by

changes in the organization or design of the work. It is then the superior's responsibility to implement these changes.

Such discussions with personnel can be conducted as part of the regular annual interviews, after 10 years' employment at the company, following changes in a worker's family situation, in the event of variations in performance, or when a worker indicates a need for them.

Early Warnings from Occupational Physicians

During occupational medical prophylaxis, occupational physicians are in a position to identify early-warning indicators of health impairments of occupational origin. A relationship based upon trust between the physician and the employee and between the physician and the company is a criterion for sound diagnosis and for effective, early consultation when a risk of work-related disease first becomes apparent.

The following diseases may be early-warning indicators in a metal production worker aged under 45:

- Degenerative diseases of the musculoskeletal system (e.g., signs of attrition in the spine region)
- Rheumatic diseases
- Coronary diseases, vascular changes
- Diseases of the respiratory tract (such as asthma)
- Mental disorders (such as depression)
- Sleep disorders

Analysis of the Risk Factors in the Current Occupation

If early-warning indicators are diagnosed during occupational medical examinations, the employee is offered a consultation. Responsibility for the consultation can be assigned to the occupational physician, the employee's immediate superior, the human resources department, the staff council, or the disability manager. The demands of the present job and sources of stresses in the family and social context are analyzed during the consultation. In addition, the employee's skills and his or her career development goals are determined by a skills analysis.

Requirements for a Follow-On Occupation

The outcome of the requirements and skills analysis is a definition of the criteria to be met by an alternative job or occupation which eliminate the critical stresses associated with the existing job and which best match the employee's skills.

Provision of Advice on a Switch to a Suitable Occupation

Based upon the results of the analysis, the employee is advised on possible alternative jobs or alternative occupations. Alternative career paths are first developed in conjunction with the employee. Following the decision for a particular career, an integral part-time training concept is developed for preparation for the follow-on job/occupation. Career matrices can be used for this purpose. These include:

- A vertical career path within the company
- A sideways career move within the company
- A change to a job or occupation outside the company

An example of a career matrix is shown in Table 1 with reference to the metal sector.

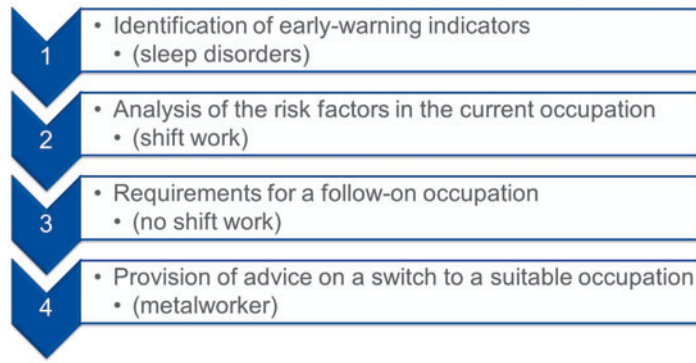
Vertical career paths leading to management positions are forms of personnel development that, where permitted by the employee's performance, exploit his or her knowledge and experience and counteract health risks before health impairments arise. Such career paths should be opened to middle-aged employees in the company in particular.

Sideways career moves channel the vocational knowledge and experience and permit their transfer between different departments, thus benefiting the company. The purpose of the change in job is often to prevent or minimize health risks. For large companies in particular, it is the easiest way of bringing about a change.

Figure 6 shows by way of example how this consulting approach is implemented.

Ergonomics and Demographics, Table 1 Vertical career paths and sideways career moves in companies with reference to the example of the metal sector

	Change in job	Change in occupation
In the company	**Vertical career path** For example, as a foreman: Shift foreman Day foreman For example, as a technical employee: Quality assurance employee Production planning employee **Sideways career move** To early shift For example, as a metal caster in continuous casting	**Vertical career path** For example, in occupational medicine: Paramedic in the emergency services Employee in occupational medicine **Sideways career move** To early shift For example, as a mold builder in the mold workshop As an employee in the logistics department
Outside the company	**Vertical career path** For example, as a technical employee: Self-employment (own production company) Engineering degree	**Sideways career move** Return to previous occupation (e.g., truck driver, cook) In a new occupation (e.g., caretaker, metalworker, media designer)



Ergonomics and Demographics, Fig. 6 A strongly simplified example of careers advice for a change of occupation (Saifoulline and Jahn 2015)

Example

1. The occupational medical examination of a metal caster in a casting plant identified sleep disorders as an early-warning indicator of significant impairments to well-being and in particular to cognitive performance.
2. The requirements analysis revealed the most critical factor for stress to be shift work against the background of the employee's family obligations and his 10-year history of shift work.
3. The following requirements were defined for the follow-on occupation, in consideration of the employee's many years of experience in the casting plant and his close affinity to the occupation:
   - No shift work
   - Flexible working hours, in order to reconcile work and family life
   - An additional qualification building upon existing vocational knowledge and experience
4. An alternative career in this case is training as a metalworker.

A Digital Guide for a Sideways Career Move

In the "Horizontal career changes" project, the approach described here for identification of a suitable occupation for a possible career change was extended to all skilled vocations. A digital

guide was developed in this project that provides companies with assistance in suitable personnel planning. Taking the form of an information portal, it supports affected individuals in the search for an alternative occupation that is as equivalent and as suitable as possible. An integrated ICT instrument contains a database of occupational profiles of all skilled vocations. A person looking for an alternative occupation creates their own personal profile by completing an electronic questionnaire. A specially developed algorithm compares the properties of the personal profile with those of the occupational profiles. The properties considered in the profiles can be divided into three categories: qualifications, preferences, and health. The result is a list of suitable alternative occupations, ranked by match level. The ICT instrument also permits detailed analysis of the results.

The alternative occupations proposed by the ICT instrument constitute preliminary information that cannot and should not replace a personal consultation. Rather, the digital guide is intended to draw attention to the problem of occupations of limited duration and to generate interest in a change of occupation. It is important that this then be followed by a personal consultation.

The digital guide is available for use free of charge on the Internet (in German only) at http://wegweiser-berufsumstieg.de.

Conclusion

Owing to the demographic shift, the proportion of older workers has been rising rapidly for some years and will continue to rise in the future. This increasingly shifts the focus to the retention of work ability. Through knowledge of the performance criteria for older employees, ergonomically optimized design of workplaces, and well-planned personnel development, work ability can be retained and enhanced. The beneficiaries are ultimately not only the ageing workforces but also younger employees.

Cross-References

- ▶ Age Diversity at Work
- ▶ Age-Related Changes in Abilities
- ▶ Human Resource Management and Aging
- ▶ Personality Disorders in Older Adults
- ▶ Technology and Older Workers
- ▶ Work Design and Aging

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Event-Related Potentials

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Synonyms

Electroencephalogram; Evoked potentials

Definition

Event-related brain potentials (ERPs) represent the synchronous activity of populations of cortical neurons measured at the scalp. This entry considers age-related differences in ERPs related to language, episodic memory, and outcome processing.

Overview

Event-related brain potentials (ERPs) represent the synchronized activity of populations of cortical neurons measured noninvasively at the scalp that are time-locked to some event of interest (e.g., the onset of a stimulus or a button press) (Luck and Kappenman 2012). ERPs provide excellent temporal resolution to examine the unfolding of information processing over time that is superior to hemodynamic measures such as functional magnetic resonance imaging (fMRI) or near-infrared spectroscopy (NIRS). In contrast, the spatial resolution of ERPs is inferior to that of fMRI, although distributed source analysis in combination with multivariate statistical techniques may provide a reasonably precise method for estimating the cortical generators of the ERPs. The ERP technique has been widely used to study information processing related to perception, cognition, emotion, and action (Luck and Kappenman 2012).

ERPs have been used extensively to examine age-related differences in neural recruitment related to topics of interest to cognitive and social neuroscientists including age-related variation in the automaticity of sensory processing, the slowing of processing speed, the encoding and retrieval of episodic memories, and the monitoring of response conflict and errors (Friedman 2012). The direct measure of neural activity makes the technique well suited for studies of neurocognitive aging as issues related to age-related variation in the coupling of the vascular and neural systems inherent in fMRI are not an issue for ERP researchers. This entry provides an overview of the effects of aging on a number of ERP components related to cognitive information processing. For those interested in the effects of aging on ERPs associated with early sensory or perceptual processing, Freidman (Friedman 2012) provides an excellent review of this literature.

The P3s

The P3 or P300 is the most extensively studied ERP component that represents at least two

distinct components (i.e., P3a and P3b) that can be dissociated based upon their psychological characteristics, neural generators, and neuropharmacological underpinnings (Polich 2007). The components contributing to the P3 are most commonly observed in the oddball task that compares the ERPs elicited by a frequent standard stimulus relative to a lower-frequency target stimulus (i.e., oddball) and/or a task-irrelevant distractor stimulus. The P3a/P3b components are both observed with auditory, visual, and somatosensory stimulation, indicating that they reflect information processing beyond the primary sensory systems. The amplitude of the P3a is maximal over the frontal midline, while the amplitude of the P3b is maximal over the central–parietal midline (Polich 2007). The P3a commonly peaks between 250 and 400 ms after stimulus onset, while the P3b can peak from anytime time between 300 and 600 ms after stimulus onset depending upon task demands. The P3a is thought to reflect stimulus-driven attentional orienting, and the P3b is thought to reflect the allocation of attention to stimulus categorization that facilitates subsequent memory processing (Polich 2007). A P3a-like component has been described in a number of different paradigms resulting in various labels being applied to this component of the ERPs including the P3a, the novelty P300, and the no-go P300. Systematic comparison of the ERPs elicited in various paradigms using multivariate statistical techniques demonstrates that these three "components" in fact reflect the same phenomenon (Polich 2007). In complex tasks used in the cognitive aging literature, the ERPs measured at the scalp often reflect a mixture of the P3a, P3b, and other components that share temporal–spatial overlap. This makes it important to carefully consider aspects of paradigm design and/or utilize statistical techniques that allow one to tease apart the contribution of different components during study design and data analysis.

The P3 has been used extensively in studies examining the effects of aging on information processing (Friedman 2012). The underlying topography of the P3a and P3b appears to be similar in younger and older adults, although this may be obscured in the manifest scalp-recorded ERPs. Consistent with the speed of processing theory of cognitive aging, the latency of the P3 increases in a fairly linear fashion from 20 to 80 years of age (Polich 1996). This effect may be somewhat stronger for auditory than visual stimuli, increase as target frequency decreases, and be greater for oddball tasks requiring counting responses relative to button presses. The age-related slowing observed for the P3 is greater and more consistently observed than the effect of aging on earlier ERP components related to sensory processing (Polich 1996), which may highlight differences between sensory and cognitive aging (Friedman 2012).

In addition to the age-related increase in the latency of the P3, a number of investigators have reported that the distribution of the P3 becomes more anterior in older adults relative to younger adults, reflecting an "anterior shift" in the oddball task (Fabiani et al. 1998). The anterior shift appears to be stronger for older adults with lower executive function than those with higher executive function. The reason for the anterior shift has been debated in the literature. It appears that the effect may at least partially result from the greater contribution of the P3a to the ERPs elicited by target stimuli in older adults than in younger adults, while the P3b distinguishing target from standard stimuli may be relatively preserved in later adulthood. Age-related differences in the contribution of the P3a and P3b elicited in the oddball task and other paradigms highlight the potential importance of using carefully designed paradigms in combination with appropriate statistical techniques to gain a clear understanding of the effects of aging on the latent ERP components that are manifest in the scalp-recorded ERPs.

The Medial Frontal Negativities

Over the last two decades, there has been an explosion of interest in transient negativities observed over the medial frontal region of the scalp in a number of different paradigms (Friedman 2012; Cavanagh and Frank 2014). These include the error-related negativity (ERN) that distinguishes errors from correct responses in

a variety of tasks, the N2 and medial frontal negativity (MFN) that distinguish incongruent trials from congruent trials in the flanker and Stroop tasks, and the feedback negativity (FN) or feedback-related negativity (FRN) that distinguishes gains from losses in gambling and reinforcement learning tasks. Each of these components has been linked to neural generators in the anterior cingulate cortex (ACC) in studies using both dipole source modeling and distributed source analysis. Consistent with these findings, converging evidence from studies using fMRI in humans and single-unit recording in primates has revealed neural activity related to choice errors, response conflict, and negative feedback in the ACC (Cavanagh and Frank 2014; Gehring et al. 2012).

The ERN represents a transient negativity over the medial frontal region of the scalp that in healthy younger adults is greater in amplitude for errors than correct responses (Gehring et al. 2012). The ERN typically peaks between 50 and 100 ms after an error is committed and reflects the activity of an endogenous error monitoring system, as feedback indicating the presence of the error is not required to elicit the component. The ERN is typically followed by the error positivity (i.e., Pe) that can extend from the frontal to the parietal region of the scalp and last for 300–500 ms after the response. The psychological processes represented by the ERN and Pe have been extensively debated, and current consensus appears to be that the ERN is related to the detection and possibly correction of the error or the restoration of goal-directed processing, while the Pe is related to conscious awareness that an error has occurred.

The effect of aging on the ERN has been studied in a variety of paradigms including choice response tasks, response compatibility tasks (e.g., flanker or Stroop task), and reinforcement learning tasks (Friedman 2012). In almost all cases, the amplitude of the ERN is reduced in older adults relative to younger adults when measured as the difference between errors and correct responses. The effect of aging on the ERN most commonly appears to result from a decrease in the amplitude of the ERPs elicited by errors in older adults, although some evidence indicates that aging can also be associated with an increase in the amplitude correct-related negativity (CRN) in older adults that thereby reduces the difference in amplitude between errors and correct responses. Potential moderators of the effect of aging on the ERN have not been extensively explored, with some limited work demonstrating that the effect of aging is not sensitive to individual differences in physical fitness. Together, the results of the extant literature lead to the suggestion that aging is associated with a decrease in the efficiency of the endogenous error monitoring system that involves the ACC and is reflected by the ERN.

The MFN is elicited in a variety of stimulus–response compatibility tasks and reflects greater negativity for incongruent (incompatible) than congruent (compatible) trials that can be observed when the ERPs are locked to either stimulus or response onset (Friedman 2012). In the flanker and Simon tasks, the MFN or N2 tends to be greatest in amplitude between 200 and 300 ms after stimulus onset, while in the Stroop and Stroop-like tasks, the component is greatest in amplitude between 300 and 500 ms after stimulus onset. The difference in the timing of component across tasks is likely related to variation in the time course of information processing, as the flanker or Simon tasks tend to produce substantially shorter response times than the Stroop task.

The effect of aging on the MFN is less consistent than the effect of aging on the ERN, but there have also been fewer studies (Friedman 2012). In studies using a Simon-like task wherein the ERPs were locked to the response, the amplitude of the MFN was similar in younger and older adults (Friedman 2012). In contrast, in studies using the color-word or counting Stroop tasks wherein the ERPs were locked to stimulus onset, the amplitude of the MFN was attenuated in older adults relative to younger adults (West and Schwarb 2006). Given the existing literature, it is difficult to know whether variation in the effect of aging observed across studies results from differences in the cognitive processes measured by the tasks that were utilized in the various studies or the method

of data processing. There is some evidence that individual differences in executive function may moderate the effect of aging on the MFN observed in the Stroop task and that the presence of age-related differences in the MFN is sensitive to the amount of interference that is encountered in the task (Friedman 2012; West and Schwarb 2006). Gaining a greater understanding of how individual differences and task-related factors influence the effect of aging on the MFN is clearly one avenue for future research.

The FN represents a transient negativity over the frontal central region of the scalp that is greater in amplitude following negative outcomes (i.e., losses or negative feedback) than positive outcomes (i.e., gains or positive feedback) in gambling and reinforcement learning paradigms between 250 and 350 ms after feedback is presented (Cavanagh and Frank 2014). Studies examining the effect of aging on the FN have consistently revealed that the amplitude of this component is smaller in older adults than in younger adults and that this results from a reduction in the amplitude of the ERPs elicited by negative outcomes (Hämmerer et al. 2011). In various studies, the reduction in the amplitude of the FN in older adults has been associated with a mild decrement in associative learning, a tendency to switch following gains and losses, and a tendency to be more conservative than younger adults. These findings may indicate that an age-related reduction in the efficiency of feedback processing could have widespread effects on efficient information processing.

In summary, aging is associated with a reduction in the amplitude of medial frontal ERP activity related to error monitoring and feedback and conflict observed in a variety of paradigms. At the neurobiological level, these data may indicate that aging is associated with a decrease in the functional integrity of the ACC and related neural structures; at the psychological level, the effect of aging on the MFNs and the ACC may contribute to an age-related reduction in degree to which negative or undesirable outcomes guide future information processing or decision making.

Episodic Memory

ERPs have been used extensively to examine the neural correlates for encoding and retrieval processes related to episodic memory in studies of item recognition and source memory (Wilding and Ranganath 2012). Successful encoding is commonly associated with slow-wave activity over the frontal and parietal regions of the scalp that can be greater in amplitude over the left than right frontal regions. The left frontal slow-wave activity has been associated with semantic retrieval and integrative processing that facilitates episodic encoding. The ERP correlates of successful retrieval are somewhat dependent upon the task that is used to probe episodic memory. In recognition memory paradigms, there are three components that consistently distinguish remembered items (hits) from forgotten (misses) or new (correct rejections) items; these include the FN400, the left parietal old–new effect, and the right frontal slow wave. The NF400 is greatest in amplitude over the medial frontal region of the scalp and has been associated with item familiarity, being similar in amplitude for recognized old items regardless of whether or not the memory includes source information or recollection. The left parietal old–new effect represents greater positivity for old items than for new items between 400 and 600 ms after stimulus onset that is typically greater in amplitude when recognition is associated with source information or recollection. The right frontal slow wave is observed less consistently than the other two components and has been associated with monitoring or meta-memory processes. In paradigms requiring source judgments or cued recall, successful retrieval is commonly associated with slow-wave activity that can be broadly distributed over the scalp from the frontal to the parietal regions. As will become clear in the paragraphs that follow, the effect of aging on ERPs related to successful encoding and retrieval in episodic memory has been quite mixed with some studies revealing minimal age-related differences in ERP activity related to episodic memory, while others reveal dramatic reductions in amplitude in older adults or ERP components that are seemingly

unique to older adults (Friedman 2012; Friedman et al. 2007).

ERPs measured at encoding reveal slow-wave activity that distinguishes between stimuli that are later remembered relative to those that are later forgotten (Hämmerer et al. 2011). The amplitude of slow-wave activity associated with encoding verbal stimuli can be attenuated in older adults relative to younger adults, and this appears to be one source of age-related declines in episodic memory (Friedman 2012). Age-related differences in ERPs related to successful encoding may reflect the failure of older adults to spontaneously utilize processing that promotes recollection or to engage in sustained integrative semantic processing that facilitates later memory. Consistent with this idea, the amplitude of the subsequent memory effect in the ERPs is similar in amplitude when individuals encode natural scenes that are thought to foster relational processing during encoding.

There is considerable variability in the effect of aging on the ERP correlates of episodic memory in studies examining recognition (Hämmerer et al. 2011). A number of studies have reported that the amplitude of the FN400 is similar in younger and old adults, a finding that converges with the behavioral literature in demonstrating that familiarity is preserved in later adulthood (Friedman 2012). However, in other studies, the amplitude of the FN400 was reduced in older adults relative to younger adults, or there was no difference in the amplitude of the ERPs elicited by hits and correct rejections in the time window where the component was observed in younger adults (Wang et al. 2012). A similar pattern has been observed for the left parietal old–new effect. In some studies, the amplitude of the component is similar in younger and older adults when source information or recollection is associated with memory retrieval; however, in other studies the amplitude of the left parietal old–new effect is attenuated in older adults, or there is no difference between hits and correct rejections. One possible explanation for variation across studies is related to the demands of the memory test, as age-related differences appear to be reduced or absent when recollection or source information is required for a successful memory judgment relative to when individuals could rely on familiarity to support successful recognition (Friedman 2012). Another possibility is that the mixed results result from variation in the characteristics of the older adults included in the samples across studies. Supporting this idea, limited work has demonstrated that individual differences in memory performance, education, and executive function may moderate the effect of aging on parietal ERPs related to episodic memory.

In addition to examining the effect of aging on the FN400 and left parietal old–new effect that are related to recognition memory in younger adults, some studies have also reported ERP components over the frontal region of the scalp associated with successful recognition that may be limited to older adults (Friedman 2012). There are not a sufficient number of studies that have examined ERPs unique to older adults to draw firm conclusion regarding the functional significance of this neural activity. The frontal ERP activity may be greater in amplitude for low-performing individuals relative to high-performing individuals, leading to the suggestion that it likely does not reflect compensatory recruitment that underpins preserved episodic memory in later adulthood.

Studies using ERPs consistently reveal two effects of aging on the neural correlates of source memory (Li et al. 2004). In younger adults, the retrieval of source information is associated with left parietal activity that resembles the old–new effect and slow-wave activity over the right frontal region. The amplitude of both of these components is attenuated in older adults, and in some studies the amplitude of the ERPs does not differ between old and new items in older adults. These findings are consistent with the age-related decline in source memory that is commonly observed in behavioral studies. In older adults, there is slow-wave activity extending from the frontal to parietal regions that reflects greater negativity when source information is retrieved relative to new items. This slow-wave activity is generally absent in younger adults. Some investigators have suggested that age-related differences in the ERP correlates of source memory may reflect variation in the type of information that

younger and older adults rely upon when making source judgments. Consistent with this idea, the left hemisphere ERP activity was reduced or eliminated in older adults when participants were instructed to use self-referential processing during encoding that presumably focused individuals to rely on a source of information known to promote episodic memory (Dulas et al. 2011).

Language

Since the discovery of the N400 in 1980, this and other ERP components (e.g., P600 and late frontal positivity) have been widely used to study various aspects of information processing related to language comprehension (Friedman 2012; Kutas and Federmeier 2011). ERPs provide an excellent tool for investigating relatively natural language process without the imposition of artificial response demands that are required when using some behavioral measures. The N400 represents a negativity in the ERPs over the central to parietal midline that varies in amplitude with the degree of fit between the meaning of a stimulus (i.e., word, picture) and the prior semantic context. Like the N400, the late frontal positivity is also sensitive to semantic aspects of information processing. This component may be related to ambiguity resolution as it is most pronounced when a word is inconsistent with a highly constrained semantic context. In contrast to the N400, the P600 represents a later positivity over the parietal region that is more sensitive to variation in syntactic variables rather than semantic features of the stimulus or linguistic context. The effect of aging on the P600 has only been investigated in a few studies, which appear to demonstrate that aging has little effect upon syntactic processing related to this component (Friedman 2012).

The effects of aging on the N400 and the linguistic variables that contribute to the generation of this component have been intensely investigated (Friedman 2012; Wlotko et al. 2010). With visual or auditory + visual stimuli, the latency of the N400 increases by about 1.5 ms per year, and its amplitude decreases by .05-.09 microvolts per year between 20 and 80 years of age (Kutas and Iragui 1998). The effect of aging on the latency of the N400 may be reduced or eliminated with auditory presentation of connected speech. Importantly, this method of presentation does not eliminate the effect of aging on the amplitude of the N400. Understanding the nature of the effects of aging on the N400 may provide insight into the development of age-associated neuropathology, as variation in the amplitude of the N400 and P600 has been shown to predict conversion from mild cognitive impairment to dementia over a 3-year period (Olichney et al. 2008).

The reason for the age-related decrease in the amplitude of the N400 has been examined in a number of studies (Wlotko et al. 2010). There is general agreement that the effect of aging on the N400 does not result from an age-related decline in semantic memory (Friedman 2012). In contrast, the results of a number of studies lead to the suggestion that an age-related decline in the use of contextual information to form expectations or make predictions during online comprehension may account for the effect of aging on the N400 (Wlotko et al. 2010). Also, other research demonstrates that the effect of aging on the N400 may result from the coordinated recruitment of the left and right hemispheres to support processing of multiple meanings of words (i.e., dominant versus nondominant) or to integrate different features (i.e., concreteness versus imagery) of words (Wlotko et al. 2010). Consistent with this idea, the amplitude of the late frontal positivity related to ambiguity resolution is attenuated, or this component is absent, in older adults. This effect of aging on the late frontal positivity would be consistent with the idea that older adults generally do not activate multiple meanings of ambiguous words during online comprehension, thereby reducing the need for ambiguity resolution.

The effect of aging on language comprehension and particularly ambiguity resolution may be sensitive to individual differences in verbal fluency, an important executive function (Wlotko et al. 2010). Two studies have demonstrated that individual differences in verbal fluency are correlated with ERP amplitude over the frontal region of the scalp when individuals are required to

resolve ambiguity related to homographs or semantic incongruity, with high-fluency older adults being more similar to younger adults than low-fluency older adults. This effect appears to be relatively limited to frontal processes as it does not extend to the N400.

Conclusions

The literature reviewed in this entry clearly demonstrates the utility of using ERPs to examine the effects of aging on neural activity related to various aspects of cognition. In some instances, the ERP data converges nicely with the cognitive aging literature (e.g., the linear effect of aging on the latency of the P3 and N400 components) (Polich 1996; Kutas and Iragui 1998). In other instances, the ERP data reveal qualitative differences in neural recruitment between younger and older adults that may not be expected within the context of a cognitive behavioral perspective (e.g., age-related variation in left and right frontal slow-wave activity related to source memory) (Li et al. 2004). Also, there is growing evidence that various individual differences may moderate the effect of aging on neural recruitment reflected by ERPs (West and Schwarb 2006; Wlotko et al. 2010) and that understanding these differences may provide insight into the development of age-associated neurodegenerative disease (Olichney et al. 2008).

Cross-References

- ▶ Cognitive Control and Self-Regulation
- ▶ Executive Functions
- ▶ Language, Comprehension
- ▶ Memory, Episodic

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Everyday Cognition

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Synonyms

Everyday problem-solving

Definition

Everyday cognition refers to the ability of individuals to solve cognitively complex real-world or "everyday" problems. Specifically, studies of everyday cognition focus on assessing the real-world manifestation of basic cognitive abilities such as memory, reasoning, knowledge, and processing speed by testing older adults' ability to solve problems using ecologically valid stimuli such as a medication label or food nutrition label.

Everyday Cognition and Everyday Problem-Solving

Terms such as "practical problem-solving" or "everyday/real-world problem-solving" are used interchangeably, and both are often applied to studies of everyday cognition. However, practical or everyday/real-world problem-solving refers to the larger domain of research focused on examining the ability of older adults to solve any kind of real-world problem. Everyday cognition refers to a subdomain of practical or everyday/real-world problem-solving, which is characterized by cognitively complex real-world problems typically drawn from domains of instrumental daily functioning such as medication use, financial management, or food preparation. These types of problems typically have one "correct" answer, and therefore, the focus is on objective performance.

Another subdomain of practical or everyday/real-world problem-solving focuses on socioemotional or affective problems that older adults might face in their daily lives (Blanchard-Fields 2009). Studies examining these socially and/or emotionally laden real-world problems typically focus on identifying the coping strategies employed in response to these problems. While socioemotional problem-solving is an important area of research, only everyday cognition is discussed here.

Theoretical Underpinnings

The study of everyday problem-solving in general and everyday cognition specifically began, in part, by questioning whether psychometric tests of cognition were appropriate assessments of older adults' cognitive functioning (Denney 1989; Willis and Schaie 1986). Some argued that despite significant and normative age-related declines in many cognitive abilities, the majority of older adults retained their ability to effectively function in their daily lives. In addition, psychometric tests were designed for and validated in samples of children and young adults in an academic setting. Thus, for older adults, who are many years removed from school environments, psychometric tests may not be sensitive measures of cognitive competence. In addition, context-free psychometric tests might underestimate older adults' ability because they do not allow them to call upon a lifetime of accumulated knowledge to solve the problem. That is, in their everyday lives, older adults can draw upon domain-relevant experiences to support and/or enhance their cognitive performance, and so relatively "a-contextual" laboratory-based assessments of cognition may produce an underestimation of true performance

competencies. These concerns with psychometric tests led some researchers to propose that measures comprised of real-world problems and stimuli that older adults might face in their daily lives might be a more accurate way to assess cognitive competency (Denney 1989; Willis and Schaie 1986).

The early everyday problem-solving research focused on identifying the kinds of problems older adults experienced in their everyday lives. These studies found that the everyday problems older adults often experienced fell into one of two overarching categories: socioemotional or instrumental. Early studies assessing individual differences in performance included both problem types, such as the seminal work by Denney (1989). However, as the field matured studies tended to focus on examining problem-solving either within instrumental domains of functioning (Willis and Schaie 1986) or socioemotional domains (Blanchard-Fields 2009).

Measuring Everyday Cognition

There are a number of different measures used to assess everyday cognition. An excellent overview of the various measures is provided by Law and colleagues (2012). Assessments of everyday cognition tend to have at least four things in common. First, as previously mentioned they generally focus on instrumental tasks of daily living which older adults must be able to solve effectively in order to remain independent. Items describe a real-world problem such as "You woke up this morning and your refrigerator is not working" and/or present real-world stimuli, such as a bank statement, and ask participants to solve problems based on those stimuli. Second, the real-world problem is clearly defined, so older participants know exactly what they are supposed to solve. For instance, there is little ambiguity as to what is the real-world problem in the following statement: "You woke up this morning and your refrigerator is not working." Third, the desired goal or end state is also apparent from the problems (e.g., you want your refrigerator to work). Fourth, most measures are performance based rather than self-report. Though some interesting findings have come from subjective measures of everyday cognition (Farias et al. 2013; Marshall et al. 2014), such assessments are often unrelated to objective performance (Tucker-Drob 2011).

Sources of Individual Differences in Everyday Cognition

Over the past 25 years, research on everyday cognition has primarily focused on identifying sources of individual differences in older adults' performance. Not surprisingly, given the early rationale for studying everyday cognition, much of the research has centered on the mapping of age differences as well as understanding the underlying role basic cognitive abilities play in everyday cognitive performance.

Age-related Differences and Changes. As previously mentioned, the study of everyday cognition was, in part, predicated on the idea that psychometric measures of cognition might underestimate older adults' true cognitive competency. Furthermore, performance on real-world measures of cognition might be preserved because elders can call upon domain-specific knowledge when solving real-world problems. Unfortunately, there has been very little evidence to support this assumption, with many cross-sectional studies reporting a negative relationship between age and everyday cognition (Allaire and Marsiske 1999; Burton et al. 2006; Diehl et al. 2005). In fact, results from a meta-analysis of over 33 age-comparative studies indicated that older adults performed significantly worse than middle-age and younger adults on measures of everyday problem-solving, particularly on items drawn from the instrumental domains of daily living (e.g., financial and medication management) (Thornton and Dumke 2005).

In addition to negative age differences, a number of longitudinal studies have found evidence of long-term decline in everyday cognitive functioning (Tucker-Drob 2011; Yam et al. 2014; Gross et al. 2011). Tucker-Drobb reported that three different measures of everyday cognition exhibited significant and negative decline over a

5-year period (Tucker-Drob 2011). In a follow-up to that study, Yam and colleagues reported that everyday cognition exhibited a quadratic over a 10-year period (Yam et al. 2014). Specifically, an early increase in everyday cognitive performance due to practice effects was overshadowed by significant declines in performance over time.

Taken together, these findings suggest that older adults' ability to solve cognitively complex everyday problems is, in general, compromised with age. However, it is possible that in some situations, perhaps where tacit knowledge for the problem or context is strongly age-related, differences may be minimized. For instance, Artistico and colleagues reported that older adults performed better than younger age groups on everyday problems set within an "older adult context" (Artistico et al. 2010). Presumably, older adults benefited from their familiarity with the context of the problem and their domain- specific knowledge of the problem. Unfortunately, the authors did not adequately assess domain-specific knowledge. It is important to note that age is not an explanatory variable but merely an index of chronological time. That is, an individual's age does not cause declines in everyday cognition, but instead a more proximal predictor(s) associated with age is driving the declines. Additional research is still needed to understand what factors can explain the age-related differences and age-related declines in everyday cognitive functioning. One such explanatory construct is basic cognitive functioning.

Basic Abilities

Given that everyday cognition is characterized by the ability to solve *cognitively* complex real-world problems, it should come as no surprise that basic cognitive abilities provide the foundation for everyday cognitive performance. That is, everyday cognition can be considered the application of basic cognitive abilities to real-world problems such that an amalgam of basic abilities is responsible for cognitive performance within everyday contexts. Evidence from cross-sectional studies suggests that lower performance on basic ability tests (e.g., inductive reasoning, memory, processing speed) is associated with lower everyday cognitive functioning (Allaire and Marsiske 1999; Burton et al. 2006; Diehl et al. 2005). In fact, Allaire and Marsiske reported that as much as 80% of the individual differences in everyday cognition were accounted for by basic cognitive abilities, particularly memory and inductive reasoning ability (Allaire and Marsiske 1999). Yen and colleagues reported that inductive reasoning and a factor representing learning and memory were both significantly related to everyday cognitive functioning, while processing speed was not related to everyday cognition (Yen et al. 2011). Informant-based subjective everyday cognition functioning is also significantly negatively related to neuropsychological clinical assessments of memory and executive functioning (Farias et al. 2013).

Evidence of the association between basic cognitive abilities and everyday cognition also comes from more recent longitudinal studies (Tucker-Drob 2011; Gross et al. 2011; Yam et al. 2014). Yam and colleagues found that 10-year decline in everyday cognition was not as dramatic as the decline observed for memory and speed (Yam et al. 2014). However, the negative trajectory for everyday cognition was greater than what was observed for verbal ability and was significantly similar to that of reasoning ability. In fact, reasoning accounted for 85% of the intercept and 96% of the slope variance in everyday cognition. Tucker-Drob reported that decline over 5 years in three different measures of everyday cognition was significantly related to decline in basic ability measures assessing reasoning, processing speed, and memory (Tucker-Drob 2011). In fact, a single latent change factor could significantly account for change in each of the basic ability and everyday cognition tests, suggesting that these declines are the "manifestation of a common underlying process." Further evidence of this common underlying process comes from Farias and colleagues (2013), who reported that lower total brain and hippocampus volume were related to worse everyday cognition (Farias et al. 2013).

Other Sources of Individual Differences. While the lion's share of research has focused on everyday cognition as it relates to age

and/or intellectual ability, some researchers have explored other sources of individual differences. For instance, markers of health such as blood pressure and number of chronic conditions have been associated with everyday cognition. For instance, Whitfield and colleagues found that the number of chronic conditions and perceived change in health status were significantly related to lower everyday cognitive performance even after controlling for demographic characteristics (Whitfield et al. 2004). In addition, lower blood pressure is associated with worse everyday cognition ability even after controlling for age and performance on tests of basic cognitive abilities. In addition to indices of physical health, higher levels of depression have been shown to be directly and indirectly (through basic cognitive abilities) associated with lower everyday cognitive performance (Yen et al. 2011). There is also evidence that depression is related to everyday cognition (Paterson et al. 2015). Higher scores on a standard measure of depression were significantly related to worse everyday cognitive functioning in older adults. The predictive salience of depression remained even after controlling for age, gender, and education.

Predictive Outcomes of Everyday Cognition

As previously discussed, early research on everyday cognition focused on cataloguing the problems older adults faced in their day-to-day lives. As the field developed, studies turned to exploring age differences and the association between basic cognitive abilities and everyday cognition. More recently, a growing group of researchers have turned to examining the extent to which everyday cognition predicts meaningful outcomes. If everyday cognition is thought to assess cognition in the real-world, then it should be strongly related to real-world outcomes. Moreover, everyday cognition was, in part, originally designed as an "alternative" to traditional measures of intelligence or cognitive functioning. Therefore, if it does not provide added value beyond basic cognitive abilities, then there may be no need to include assessments of everyday cognition in addition to basic cognitive ability tests. It is important to note that when everyday cognition is used as a predictor, there should not be an assumption of causality. That is, everyday cognition does not necessarily cause the outcome, but it is related to explaining individual differences in the outcome.

One such outcome is mortality, where lower performance on measures of everyday cognition is uniquely related to a greater likelihood of death (Allaire and Willis 2006; Weatherbee and Allaire 2008). For instance, Weatherbee and Allaire reported that performance on a measure of everyday knowledge was a significant and unique predictor of death even after controlling for a number of basic cognitive abilities (Weatherbee and Allaire 2008). In another study, everyday cognition was a significant and unique predictor of nearness to death (Allaire and Willis 2006). Perhaps related to morality, older adults who performed better on measures of everyday cognition were more likely to remember to take their medications even after controlling for performance on basic cognitive ability tests (Neupert et al. 2011). Thus, performance on everyday cognition may be an indirect indicator of mortality risk, in that it can identify older adults who are likely to adhere to their health provider's prescribed medication and/or treatment plan, which can sustain their health and quality of life and reduce their mortality risk. Not surprisingly, everyday cognition also serves as a unique predictor of older adults' self-reported instrumental functioning (Allaire and Marsiske 2002; Allaire et al. 2009), accounting for all individual differences in subjective instrumental functioning associated with basic abilities and also adding unique explanatory power (Allaire and Marsiske 2002).

Cognitive Impairment. Everyday cognition is also used as a predictor of mild cognitive impairment (MCI) which is considered the transitional period between normal cognition and dementia. Cross-sectional studies of community-dwelling elders report that performance on various measures of everyday cognition significantly predicts impairment or MCI status even after controlling for performance on cognitive screening or basic cognitive ability measures (Allaire et al. 2009;

Burton et al. 2009; Allaire and Willis 2006). Allaire and colleagues reported that older adults with MCI performed significantly worse on the three instrumental subdomains of an everyday memory test and that performance on the subdomain assessing of financial management was a significant and unique predictor of MCI status even after controlling for a battery of basic cognitive ability tests (Allaire et al. 2009). Thomas and Marsiske reported that everyday cognitive performance was worse in older adults with amnestic MCI, then nonamnestic, and then unimpaired (Thomas and Marsiske 2014).

Studies from the clinical literature have also found that everyday cognition plays a central role in differentiating between impaired and nonimpaired older adults. For instance, a study using an informant and proxy subjective assessment of everyday cognition, while not ideal, found that items such as "remembering a few shopping items" or "balancing a checkbook" significantly discriminated MCI from non-MCI older adults (Marshall et al. 2014). In addition, this same study also found that older adults with poorer everyday cognition were more likely and more quickly to progress from normal to impaired status. However, this study did not control for basic cognitive abilities. Other studies have also reported that differences between MCI and non-MCI older adults are particularly salient when the everyday task is memory laden (Farias et al. 2013).

Interventions

Since the late 1970s, a considerable amount of research has focused on the extent to which older adults' basic cognitive functioning is amenable to intervention. As part of this research, measures of everyday cognition have been used as outcome variables. Their use in outcome batteries is to determine if the cognitive training intervention impacts domains related to but still unique from the basic abilities which are the focus of the intervention. However, there is little evidence that interventions focused on improving basic cognitive abilities have a robust or reliable impact on older adults' everyday cognition functioning. For instance, results from the ACTIVE study have suggested that while improvements in trained abilities are evident, these gains do not consistently transfer to measures of everyday cognition (e.g., Rebok et al. 2014).

Given this lack of transfer, some studies have examined whether everyday cognition is amenable to direct intervention. For example, Thomas and Marsiske (2014) examined the outcome of providing simple verbal instructions or prompts such as "look harder" or "try again" when a participant was unable to correctly answer a question on an everyday cognition test. The results suggested that prompts significantly improved performance. Promoted performance did not exhibit significant age-related decline like unprompted performance. Moreover, participants with MCI benefitted the most from prompts with prompted performance similar to that of the unprompted performance of non-MCI participants. Another study adapted the strategies used to train inductive reasoning ability and applied them to real-world or everyday problems (Williams et al. 2014). Participants from assisted living facilities that received this training experienced significant gains in everyday cognitive performance relative to participants that did not. In addition, these gains were maintained 3 months later.

Conclusion

With the burgeoning older adult population, there will be an increasing concern among older adults about experiencing cognitive impairment and, subsequent, loss of functional independence. Understanding the antecedent of and outcomes associated with an older adult's ability to perform cognitively demanding real-world tasks is at the core of everyday cognition. Even though everyday cognition is correlated with basic abilities, it remains sufficiently distinct enough to warrant additional research. While studies have begun to point out that everyday cognition is a salient and unique predictor of important real-world outcomes, additional research is warranted to identify

modifiable determinants of impaired everyday cognition. Such research can be useful in designing successful interventional protocols to improve cognitive functioning and well-being.

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Executive Functioning

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Synonyms

Central executive; Controlled processing; Response inhibition; Set-shifting; Working memory updating

Definition

Executive functioning is an important concept in neuropsychology and broadly refers to our ability to plan and coordinate complex behavior. The term is used widely in describing performance on cognitive tasks that require planning, strategy use, self-regulation, focused attention, inhibition, and other supervisory functions.

Executive Functioning

Our executive functions allow us to organize the actions of lower-level cognitive processes in order to behave flexibly in the face of an ever-changing environment. A multitude of complex cognitive tasks have been developed to assess executive functioning, and healthy aging appears to impair performance on many of these measures. While it has often been proposed that executive functioning reflects the operation of a number of subprocesses, such as planning, strategy use, self-regulation, focused attention, and so on, the complex nature of the measures used to asses executive functioning has made this difficult to clearly establish. However, over the past two decades, a great deal of progress, using psychometric methods, has been made toward identifying core processes underlying executive functioning. The emerging view is that there are separable but interdependent components underlying performance of complex executive tasks. This approach has also been used to assess the effect of healthy aging on specific processes in order to better characterize the decline of executive functioning with age. Given the pervasive effect of age on cognition, much of this work has also attempted to establish whether the effect of age on specific functions is greater than would be expected given age-related decline in speed of processing. This entry does not aim at providing a comprehensive review of the topic; for such reviews see MacPherson et al. (2015), Jurado and Rosselli (2007) and Phillips and Henry (2008). Its aim is to briefly touch upon state-of-the-art issues in this field with emphasis on current theories of cognitive aging.

Fractionating Executive Functioning

In their highly influential paper, Baddeley and Hitch (1974) made the distinction between low-level storage buffers for verbal and visuospatial information and a higher-level controlling mechanism they termed the "central executive." This executive component was said to coordinate the action of the "slave" storage systems and

allow flexible behavior in the face of constantly changing goals. Whether executive functioning reflects the action of a single general-purpose control system or multiple separable processes, working in concert, has since proven controversial. Neuropsychologists have developed a wide array of measures to assess executive functioning, and Table 1 provides a selective list of commonly used tasks. These measures are inherently complex, and, given this problem of task impurity, there is widespread disagreement as to what underlying abilities these tasks actually assess (MacPherson et al. 2015; Jurado and Rosselli 2007). Consequently, psychometric methods have proven useful in identifying potential core processes that support executive functioning. These methods assess patterns of shared variance between conceptually similar tasks and attempt to explain performance on an array of measures in terms of underlying, latent variables. The emerging view from this line of research is that the central executive can be fractionated into separable but highly interdependent executive processes (Jurado and Rosselli 2007; Miyake et al. 2000; Miyake and Friedman 2012).

In their review of the literature, Miyake and colleagues (2000) identified three executive functions, or processes, that are commonly referred to when explaining performance on measures of executive functioning. These three executive functions are as follows:

1. *Updating*: When information currently stored in working memory – the small amount of material that can be actively maintained in the face of concurrent processing – is no longer relevant to current goals, the space must be freed up via the removal of irrelevant items. This ability to clear and update working memory is crucial for the efficient use of this limited capacity workspace. Updating is typically assessed with tasks that require simultaneous storage and processing of information (see Table 1).
2. *Shifting*: In day-to-day life, it is rarely the case that one task can be completed without attention being diverted to another. This ability to switch between different mental sets necessitates that the appropriate rules for a given task are maintained and engaged/disengaged as required. Measures of shifting typically compare performance between conditions in which participants characterize stimuli according to a single rule, to conditions in which there are two or more rules to shift between (see Table 1). These measures of task switching are considered important indices of cognitive control.
3. *Inhibition*: Much of our behavior is automatic and based on well-learned responses to stimuli. However, it is often desirable to inhibit these prepotent responses if the automatic reaction is inappropriate. Typical assessments of this construct require speeded responses that run counter to well-learned stimulus–response mappings, for example, naming the color font in which the word BLUE is presented (see Table 1). Inhibition may also refer to the ability to ignore irrelevant information or the ability to resist the distracting effects of no-longer-relevant information, also known as proactive interference (Miyake and Friedman 2012).

Having identified these core executive functions in the literature, Miyake et al. (2000) administered a range of simplified executive functioning measures to a group of young, college-aged adults. Using latent variable modeling, they then assessed patterns of association between the different measures to examine whether their three proposed executive functions could be separated. A model separating the contributions of updating, shifting, and inhibition to performance on measures of executive functioning gave a better account of their data than a model with a single component. However, in the favored model, the correlations between the three components were moderate to large (0.42–0.63) suggesting that, while the three functions are separable, they are interconnected. What underlies this unity is very much up for debate, although it has been noted that the requirement to actively maintain task goals is a basic feature of all executive processes (Miyake and Friedman 2012).

The idea of separating updating, shifting, and inhibition has gained support from subsequent

Executive Functioning, Table 1 Commonly used measures of executive functioning

Measure	Description	Outcome measure(s)	Putative domains tapped
Wisconsin card sorting test (WCST)	Participants arrange cards, one at a time, into four piles. Cards can be sorted on the basis of multiple features (color, shape, number) but only one is the correct rule at any one time. Feedback is given after each card and the sorting rule changes without warning	The number of incorrectly sorted cards following a rule change. Referred to as the number of perseverative errors	Shifting (Miyake et al. (2000) found their shifting factor predicted performance on the WCST), inhibition, sustained attention
Go/no-go	Participants make a response (e.g., press a button) as quickly as possible if a certain condition is met (go trial; e.g., when an *X* is presented) but not otherwise (no-go trial; e.g., any other letter is presented). No-go trials are infrequent	Reaction time The number of hits (responses on go trials) and false alarms (responses on no-go trials)	Inhibition, goal maintenance (no-go rule)
Verbal fluency	Generate as many different words possible in a given time period. In the most common variants, participants generate words beginning with the same letter (phonemic fluency) or words belonging to the same category (semantic fluency)	The number of words produced. The number of repeated words (perseverative errors)	Inhibition, working memory updating, access to long-term memory (see Miyake and Friedman 2012)
Working memory span	This refers to a selection of tasks requiring simultaneous processing and storage of information. In operation span participants verify an equation (e.g., (3 * 4)−7 = 3?) and then are given a word to store for later recall. Reading span is similar except that participant verifies a sentence then remembers the last word	The total number of items (e.g., words) recalled, or if an adaptive method is used the last level at which the participant met a criterion (e.g., two out of three trials correct)	Working memory updating, shifting
The Stroop task	In the most common variant of this task, participants must name the color font that a color label (e.g., BLUE) is presented in. This is compared to a baseline condition in which the participant either names the color of meaningless units (e.g., #####) or names color labels presented in black font	Reaction time difference between incongruent trials (the font matches the color label) and incongruent (mismatch) trials Difference between incongruent trials and baseline trials	Inhibition, cognitive control
Trail-making task (TMT)	These tasks are typically paper-and-pencil and require participants to connect randomly arranged dots. In a baseline version (Part A), the dots are connected in order of numeric label. In the comparison task (Part B), dots are connected by alternating between numeric and alphabetic labels (e.g., 1 → A → 2 → B. . .)	Difference between baseline and switching tests in terms of time taken to complete or number of errors made	Shifting, speed of processing

See Jurado and Rosselli (2007), Baddeley and Hitch (1974), and Lezak et al. (2012) (and the references therein) for more detail on each task and for additional tasks commonly used to assess executive functioning

studies using a similar individual differences approach (see Jurado and Rosselli 2007; Miyake and Friedman 2012 for reviews). Of course this list is an oversimplification, and there are other important processes that likely contribute to measures of executive functioning (see, e.g., Fisk and Sharp 2004; Lezak et al. 2012). In fact, a three-factor model would be insufficient to account for the large number of behavioral responses we can observe and measure either in healthy individuals or in those affected by brain diseases, which are thought to result from the function of an executive system (e.g., planning, selective attention, monitoring, decision-making, and others) (Lezak et al. 2012). Thus while conceptualizing executive functioning in terms of these separable but interrelated components is clearly a simplification, it provides a useful focus for discussing studies of the neural correlates and age-related decline of executive functions.

Neural Correlates of Executive Functioning

Damage to the frontal lobes has long been associated with profound behavioral changes. Patients with frontal lobe lesions can exhibit a range of deficits including an impaired ability to initiate goal-directed action and socially inappropriate, impulsive behavior (MacPherson et al. 2015; Lezak et al. 2012). Historically this has led to the suggestion that the frontal lobes, particularly prefrontal cortex, are the seat of executive control (see MacPherson et al. 2015 for a historical overview). However, further evidence from neuropsychology and neuroimaging studies has shown that this mapping of executive functions purely onto the frontal lobes is highly misleading. While measures of executive functioning are *sensitive* to frontal lobe lesions, they are certainly not *specific* as lesions to other areas have also been associated with impaired performance (MacPherson et al. 2015; Jurado and Rosselli 2007; Lezak et al. 2012). Studies assessing executive tasks along with neuroimaging measures, such as functional magnetic resonance imaging (fMRI) or positron-emission tomography (PET), have shed further light on the neural correlates of executive functioning (Collette et al. 2006).

Early neuroimaging studies of executive functioning compared tasks presumed to pose some executive demand to baseline tasks without such demand and, in general, found activation of a wide-ranging network including both anterior and posterior areas (Collette et al. 2006). However, as multiple processes contribute to performance of executive tasks (Miyake et al. 2000), it is difficult to identify activation involved in, say, shifting with a single-task measure. Consequently, one notable study in the field used PET to measure regional cerebral blood flow (rCBF), while participants performed a range of tasks selected to place primary demand on updating, shifting, or inhibition (Collette et al. 2005). Consistent with earlier findings, Collette and colleagues (2005) found activation of a large frontoparietal network common to all tasks that they assessed. This network included the left superior parietal gyrus and right intraparietal sulcus along with regions of the dorsolateral prefrontal cortex.

As well as assessing common activation, the use of multiple measures allowed them to perform interaction analyses to identify areas disproportionately associated with one function relative to the others. This method of analysis suggested that the hypothetical processes of shifting, updating, and inhibition do exhibit separable patterns of activity. Performance of tasks involving the updating of working memory representations was associated with the activity in inferior frontal and frontopolar cortices as well as the intraparietal sulcus. Activity associated with inhibiting prepotent responses was found in the orbitofrontal cortex along with middle and superior frontal gyri. Finally, shifting was associated with greater rCBF to the left intraparietal sulcus.

While it is difficult to make strong conclusions on the basis of neuroimaging data, these findings complement the behavioral data nicely. There appear to be separable patterns of activity associated with the performance of tasks primarily assessing updating, shifting, and inhibition, as well as a large frontoparietal network engaged regardless of task demand.

Aging and Executive Functioning

Healthy adult aging is associated with reduced performance across a range of cognitive variables, and measures of executive functioning are no exception. For example, on the Wisconsin Card Sorting Test (WCST; see Table 1), older adults show an increased number of perseverative errors relative to younger adults (MacPherson et al. 2015; Phillips and Henry 2008). That is, following a change to the sorting rule, older adults are more likely to erroneously use the old rule to sort the cards and take longer to discover the new rule. Similarly, studies using the go/no-go task tend to find that older adults produce a greater number of errors (e.g., responses on no-go trials) and slower response times relative to younger groups (MacPherson et al. 2015; Phillips and Henry 2008). Further, structural neuroimaging studies have found evidence of pronounced deterioration of the frontoparietal network implicated in performance of many executive tasks. The frontal lobes in particular appear to be greatly affected by the aging process. Gray matter volume in the prefrontal cortex exhibits pronounced decline relative to other areas, and white matter hyperintensities are observed with greater frequency in the frontal lobes (Raz and Rodrigue 2006).

However, as highlighted above, multiple processes underlie performance on complex measures of executive functioning, and older adults may take longer or make more errors for many different reasons (Phillips and Henry 2008). Thus, in attempting to understand the effect of healthy aging on executive functioning, it is important to take a broad range of measures to separate out age-related decline in executive processes. Further, it is important to disentangle change to specific executive processes, such as a reduced ability to update the contents of working memory, from more general changes associated with age, such as reduced information processing speed (Albinet et al. 2012).

Fractioning Executive Functioning in Old Age

An important starting question, before discussing the decline of specific executive functions with age, is whether the performance of older adults on complex measures of executive functioning reflects the operation of the same underlying abilities as in younger adults. That is, is it still possible to separate out the contributions of shifting, updating, and inhibition components or do abilities become dedifferentiated (i.e., less distinct) with age? Several studies have adopted an individual differences approach to assess the latent factor structure of executive functioning measures in older groups. In contrast to the idea of dedifferentiation, many of these studies have found that the three-factor solution gives a good account of performance in groups of healthy older adults (Fisk and Sharp 2004; de Frais et al. 2009; Vaughan and Giovanello 2010).

It should also be noted, however, that other investigators have found two-factor solutions. For example, Hull and colleagues (2008) found that a two-factor model, with no distinction between updating and inhibition but with a separate shifting component, fitted their data just as well as the more complex three-component model. On the other hand, Hedden and Yoon (2006) found a separable inhibition factor in their group of older adults but were unable to separate shifting and updating factors (see also Androver-Roig et al. 2012). While these studies may suggest some degree of dedifferentiation with age, it is the case that even in college-aged adults, the existence of a distinct inhibition factor, that can be separated from the shared variance between the other executive processes, is a matter for debate (Miyake and Friedman 2012). The choice of measures used to construct the factors is likely to be an important reason for this discrepancy.

Interestingly, findings from the large-scale Victoria Longitudinal Study suggest that, in fact, the separability of different executive components may be a good indicator of general cognitive functioning in old age (de Frais et al. 2009). That study assessed the structure of executive functioning in over 500 participants aged between 53 and 90. On the basis of a broad cognitive battery – assessing speed, reasoning abilities, as well as episodic and semantic memory – the group was split into high performers (termed "cognitive elites"), those performing at a normal level and

those who showed a mild level of cognitive impairment. At the baseline assessment, the three-factor model, with separable updating, inhibition, and shifting components, fit the data from the high and normally performing older adults. However, the three-factor model did not fit the data from the cognitively impaired group; their pattern of performance was explained by a single component, consistent with dedifferentiation of executive functions. Further, the cognitively healthy groups (high and normal performers) showed stability in their underlying abilities over a 3-year follow-up period.

Thus, much of the extant literature suggests that in groups of healthy older adults, it appears to be possible to separate the contribution of different underlying executive processes to complex measures of executive functioning, just as can be done for younger adults.

Does Age Differentially Affect Executive Functions?

Given that the contributions of shifting, updating, and inhibition appear to remain largely separable with age, the question becomes: does healthy aging affect all executive processes equally or do some processes exhibit a disproportionate age-related effect? The nature of executive functioning measures makes this an inherently difficult question to answer. As noted above, performance on a measure like the WCST may be impaired for a number of reasons, such as reduced speed of processing, failure to inhibit overlearned responses, an impaired set-shifting ability, or a mixture of these factors. However, some have adopted the multivariate approach of Miyake and colleagues (Miyake et al. 2000) to assess the effects of age on the separable but interconnected executive processes. These studies have also attempted to disentangle specific change from the more general age-related change to speed of processing.

One study assessing healthy adults' (aged 20–81) performance on a range of executive functioning tasks found a significant relationship between age and the factors reflecting updating, inhibition, and shifting ability (Fisk and Sharp 2004). However, when measures of processing speed were accounted for in the statistical model, the amount of variance in executive functioning accounted for by age was greatly reduced. This reduction of age-related variance in executive functioning when accounting for measures of speed has been found many times (Albinet et al. 2012; Androver-Roig et al. 2012; Sylvain-Roy et al. 2014). However, despite the overall reduction in age-related variance, this study found that a significant relationship remained between age and the component representing the ability to shift between mental sets, suggesting that age may impair shifting ability *over and above* the reductions seen in information processing speed.

Similar conclusions have also been reached in a recent series of meta-analyses of the executive functioning and cognitive aging literature (Verhaeghen 2011). The estimated age effects on many measures of inhibition were no greater than that predicted by age differences in matched baseline measures (i.e., tasks with similar structure but without the requirement of executive control). This analysis did, however, reveal a disproportionate effect of age on task switching and was able to probe further into the possible origin of this deficit. The cost of having to switch between two sets of task rules can be expressed as the difference in performance (in this case RT) between blocks of trials in which a single-task rule must be applied as opposed to blocks in which participants must switch between rules. The resulting contrast gives the *global task-switching cost*. Alternatively task-switching costs can be calculated as the difference in performance between trials on which a switch was required (i.e., the previous trial used a different rule) versus trials where no switch was required (i.e., the previous trial used the same rule). Here the resulting score is referred to as the *local task-switching cost*. The meta-analyses revealed that older adults exhibited a disproportionate global task-switching cost, whereas the local cost was no greater than expected from matched baseline measures. This global task-switching deficit was interpreted as a reduced ability to simultaneously maintain two sets of task rules, whereas the lack of a disproportionate effect of age on local switching suggests

that the ability to engage the relevant task rules when a switch is required is well preserved (see also Phillips and Henry 2008). Thus the increased number of perseverative errors exhibited by older adults on tasks such as the WCST (MacPherson et al. 2015; Phillips and Henry 2008) would be interpreted as a failure to maintain and retrieve the new appropriate rule, rather than a failure to initiate rule following.

There is additional evidence that performance on measures of set shifting may be an important determinant of day-to-day functioning in old age (Vaughan and Giovanello 2010). This study extracted shifting, inhibition, and updating factors from the performance of 100 older adults (aged 60–90) on a range of measures. They also included self-report and performance-based measures of instrumental activities of daily living, which give an indication of a person's ability to live independently. While none of the executive processes predicted self-report measures of daily functioning, the shifting component significantly predicted performance-based measures. The authors conclude, given that self-report measures are prone to overestimation, the ability to shift between different mental sets appropriate to current goals may be an important determinant of an older adults' ability to manage daily life.

In summary, studies adopting a psychometric approach to assessing executive functioning across the life span and meta-analyses of the literature suggest that the ability to shift between mental sets, and more specifically concurrently maintain two sets of task rules, may exhibit disproportionate decline with age. However, it is important to note that findings are mixed as other groups have found evidence for a disproportionate effect of healthy aging on the ability to inhibit prepotent responses (Sylvain-Roy et al. 2014) or a more general effect of age across the subprocesses, even after accounting for age-related slowing (Albinet et al. 2012). Much of this ambiguity may be attributable to different studies using different measures of the underlying constructs and of processing speed. Further it appears that when these studies control for measures of processing speed, the variance in executive functioning attributable to age is greatly reduced (Fisk and Sharp 2004; Albinet et al. 2012; Androver-Roig et al. 2012; Sylvain-Roy et al. 2014). While this may suggest that much of the decline in executive functioning is accounted for by senescent decline at a lower level in the processing hierarchy, this should be interpreted with caution. It is often assumed that measures of processing speed capture a more "primitive" aspect of cognition; however, many commonly used measures of speed appear to require controlled processing (Phillips and Henry 2008; Albinet et al. 2012). It is reasonable to suspect that slower speed of processing leads to poorer performance on executive functioning measures, but nevertheless it is also conceivable that speed of processing could be slowed by poor executive control; for example, older adults could take longer to process information *because* they are less able to inhibit prepotent responses. Thus a more thorough theoretical analysis of the mutual relationship between speed of processing and different executive functions is required to gauge their relative contributions to age-related decline on complex behavioral measures (Albinet et al. 2012).

Further Fractionation of Executive Functioning

While focusing on three core executive processes is useful for guiding discussion, further fractionation of executive functioning seems inevitable. For example, the concept of inhibition as discussed above was specifically framed around avoiding inappropriate but automatic responses, but this term may also apply to reducing the interfering effects of previously encountered material (proactive interference) or to preventing task-irrelevant information from distracting task performance (Miyake and Friedman 2012). The suggestion that older adults have a specific deficit in inhibiting distracting information is highly influential in the cognitive aging literature (Hasher and Zacks 1988). Indeed research does suggest that older adults are less able to ignore task-irrelevant distractors, and neuroimaging work has begun to shed light on the mechanisms underlying this. One fMRI study presented younger and older

adults with a series of images of faces and scenes to remember over a brief interval (Gazzaley et al. 2005). Their task involved selectively attending to one of these categories; for example, participants would have to attend to faces while ignoring the scenes presented. Looking at a specific scene-selective region of interest in the left parahippocampal gyrus, the authors found the expected suppression of activity when younger adults were ignoring scenes relative to trying to encode them. Their older adults, on the other hand, did not exhibit the same suppression effect. In fact this seemed to be driven by the very lowest performers in the older group, as high performing older adults exhibited the suppression seen in the younger adults. Thus *inhibition* appears to be multifaceted itself (Miyake and Friedman 2012), and it may be that age has a differential effect on its subcomponents.

Further, there is evidence that the ability to coordinate two tasks at once may be a distinct executive function. The latent variable study of Miyake et al. (2000) found that a measure of dual tasking did not load highly onto any of their three core executive processes, suggesting the possibility that dual tasking reflects a somewhat distinct function (see also Fisk and Sharp 2004). While performance on many measures of executive functioning changes with age, it appears that, under certain circumstances, the ability to coordinate two tasks at once is relatively unimpaired. For example, Logie and colleagues (2004) required participants to retain a sequence of digits while they tracked a moving stimulus with a stylus on a computer screen. Crucially, however, they measured participants' performance when completing these tasks in isolation, in order to titrate the demand of each task (i.e., the number of digits given and the speed of the tracking stimulus) in the dual-task condition. The small cost associated with performing the tasks concurrently was no greater in their older group compared to their younger group. However, a group of patients with Alzheimer's disease (AD) showed a large reliable performance cost. Given that each task was performed within proficient single-task levels, this suggests that AD patients have a specific deficit in dual tasking.

In fact, recent work with a familial form of AD has suggested that a deficit in dual tasking may signify early changes associated with the disease (MacPherson et al. 2012). Carriers of a genetic mutation exhibited a pronounced deficit when performing the digit recall and tracking tasks concurrently, whereas noncarrier family members did not. Crucially, these carriers did not meet diagnostic criteria for AD and, given the typical age of onset in this cohort, would not be expected to for approximately 12 years. This raises the intriguing clinical possibility that measures of dual tasking, properly titrated, may differentiate between healthy and pathological aging at an early stage.

Neuroimaging of Executive Functioning in Older Adults

There have been many neuroimaging studies that have assessed age differences in activation patterns during the performance of executive functioning tasks. However, these studies are subject to the caveat mentioned many times above; namely that single tasks do not give sufficient insight into the processes underlying executive functioning. Future imaging studies assessing age-related activation differences across a wide range of tasks (as was done in the study of Collette et al. (2005) described above) would be highly informative establishing whether age has a general effect on the neural substrates of executive functioning or whether specific differences occur.

However, one clear finding from many neuroimaging studies across a broad range of tasks is that older adults exhibit patterns of *overactivation* relative to younger adults. This overactivation appears to be more extensive for tasks requiring executive control relative to tasks assessing memory or perceptual function and is primarily found in the dorsolateral prefrontal cortex (Spreng et al. 2010). The finding that this hyperactivity is usually exhibited by better performing older adults has contributed to the suggestion that it is

in some way compensatory and acts as a scaffold supporting less efficient brain areas (Park and Reuter-Lorenz 2009). However, this over-recruitment could represent a non-specific degradation of brain function or dedifferentiation of cognitive processes with age (see Spreng et al. 2010 for a review).

Interestingly, a meta-analysis of 24 functional imaging studies covering a range of executive functioning tasks and 22 studies assessing age-related change to gray matter volume has recently shown considerable overlap between areas overactivated by older adults and regions exhibiting disproportionate gray matter loss with age (Di et al. 2014). The clusters were found in the bilateral dorsolateral prefrontal cortex, and overactivation of this region was not associated with poorer task performance relative to younger controls. These findings could be leveraged in support of either the compensatory or general inefficiency/dedifferentiation views. That areas showing the greatest volumetric decline were also those exhibiting overactivation is certainly reconcilable with the argument that the additional recruitment is a product of degradation and neural inefficiency. However, that this activation was not associated with any gain or loss in performance could also suggest that hyperactivation serves to compensate for structural decline (Park and Reuter-Lorenz 2009). The compensation account is clearly very flexible, and it will take large longitudinal studies to establish the functional significance of hyperactivation during executive functioning and other tasks (Spreng et al. 2010; Di et al. 2014).

While more work needs to be done to link neuroimaging measures to behavioral measures of executive functioning in old age, it is interesting to note that there may be behavioral evidence for the compensation hypothesis from complex executive functioning tasks. In younger adults, Miyake et al. (2000) found performance on the WCST was best predicted by the shifting factor from their latent variable model. On the other hand, Hull et al. (2008) found that their working memory updating factor predicted WCST performance best in their group of older adults. If we accept that age disproportionately affects shifting ability – although as discussed above the evidence is mixed – it may be the case that more intact executive processes can be called upon to support less well-preserved functions in the performance of multifaceted executive functioning tasks.

Conclusion

In summary, a great deal of progress has been made in recent years toward understanding the core processes underlying executive functioning. Studies adopting a multivariate approach have identified separable but highly interconnected factors representing the ability to inhibit prepotent responses, shift between mental sets, and update the contents of working memory. Contrary to the predictions of dedifferentiation, these diverse functions appear to remain largely separable in healthy old age although this may break down in mild-cognitive impairment.

However, whether or not executive processes exhibit differential decline is unclear. The studies discussed above suggest some reason to suspect that older adults have specific difficulty in shifting between tasks or maintaining multiple task rules. Nevertheless, findings are mixed, and this likely depends on the precise measures used to establish the underlying constructs. Further, it appears that much of the impairment exhibited by older adults on complex measures of executive functioning may attributable to more general decline, such as reduced speed of processing. Although it is important to note that commonly used measures of processing speed may include an element of executive control, therefore the effect of controlling for processing speed measures in analyses should be interpreted with caution. It seems likely that the substrates of executive functioning will be fractionated even further through the use of theory-driven tasks that aim to better isolate executive processes. Finally, the assessment of tasks which rely on executive functions which are age

insensitive, such as dual tasking, can open new diagnostic opportunities for the early detection of abnormal variants of aging, such as Alzheimer's disease.

Cross-References

- ▶ Age-Related Slowing in Response Times, Causes and Consequences
- ▶ Aging and Inhibition
- ▶ Executive Functions
- ▶ History of Cognitive Slowing Theory and Research
- ▶ Working Memory in Older Age

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Executive Functions

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Synonyms

Cognitive control; Executive control

Definition

Executive functions are higher-level cognitive control functions supporting the flexible adaptation to changing environmental demands. They include abilities such as updating, shifting, and inhibition, which are subject to significant age-related changes. These age differences are associated with age-related changes in the neural substrate supporting executive processes. However, the brain is plastic up to very old age, and executive functions can be improved by intensive cognitive and physical training in adulthood.

The Concept of Executive Functions

Executive control is an umbrella term for a broad set of higher-order cognitive processes supporting the flexible regulation of thoughts and actions in the service of adaptive, goal-directed behavior. Executive control is especially required in novel, ambiguous, or complex situations, when there are no well-learned routines for action selection (Baddeley 2000; Jurado and Rosselli 2007). Executive abilities allow us to think divergently and creatively, for instance, when we are stuck with a problem and need to develop new solutions to overcome it. They help us to maintain a goal and focus our attention in the face of distraction, while staying flexible enough to adjust our behavior quickly to unpredicted changes in the environment. We need executive skills to resist temptation and to suppress inappropriate habitual behaviors. Executive functions enable us to plan ahead, to juggle multiple pieces of information in our mind and make new connections between them. It is thus not surprising that executive control is a strong predictor for various life outcomes, such as academic achievement, socioeconomic status, and physical health.

There is a fundamental debate as to whether executive functions can be best described as a unitary or multidimensional construct. While the former view holds that a single ability or common cognitive mechanism underlies all aspects of executive functioning (unity), the latter view assumes that executive functions involve related, but separable, components (diversity). The unity framework includes influential concepts such as the supervisory attentional system in the model of attention for action by Norman and Shallice (1986) or the central executive in Baddeley's working memory model (Baddeley 2000). Further, it has been suggested that perceptual speed and/or basic reasoning skills may form a common basis for executive control operations (Salthouse 2005).

In line with the idea of a unitary control system, studies using confirmatory factor analysis and structural equation modeling have typically revealed substantial correlations between the latent constructs underlying performance in executive control tasks (e.g., Friedman et al. 2011; Miyake et al. 2000). These studies, however, also showed that the latent factors explained unique variance and thus may represent separable abilities. Miyake and colleagues (2000), for

instance, demonstrated that interindividual differences in executive functions in young adults are better accounted for by a three-factor model with the latent variables *shifting*, *working memory (updating)*, and *inhibition* than by single- or two-factor models. Generally considered as core components of executive control, these factors describe the ability to (i) flexibly switch between different tasks, goals, or mental sets (*shifting*); (ii) update or monitor task-relevant information to be maintained in working memory (*working memory/updating*); and (iii) withhold prepotent responses and suppress attention to irrelevant stimuli as well as interfering thoughts and emotions (*inhibition*). The three main latent factors have been found to contribute differentially to more complex executive functions, such as planning or concept formation.

Notably, more recent work has shown that only the shifting and updating factors captured unique variance that was separable from a higher-order unity factor ("common executive function"; Friedman et al. 2011). Further support for a "hybrid" unity/diversity framework comes from neuroscientific studies showing that different executive control processes rely on overlapping but separable networks of neural activity (Jurado and Rosselli 2007; Collette et al. 2006). A fundamental cognitive mechanism that might underlie the common factor of executive control is the ability to stably maintain task goals in working memory (Braver and West 2008; Miyake and Friedman 2012), whereas updating and shifting have been linked to the ability to efficiently "gate" goal-relevant information into working memory (updating) and to quickly remove contents from working memory when they are no longer needed (shifting; Miyake and Friedman 2012; Herd et al. 2014).

Convergent evidence indicates that the basic organization of executive functions is similar in younger and older adults. While some studies replicated Miyake et al.'s three-factor structure in healthy elderly populations, others revealed two-structure solutions with the subcomponents (a) shifting and updating or (b) shifting/updating and resistance against proactive interference (for review, Adrover-Roig et al. 2012). Importantly, single-factor models did not seem to provide an appropriate description of executive functioning in either of the abovementioned studies. Overall, it has been concluded that aging is associated with changes in the relative contribution of the different subcomponent processes to performance on executive control tasks rather than with a fundamental reorganization of executive functions.

Age-Related Changes in Executive Functions

Compared to other cognitive domains, such as procedural and semantic memory, language, or emotion regulation, executive control seems to be particularly affected by aging, with a sharp drop occurring after the age of 60 (Jurado and Rosselli 2007). Consistent with the unity/diversity view, both global and component-specific mechanisms have been shown to account for declines in executive functions with advancing age. Prominent examples for global mechanisms that are thought to impact all components of executive control are reduced information processing speed (Salthouse 2005) and impaired goal maintenance (e.g., Braver and West 2008; Miyake and Friedman 2012). Specifically, Salthouse and colleagues suggested that the apparent diversity of age-related cognitive deficits can be explained by a generalized slowing of cognitive processing. This argument is based on their observation that (i) measures of executive functions, reasoning, and processing speed were highly correlated and (ii) controlling for processing speed eliminated or strongly diminished age differences in executive functioning (Salthouse 2005). However, other studies found age-related deficits in executive control when differences in speed of processing were taken into account (e.g., Albinet et al. 2012). Moreover, commonly used measures of processing speed, such as the Digit-Symbol Substitution Test, are "impure" in that they also tap inhibition, shifting, and working memory, which may explain their shared variance with executive control tasks. Using hierarchical regression

analyses, Albinet and colleagues (2012) demonstrated that despite sharing common variance, processing speed and the three main control components are independently affected by chronological age. This finding argues against the view that age-related decrements in executive functions are exclusively mediated by generalized slowing.

Several theoretical frameworks contend that the ability to actively maintain behavioral goals or task sets in order to bias task-appropriate response selection plays a pivotal role in executive functioning (e.g., Braver and West 2008; Miyake and Friedman 2012). An elegant paradigm to examine age differences in the integrity and robust maintenance of goal representation is the AX-Continuous Performance Test (AX-CPT; Braver and Barch 2002). In this paradigm, participants are presented with different cues ("A" vs. "non-A") that specify the appropriate rule for responding to a subsequent probe stimulus ("X" vs. "non-X"). When an "A" cue is followed by an "X" probe (AX trials), a target response must be given, while "X" probes preceded by "non-A" cues (BX trials) as well as all "non-X" probes (AY and BY trials) require a non-target response. Since AX-trials are presented more frequently than other trial types, "X" probes elicit a strong tendency to make a target response. Thus, failures to maintain a stable representation of the rule context ("A" vs. "non-A") should lead to *higher* error rates when "X" probes are preceded by "non-A" cues (BX trials) but *lower* error rates when "A" cues are followed by "non-X" probes (AY trials). Consistent with the goal maintenance account, Braver and colleagues observed exactly this error pattern when comparing younger and older adults' performance on the AX-CPT. Older adults produced more BX than AY errors, while the opposite was true for younger adults. Notably, these age differences were even more pronounced when distractors were presented during the cue-probe delay. This latter finding indicates that older adults are more susceptible to distraction, most likely due to their weaker maintenance abilities. Interestingly, increasing maintenance demands by manipulation the length of the cue-probe delay (1 vs. 5 s) resulted in differential effects in younger and older seniors. While younger seniors' performance did not differ between the two delay conditions, older seniors showed worse BX but better AY performance with longer delays.

Based on these findings, Braver and Barch (2002) concluded that the younger seniors' deficits in BX trials result from their difficulties with updating – rather than maintenance – of the rule context. Thus, updating mechanisms might be more vulnerable to advancing age than maintenance, which shows impairments only at older age or under more challenging conditions (e.g., distraction). In line with this assumption, complex working memory tasks that require updating and monitoring, such as reading or operation span, usually reveal more substantial age differences than simple span tasks. In further support of a particularly high susceptibility of updating skills to cognitive aging, previous work identified updating as the most important predictor of older adults' performance on tasks tapping complex executive functions, such as Tower of Hanoi (TOH) and Wisconsin Card Sort Test (WCST) (cf. Adrover-Roig et al. 2012). In younger adults, by contrast, the Miyake et al. study (Miyake et al. 2000) found inhibition and shifting to be the best predictors for TOH and WCST performance, respectively.

While the ability to update and maintain information in working memory is characterized by a constant age-related decrease, the ability to flexibly shift between tasks seems to be less affected by age. One frequently used experimental task to measure this skill is the task-switching paradigm including conditions in which participants are required to shift back and forth between two or more tasks (*mixed-task blocks*) and conditions that do not require task switches (*single-task blocks)*. Shifting skills are measured as the difference in performance between task-switch and task-repeat trials within mixed-task blocks (*specific switch costs*). Further, by contrasting mixed-task blocks with single-task blocks, this paradigm allows to determine performance costs due to the greater maintenance demands in the dual-task situation (*general switch costs*). When the general age-related slowing of processing

speed is controlled for, age differences are usually only found for general switch costs but not for specific switch costs (e.g., Verhaeghen and Cerella 2002).

It is interesting to note, however, that the common component of executive control and the shifting-specific subcomponent often tend to be negatively correlated (e.g., Friedman et al. 2011). In a recent study, Herd and colleagues (2014) used neural network modeling to show that this might reflect opposite effects of stable maintenance on the two factors. Specifically, the authors demonstrated that stronger goal representations led to an overall decrease in reaction times for both task-switch and task-repeat trials in mixed-task blocks relative to single-task blocks, resulting in a reduction of general switch costs. This effect was smaller for task-switch trials, where participants needed to overcome the stronger goal representations, resulting in an *increase* of specific switch costs. Thus, spared shifting abilities in old age might actually be a byproduct of impaired maintenance skills. Further research is needed to determine how the putative shifting-specific processes – removal of no-longer-relevant information from working memory and automatic persistence of those contents – change with advancing age.

Robust goal maintenance is particularly important in the face of strong interference from competing response tendencies or goal-irrelevant information and usually considered to be a key determinant of inhibition (Miyake and Friedman 2012). Indeed, the abovementioned neural network simulations by Herd et al. (2014) revealed that in the Stroop color-word interference task, strong goal representations particularly benefitted incongruent trials and hence were associated with reduced interference effects. Interestingly, age-related impairments do not reliably occur for all types of inhibitory control. In particular, a number of findings have suggested that older adults' deficits in inhibitory processing as measured by the Stroop task or negative priming reflect global changes in processing speed or impaired sensory processing (e.g., Verhaeghen and Cerella 2002). However, in support of the goal maintenance account, West and colleagues (Braver and West 2008) found that older participants showed disproportionally higher rates of intrusion errors (i.e., naming the word instead of the ink color) when color and word naming alternated in a trial-by-trial rather than block-wise fashion. Notably, this effect was separable from the switching demand itself and has been argued to reflect a weaker representation of the currently relevant task goal. Similarly, Mayr and colleagues (2014) suggested that older adults' higher susceptibility to irrelevant memory traces in interference tasks results from their difficulties to reestablish a stable maintenance mode after any kind of interruptions (e.g., conflict, task switch). More consistent age-related impairments have been observed in tasks that require participants to withhold their responses upon intermittently presented stopping signals (i.e., stop-signal tasks, go-nogo tasks) or tasks that require the inhibition of the automatic orienting response to salient visual distractors (anti-saccade tasks; cf. Buitenweg et al. 2012).

It is important to note that not all individuals are equally affected by cognitive aging. Indeed, in some older adults, executive functions are remarkably spared. Correlational data indicate that greater engagement in intellectual, social, and physical activities is associated with stronger resilience to cognitive decline in later life (for review, Reuter-Lorenz and Park 2014). Most theories of cognitive aging share the assumption that at least two mechanisms contribute to the protective effect of those environmental variables. First, an enriched lifestyle could directly counteract age-related changes in brain anatomy and physiology, thereby promoting brain health and increasing the threshold for cognitive deficits. Second, environmental enrichment is thought to enhance the ability to adapt to age-related brain pathology and to preserve cognitive function, for instance by compensatory recruitment of additional brain regions and alternative neural circuits. Conversely, depleting genetic and environmental variables, such as vascular risk factors, head trauma, or low socioeconomic status, have detrimental effects on brain health and aggravate the effects of aging on executive and other cognitive functions.

Neurobiological Underpinnings of Executive Control and Cognitive Aging

Executive control is inextricably linked to the functioning of the frontal lobes, especially prefrontal cortex (PFC). Evidence from neuroimaging and lesion studies revealed, though, that executive functions are supported by a distributed neural network, involving prefrontal and parietal areas as well as subcortical structures, such as basal ganglia, thalamus, or cerebellum (Duncan and Owen 2000). The results of these studies are largely in accordance with the view that both shared and unique mechanisms underlie executive functioning. Specifically, it has been shown that shifting, updating, and inhibition tasks elicit an overlapping pattern of activation in frontal (e.g., dorsolateral PFC, anterior cingulate cortex) and parietal regions (e.g., superior and inferior parietal lobe, precuneus). Component-specific activations have been found in distinct prefrontal, occipital, and temporal areas as well as subcortical regions (e.g., Collette et al. 2006). Consistent with the neuroimaging findings, data from lesion studies revealed that patients with brain damage to different frontal regions show both common and unique performance deficits on executive control tasks.

There are similarities between certain aspects of aging-related neurocognitive changes and the neuropsychological deficits displayed by frontal-lobe patients, especially those with lateral frontal damage. The idea that cognitive impairments in older adults are strongly linked to frontal dysfunction ("frontal lobe hypothesis") has received substantial support from neurophysiological studies demonstrating that aging is associated with various changes in prefrontal structure and physiology, such as white matter integrity, grey matter volume, metabolic markers of neural integrity, and neurovascular factors (Raz and Rodrigue 2006). Although disruption of white matter integrity has been primarily associated with the generalized age-related decrease in processing speed, a number of studies demonstrated more specific correlations between separable white matter systems and age-related impairments in task-switching, working memory, and inhibition. Reductions in grey matter volume in PFC have been found to predict performance on age-sensitive executive control tasks such as the WCST or TOH. Further, there is evidence indicating that changes in synaptic connectivity (e.g., reduced synaptic and dendritic density) might play a more important role in explaining cognitive decline in old age than white and grey matter disruption as such.

It is important to note that age-related changes in brain structure are not restricted to frontal cortex but occur throughout the brain. In fact, brain aging has been shown to progress along an anterior-to-posterior gradient rather than being specific to PFC. Moreover, it is well established that deficits in dopamine (DA) function contribute to many of the cognitive impairments observed in old age (Bäckman et al. 2000). DA levels decline monotonically with increasing age (at a rate of about 10% per decade), and markers of advanced DA depletion predict age-related deficits in executive functions, processing speed, episodic memory, reward-based learning, and decision making.

Braver and colleagues (Braver and Barch 2002) provided an integrated theoretical framework for the role of frontal and dopaminergic dysfunction in cognitive aging. According to this account, dorsolateral PFC (dlPFC) contributes to executive control by maintaining goal representations and other task-relevant context information and to use this information to bias (or contextualize) lower-level information processing in posterior cortical regions. The neurotransmitter DA is thought to play a key modulatory role over dlPFC function by regulating maintenance and updating ("gating") of goal representations. Age-related deterioration in PFC and DA function, thus, are assumed to result in a specific impairment in the ability to actively update goal/context information into working memory and to maintain this information robust against interference. Consistent with the idea of a frontostriatal functional dissociation between maintenance (PFC) and updating (striatum), accumulating evidence points to complementary roles for DA in PFC and basal ganglia, with higher prefrontal DA levels promoting stabilization of goal representations and higher striatal DA levels

flexible updating (Cools and D'Esposito 2011). Thus, the loss of dopaminergic function with normal aging may contribute to both increased distractibility (i.e., impaired maintenance) and updating deficits that have been observed in older adults. In support of this notion, Raz and colleagues (Raz and Rodrigue 2006) found a pronounced age-related decline in frontostriatal DA activity and striatal volume.

Functional neuroimaging studies have provided ample evidence that brain aging is not only reflected structural changes but also differences in brain activity. Common aging-specific patterns of brain activity include over- and underactivation, a loss of functional selectivity of neural responses in different regions and networks (dedifferentiation), and altered functional connectivity among different brain areas. Most of these effects are thought to reflect compensatory mechanism that accompany neurocognitive decline. Compensatory strategy changes, in turn, might initiate changes in brain structure, resulting in a complex interplay between structural and functional effects. A typical example of compensatory neural "scaffolding" is the "posterior to anterior shift" in functional brain activity with advancing age, which has been interpreted as an overrecruitment of frontally mediated control processes in response to the reduced distinctiveness of neural representations in posterior regions. Moreover, older adults often show greater and more bilateral PFC activity at lower levels of task demand than younger adults – a domain-general pattern known as hemispheric asymmetry reduction. Interestingly, both patterns also seem to be reflected in age-related changes in functional connectivity.

Despite the well-documented generality of compensatory neural mechanisms, a recent meta-analysis provided evidence for dissociable patterns of age differences in brain activity during working memory and inhibitory control tasks (Turner and Spreng 2012). Specifically, the authors found that working memory tasks were associated with more bilateral activation of dlPFC as well as greater activation of left supplementary motor area and inferior parietal lobule in older compared to younger adults. During inhibitory control tasks, older adults showed a separable pattern of effects, involving stronger recruitment of right (but not left) inferior frontal gyrus and left presupplementary motor area. Nonetheless, the overall spatial distribution of working-memory versus inhibition-specific brain activation profiles was largely comparable in younger and older adults.

Plasticity of Executive Functions in Older Age

Given that executive functions decline with increasing age, there has been growing scientific interest in interventions designed to improve them. Recent studies have applied a wide range of cognitive and physical training interventions, revealing that cognitive plasticity (i.e., the potential modifiability of a person's cognitive abilities and brain activity) is considerable up to very old age (for reviews, Karbach and Verhaeghen 2014; Ballesteros et al. 2015).

Cognitive interventions can be divided into three major categories: (i) strategy-based trainings, (ii) process-based trainings, and (iii) multimodal interventions. Strategy-based trainings aim to improve specific cognitive operations – typically those that are most impaired in older age – by teaching participants an explicit strategy on how to solve the given task or problem. For example, the so-called method of loci helps individuals to improve their memory performance by associating the to-be-remembered items with a sequence of specific physical locations along a "mental route" in a familiar place such as their apartment. Although strategy trainings have been shown to result in considerably large and sustained performance gains, improvements are often limited to the trained task, with little evidence of transfer to untrained functions. Training regimes that involve a combination of multiple strategies or focus on more complex functions, such as reasoning, problem solving, or goal management, seem to yield a more generalized beneficial effect on untrained measures of executive function as well as indicators of daily life functioning.

Process-based cognitive intervention programs aim to improve specific cognitive processes, such as speed of processing or working memory, by training participants on tasks that are thought to heavily tax these functions. Only a relatively small number of studies have examined the effects of set-shifting in older adults (Buitenweg et al. 2012). Available evidence indicates that relatively short shifting practice (less than 10 training sessions) can yield significant performance improvements, particularly in terms of general switch costs. Most importantly, training-induced gains have been shown to transfer to untrained tasks and abilities, such as inhibition, attention, and reasoning. Specifically, several studies demonstrated that shifting practice results in reduced Stroop interference effects, better performance on verbal and spatial working memory tasks, and increased fluid intelligence scores in both younger and older adults. Transfer effects have been attributed to the fact that task-switching paradigms put high demands not only on shifting but also on maintenance and interference control and hence tap into multiple subcomponents of executive control. Additionally, transfer to more complex functions (e.g., reasoning skills) might derive from the requirement to efficiently coordinate multiple tasks. Despite promising initial findings, some studies have failed to obtain practice-induced transfer effects to untrained tasks after set-shifting training in older adults. Thus, more research is needed to determine the conditions under which shifting practice may compensate for age-related decline in executive control and associated impairments in daily functioning.

Working memory updating trainings in healthy older populations revealed substantial performance improvements on the trained as well as structurally similar tasks (Karbach and Verhaeghen 2014). In terms of transfer to other dimensions of executive control, intelligence, or reasoning, however, the findings are less consistent. Studies that have systematically assessed the potential of working memory updating training to improve executive control functions in the elderly are scarce. In younger adults, generalization of performance gains to other measures of executive functions and intelligence are most commonly reported for adaptive trainings, i.e., when task difficulty is individually adjusted over the course of training to match participants' performance levels. Even though transfer effects of updating practice have often been found to be absent or considerably smaller in older participants, a number of recent meta-analyses found small, but reliable, transfer effects of working memory and executive function training to untrained cognitive skills, particularly fluid intelligence. Interestingly, these studies revealed that overall the magnitude of training-induced performance gains is comparable in younger and older adults. It should be noted, however, that not all meta-analytic studies found evidence for benefits of training on executive functions. These inconsistencies might be attributable to methodological factors such as the total number of included studies, criteria for study exclusion, heterogeneity of trained tasks and populations, as well as the specific coding of transfer measures.

Only a very small number of training studies that have been conducted with older adults focus directly on inhibition. As reviewed in Buitenweg et al. (2012), practice on tasks tapping inhibition, such as Stroop or Simon task, improved inhibitory control in elderly but the training-induced gains did not generalize to untrained tasks. A notable exception is a recent study by Mishra and colleagues (2014) that used an adaptive distractor-suppression training to enhance interference control in healthy aging. The training did not only affect behavioral and neural indicators of interference effects in the trained task but also had beneficial effects on unrelated measures of working memory and sustained attention.

Given that a general decrease in information processing speed is thought to play an important role in the age-related decline of executive functions, several interventions have targeted speed of processing in older adults. Speed of processing trainings have been shown to induce large and sustained improvements in speed scores. While some studies reported transfer to untrained functions such as visual-spatial abilities, attention, and everyday speed measures, training gains did not

generalize to executive control measures. Another relatively recent approach to improve executive control and other aspects of cognition in older populations are video game trainings. Results, thus far, show that video game playing can enhance several age-sensitive cognitive functions, including visuospatial attention, memory, and speed of processing, but training gains do not seem to transfer to executive functions.

In recent years, some progress has been made in identifying neural substrates of training-induced plasticity in older age (Brehmer et al. 2014). Training-related changes in brain structure (e.g., grey and white matter volume) have been observed in task-relevant areas rather than globally throughout the brain. Performance gains on executive control tasks were associated with activation increases, decreases, or a combination thereof, in frontoparietal control regions as well as subcortical areas. While activation increases are thought to reflect compensatory strategies, activation decreases are usually interpreted as an indicator of increased neural processing efficiency. In general, neural activation changes can be classified as functional redistribution or functional reorganization, with the former denoting quantitative changes in activation levels within the same or similar brain regions and the latter denoting qualitative changes in the spatial pattern of brain activation. Cognitive interventions often induce a reduction of age-related activation differences, such that after training, brain activation in the elderly approximated that in younger adults.

Interestingly, a number of working memory training studies revealed a pattern of activation decrease in frontoparietal regions in association with activation increase in the striatum. This pattern might reflect faster and less effortful updating of working memory representations due to more efficient information processing in corticostriatal circuits, e.g., as a consequence of more salient striatal updating (gating) signals. In younger but not in older adults, the training-related increase in striatal activation predicted transfer effects to a structurally similar untrained task that also activated the striatum. The latter finding is consistent with the idea that transfer is increased if the training task and the transfer task engage overlapping cognitive processing components and brain regions.

Aside from cognitive training interventions, physical training, especially from the domain of cardiovascular training, can improve cognitive functions. These positive effects of physical exercise were particularly pronounced in the domain of executive control (Ballesteros et al. 2015). They have been reported for healthy older adults as well as for individuals with cognitive and physical impairments and have been accompanied by changes in cerebral blood flow and the modulation of activity in task-relevant brain areas. Hence, both cognitive and physical activity in older age may be effective ways to support executive functioning in the aging brain. Indeed, multimodal training approaches that combine various types of interventions, including social engagement, cognitive trainings, and physical stimulation, have yielded promising results in terms of improving executive functions and daily life functioning. The complexity of multimodal interventions, however, entails methodological challenges that have not been fully resolved yet. For instance, it is often difficult to determine to what degree single components and/or interactions between different components contributed to training gains.

Summary and Conclusion

Executive control functions include a number of processes such as updating, shifting, and inhibition, all of which are subject to significant age-related changes across the adult life span. These age differences have been linked to structural and functional alterations in the neural substrate supporting executive processes. Consistent with the "frontal lobe hypothesis" of cognitive aging, the greatest change in brain anatomy and physiology is evident in anterior brain regions. However, research on cognitive aging has also shown that the brain is plastic up to very old age and that executive control can be modulated by lifestyle factors as well as intensive cognitive and physical training in adulthood. Environmental

enrichment, including intellectual, social, and physical activities, is associated with stronger resilience to cognitive impairments in later life by (i) directly counteracting neurophysiological deterioration and (ii) compensatory recruitment of additional brain regions and alternative neural circuits to adapt to depleted neural resources and to preserve cognitive function. Given the contribution of executive functions to various life outcomes and daily life functioning, many studies have investigated the effectiveness of cognitive training interventions designed to improve executive control in older adults. Particularly, switching and updating training have yielded promising effects such that they appear to offer a great potential to improve not only trained but also untrained functions and skills, including inhibition, attention, and reasoning, across the adult life span. Nonetheless, a number of studies have raised questions about the robustness and consistence of transfer effects, especially in older adults. In particular, previous training studies have been criticized on methodological grounds. Key issues include expectation effects, test-retest effects, cognitive depletion effects due to extensive cognitive assessment, appropriate selection of the control group(s), nonrandom assignment of participants to experimental vs. control group(s), and comparability of results from studies using different training regimes. Thus, there is a clear need for carefully designed studies that integrate behavioral measures of cognitive plasticity with structural and functional neuroimaging data – within the broader framework of longitudinal and interindividual differences approaches – to systematically determine the factors that moderate the effects of training interventions on executive control functions in later life.

Cross-References

- ▶ Age-Related Changes in Abilities
- ▶ Berlin Aging Studies (BASE and BASE-II)
- ▶ Cognitive Control and Self-Regulation
- ▶ Cognitive and Brain Plasticity In Old Age
- ▶ Executive Functioning
- ▶ Life Span Developmental Psychology

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Expertise and Ageing

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Synonyms

Skill maintenance; Exceptional performance

Definition

The concept of expertise refers to individuals' superior levels of performance in specific domains. Domains of expertise and the levels of performance necessary to attain expert status depend on historical and cultural contexts. Skills like writing or driving a car sufficed for expert status in earlier times, but they are minimum requirements for most jobs nowadays. Expert swordsmanship has come out of fashion while excelling in web design was unknown to our ancestors. In aging societies the question if and how expert levels of performance can be maintained into later adulthood has gained central significance. Workforces in most OECD (Organisation for Economic Co-operation and Development) countries are aging rapidly: the age group of 40–45-year-olds formed its largest segment in 2006, and between 1980 and 2006, the median age of the American workforce increased from 35 to 41 years (Ng and Feldman 2008). Fewer young people enter the workforce and those who do have nowadays enjoyed longer periods of training. A main factor is the increasing employment rate of older employees, which is largely the result of reductions in the traditional safety nets of funded (early) retirements even in European welfare states.

Cognitive aging research portrays a rather grim perspective on levels of functioning in older adults. Tests measuring the speed and accuracy of basal processes like visual search or comparison operations are referred to as performance IQ (Intelligence Quotient) or fluid intelligence in the literature, and performances on these tests show considerable age-related declines (Kaufman 2001). Due to the age-referenced definition of IQ, the average 50-year-old has to perform at roughly 85–90% the speed of a 25-year-old to obtain the same IQ score. Adults in their 60s typically take 1.6–2 times as much time compared with 20-year-olds to perform speeded tests or experimental tasks – a phenomenon called *general age-related slowing* (Salthouse 1996). Meta-analytic reviews also point to age-related declines in working memory and reasoning (Verhaeghen and Salthouse 1997), the ability to perform two tasks simultaneously (Verhaeghen et al. 2003), and cognitive control (executive functions) (Rhodes 2004). Cognitive control comprises planning complex actions, the maintenance of

task-relevant information (task sets), inhibition of irrelevant task sets, and switching task sets when performance conditions change. Onsets are later and rates of age-related declines are much shallower for "crystallized intelligence," that is, abilities based on knowledge, experience, and culturally transmitted skills (Li et al. 2004).

Studies from organizational psychology appear to defy the negative implications from cognitive aging research. In what has been the most comprehensive meta-analysis of studies on the relation of age and job performance to date, Ng and Feldman (Ng and Feldman 2008) found that core task performance on the job and creativity was largely unrelated to age. In additional analyses Ng and Feldman found that the age x core performance relation followed an inverted U-shape function: performance in core skills improved with age in younger workers (<40 years), presumably because of growing job-related experience, and it became slightly negative in employees age 40+. Related effects wee small however, and the authors concluded that here is little to suggest from the meta-analytic reviews that older workers or employees cannot function in their jobs, lack creativity, or that their other performance aspects deteriorate noticeably relative to young adults. One reason for this apparent contradiction with findings from cognitive aging research may be the definition of "older" traditionally applied in organizational psychology (Ng and Feldman 2008). For pragmatic reasons (early retirement age, low workforce participation rates), the authors considered "older" to be individuals of age 40+. In standard textbooks of life span developmental psychology (Berk 2014), the period 40–65 years corresponds to middle adulthood, and participants in cognitive aging studies typically are in their late 60s or older. A second reason is that cognitive aging studies for the most part use psychometric tests and experimental tasks with unfamiliar materials and they compared young and older individuals' performances in novel and untrained settings. Arguably, the specific skills, which have been acquired and exercised for considerable amounts of time in professional contexts, show a friendlier age-related development.

Expertise research differs from both cognitive aging and organizational psychology with respect to the type and the levels of performances studied. Expertise research focuses on domain-specific rather than domain-general functions. The broad varieties of job performance studied by organizational psychologists do not correspond to the narrower concept of expert-level performance. While the boundaries between expert and novice performance are far from well defined, authors (Ericsson and Smith 1991; Salthouse 1991) agree on defining expertise as a stable individual attribute. This attribute should not be based on experience (seniority) or social judgment, but on the actual level of performance. Expert performance must be replicable and measurable taking the requirements of a certain domain into account.

Extant models of expertise posit that experts have developed specific mechanisms, which allow them to circumvent the process limitations constraining normal (i.e., novice) performance (Chase and Ericsson 1981; Ericsson et al. 1993). This metaphor implies that experts do things differently and that their brains also differ from novice brains. Examples of cognitive mechanisms are chess players' memory for game positions, the advance coordination of fingers in rapid typing, and hand-independent timing in pianists. Evidence for expertise-specific adaptations at the neural level comprises enlarged hippocampal regions in expert taxi drivers (Maguire et al. 2000) or enlargements in sensorimotor cortices in musicians (Amunts et al. 1997; Elbert et al. 1995). These examples illustrate that expert mechanisms are not "tricks of the trade" one can pick up in a crash course. Ericsson and colleagues argued that attaining international-level expertise in any domain typically requires 10 years or at least 10,000 h of *deliberate* practice (Ericsson et al. 1993). Deliberate practice is goal-directed learning, which requires careful monitoring of one's own performance and the continuous search for ways to improve. At least during the initial acquisition phase, this occurs ideally under the auspices of a coach, who is an expert herself/himself. The deliberate practice model depicts expertise development as a long-distance race, during which the individual has to negotiate

effort, *motivational*, and *resource* constraints. Because its practice is inherently effortful, nature deliberate practice activities can only be sustained for limited amounts of time, and they call for sufficient recuperation. What distinguishes deliberate practice from leisurely exercise is the motivation to improve and to overcome weaknesses in one's own performance. Resource constraints relate to external (teachers, parental support) and internal (physical health, concentration) types of support or limitations. Discussions in the literature abide as to whether deliberate practice is only a necessary or a sufficient prerequisite of attaining expert-level status (Hambrick et al. 2014; Macnamara et al. 2014; Meinz and Hambrick 2010); however, all theoreticians agree that it is a critical factor. Several authors have argued for inherited individual differences or gene-environment correlations, which determine, for example, adult levels of musical accomplishment (Hambrick and Tucker-Drob 2015). A related question is whether individual differences in domain-general cognitive abilities (i.e., intelligence) determine only initial progress in learning (Ackerman 1988; Fox et al. 1996) or if they continue to constrain accomplishments at superior or expert levels of performance (Hambrick and Engle 2002; Wai 2014). Controversies and answers to these questions depend to a large degree on how the type and level of performance necessary to be considered an expert is defined (Ericsson 2014). Whatever the precise perspective on the precursors of expertise, maintaining expertise into later adulthood amounts to a considerable extension of the long-distance race because age changes the nature of effort, motivational, and resource constraints.

Accounts for High Levels of Accomplishment in Older Experts

The primary goal of the experimental study of expert performances is to demonstrate reliable differences between experts and novices in tasks reflecting accomplishment in a specific domain. In the context of aging, the key questions are whether these performance advantages continue to exist for older experts when compared with age-matched controls. For theoretical reasons such age x expertise studies try to address three other questions: (1) do experts, who excel in their domains also differ from "normal" individuals when it comes to domain-general abilities such as general intelligence (processing speed, working memory) or cognitive control (monitoring and controlling attention, suppressing irrelevant information, updating information in working memory, switching between task sets and plans)? (2) Does domain-specific expertise also convey an advantage in near-transfer domains that are subject to age-related decline in the general population (e.g., are older chess masters also better in reasoning tests?)? (3) Does the level of expert performance maintained depend on older experts' investments into certain activities (e.g., practice)? Depending on the answers to these questions, we can distinguish four different accounts of expert or exceptional performance in later adulthood in the literature.

The *preserved differentiation* or a priori *disposition* account maintains that (experts) have always been superior in skill-relevant abilities, such that their advantages at any age could be attributed to interindividual differences with long-term stability that already existed prior to expertise acquisition. For example, a predisposition for visual imagery might nurture interest in and a professional choice for graphic design or architecture. The second position, *expertise-driven general ability account* emphasizes transfer to broader cognitive abilities. The idea is that acquiring expertise involves gradual improvements in some, though not necessarily all, domain-general functions. For example, daily professional challenges to keep complex facts in memory might foster increases in working memory span. *Differential preservation* or *selective maintenance* accounts emphasize the role of specific over broad abilities. Accordingly, expertise at any age rests on specific mechanisms, which age more gracefully than general mechanisms, presumably because experts actively maintain them through continued use or deliberate practice. Finally, the *compensation* account posits that older experts actively acquire specific mechanisms when

experiencing age-related decline of those mechanisms supporting their expertise.

Experimental Studies of Expert Performance in Young and Older Adults

Expert performance has been studied under laboratory conditions with age-comparative samples for such diverse domains as typewriting, games (chess, bridge, GO, mastermind), piloting, and air traffic control, management skills, visual search in medical assistants, fine motor control in mechanics, memory for numerical information in accountants, auditory processing in musicians, and musical performance (for a review, see Krampe and Charness 2006). Across studies experts in their late 50s and 60s typically perform at levels comparable to or slightly below those of experts in their late 20s. Even for experts of more advanced ages, studies have reported at least reduced age-related decline compared with age-matched novices. At the same time, older experts showed the typical reductions in measures of domain-general processing, which were similar to those observed in age-matched controls. This pattern of results strongly suggests that older experts rely on domain-specific mechanisms to circumvent the processing constraints of domain-general functions just like young experts do. In line with this assumption, benefits are the highest in the most complex skill-related tasks, where experts can bring their most adapted specific processes to bear. As an example, professional pianists have a higher single-finger tapping rate compared with novices and amateur musicians; however, their advantages are magnified when complex sequencing of multiple fingers is required. In turn, age effects in the novice group are the largest in the most complex conditions because they related tasks require increased engagement of domain-general functions like working memory or cognitive control. These functions are known to be most affected by age-related decline (West 1996).

It is hardly feasible that such highly specific adaptations reflect a priori (e.g., innate) dispositions. Instead, the pattern agrees best with the selective maintenance account. Studies investigating experts' activities revealed a clear relation between levels of expert performance and the amount of practice that went into acquisition (Ericsson et al. 1993). Deliberate practice seems to be as important when it comes to maintaining expertise into later adulthood (Charness et al. 1996; Krampe and Ericsson 1996). In particular, the study by Krampe and Ericsson suggests that it is not years of experience, starting age, or practice during young ages, but the amount of practice invested during recent years, which determines the degree of maintenance.

The specificity of the expertise advantage in older experts is in line with the assumptions of limited transfer to other skills or to general dimensions of cognitive abilities (Hambrick et al. 1999; Owen et al. 2010). Individual differences in cognitive abilities (Ackerman 1988) correlate with learning rates in early stages of skill acquisition, but these correlations weaken once learning proceeds to expert levels. These findings are at odds with the expertise-driven general ability account, which posits that the acquisition of a specific skill leads to improvements at the level of general abilities. One specific version of this account continues to enjoy enormous popularity in science and the media, namely, the assumption that music lessons boost intelligence in children. Two intervention studies indeed found small but reliable benefits of music training for broader intellectual abilities in preschool children and 6-year-olds. Surprisingly, these advantages are smaller in adults and absent in professional musicians. Some authors argued for medium transfer of skills such that cognitive control (executive functions) or language processing rather than broad mental abilities benefit from musical training in adults. In the aging context, it is next to impossible to distinguish whether group differences in general abilities reflect expertise-driven mitigation or preserved differences, which existed prior to skill acquisition. For example, two studies found superior performances on tests of broad visuospatial abilities in architects (Salthouse et al. 1990) or graphic designers (Lindenberger et al. 1992). At the same time, age-related differences were similar in experts and novices ruling out experience-related mitigation. The authors argued that the

preserved difference account provided the best explanation for these findings.

Evidence for the compensation account remained suggestive. Charness (1981) proposed that older chess experts compensate for slower search rates by relying on refined, knowledge-based processes of move selection. Other authors (Bosman 1993; Salthouse 1984) have speculated that older expert typists compensate for slower reaction time and reduced dexterity by increasing their eye-hand span (the amount of text they look ahead during transcription typing). An inherent problem of the compensation account is that it is difficult to determine whether older experts indeed acquired specific mechanisms in reaction to (as compensation for) age-related declines they experienced or whether these mechanisms were better preserved than other component functions found in young experts.

Limitations on Selective Maintenance of Expertise

A key factor determining experience-related mitigation is how closely experimental tasks relate to the expertise under investigation. However, even if tasks are closely related to the expertise under investigation, skill maintenance is typically not perfect if young expert performance is taken as a benchmark. Studies on highly demanding professions like piloting or air traffic control (Nunes and Kramer 2009; Taylor et al. 2007) found that sparing from age-related decline is frequently limited in scope. In particular, these studies showed that some component skills are more easily maintained than others with speed or working memory demands marking those components more sensitive to aging even in experts. Obviously domains of expertise differ with respect to how many of such components they comprise, how sensitive they are to aging, and whether compensatory mechanisms are effective to prolong high levels of performance into late adulthood.

Several studies also suggested that solid reductions of age-related declines in specific skills require a certain level of expertise or accomplishment. For example, amateur musicians (Krampe et al. 2001; Meinz and Salthouse 1998) or private-licensed pilots (Morrow et al. 1993) were found to show "normal" age-related declines even in tasks related to their hobbies. On the other hand, even top performers in their domain, who are highly motivated to maintain their levels of performance, are not immune to the effects of aging. In his longitudinal analyses, Simonton (Simonton 2012) showed that creative experts in their 60s and 70s were more productive than young experts starting their careers; however, peak productivities were at younger ages (late 30s and early 40s, depending on domains).

Summary and Implications

Expertise denotes domain-specific skills the development of which can be described as a gradual decoupling of expert mechanisms from domain-general functions. The available evidence gives reasons for cautious optimism that specific skills can be maintained at high levels into late middle adulthood or even old age. Naturally the typical cross-sectional studies in the age x expertise domain are subject to cohort and selection effects. Arguably, older experts in these studies could represent the survivors of an age-graded winnowing process by which individuals with pronounced age-related declines in relevant capacities or insufficient motivation to maintain their skills have dropped from the field (or have been promoted to positions where more social skills matter). A second methodological constraint is that all evidence related to capacities assumed to moderate age-related changes in expert performance is correlational, and this is equally true for estimates of practice intensity.

Decoupling of expert from domain-general mechanisms goes a long way, and experts, who continue to strive for their best performances, show remarkably little age-related decline. However, expertise is not immune to aging. When experimental tasks cover a broad range of component skills, maintenance in older experts is rarely perfect, and some component skills are more difficult to maintain than others. This has important implications for certain professions as the studies

of air traffic controllers and pilots illustrate. The degree of decoupling of expert mechanisms from domain-general mechanisms might itself change with age. Theories of life span intellectual development refer to this phenomenon as differentiation-dedifferentiation (Li et al. 2004). Dedifferentiation means that at advanced ages acquired specific skills and their neural underpinnings become vulnerable, and we have to default to domain-general processes again. The implication is that expertise can certainly buffer age-related decline, but this effect does not extend endlessly into very old age.

Expertise does not rest on mere experience lest it fades away in the ruts of routine. An important implication for aging is that the maintenance of expertise does not come for free, but it requires continued efforts in the sense of deliberate practice. This is particularly true as most domains nowadays undergo rapid changes in component skills and standards. Meeting these challenges in terms of time, energy, and motivation becomes increasingly difficult considering physical and mental changes in later adulthood. The type of activities experienced as gratifying and the goals pursued differ between young and older adults (Ebner et al. 2006). There is no reason to assume that this typical adult development should be totally different in experts. From these perspectives the question whether young adult levels of performance could be maintained in principle becomes an academic one.

Cross-References

- ▶ Active Aging
- ▶ Age-Related Changes in Abilities
- ▶ Cognitive and Brain Plasticity in Old Age
- ▶ Lifelong Learning and Work
- ▶ Workplace Creativity, Innovation, and Age

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