

# Future Directions in the Study of Health Behavior among Older Adults

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## Key Words

Health-behavior change · Selection optimization and compensation · Socioemotional selectivity · Social participation · Old age

## Abstract

The study of health behaviors and fostering health-behavior change is an important endeavor even in old age. The aim of this viewpoint article is threefold. First, we use a broad perspective for the definition of health behaviors to capture all relevant aspects of health-behavior change in older adults. Particularly, we suggest a distinction between proximal (e.g., physical activity) and distal health behaviors (e.g., social participation). Second, we recommend a stronger orientation towards processes in order to study health behaviors and the design of health-behavior change interventions. Third, we review the advantages of a developmental perspective in health psychology. Future directions in the study of health behavior among older adults are discussed.

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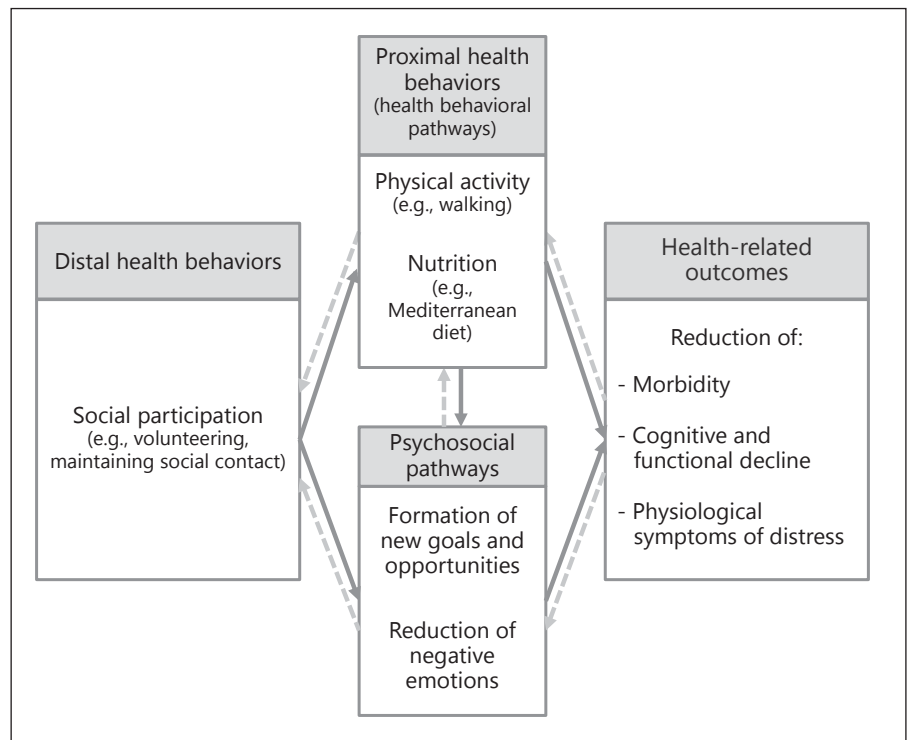
## Introduction

In their discussion on successful aging, Baltes and Baltes [1] argue that a healthy lifestyle is desirable to reduce the probability of pathological aging and to strengthen one's reserve capacity. This implies that our health promotion efforts should include the whole age range to prevent cumulation of health risks over the life span and

to achieve longer disease-free periods during later parts of life [2]. However, this proposition is contrasted by the fact that health-behavior change interventions are often solely designed for younger individuals (specifically children, adolescents, younger or middle-aged adults). Consequently, there is a lack of and a need to develop effective health-behavior change interventions that are suited for older adults in particular. In this vein, we address the following three themes in this viewpoint article. (1) We first suggest a broad perspective for the definition of health behaviors to capture all relevant aspects of health-behavior change in older adults. Particularly, we suggest a distinction between proximal (e.g., physical activity, nutrition) and distal health behaviors. For the latter, we focus on social participation as an example (fig. 1). (2) In addition, we recommend a stronger focus on processes regarding the study of health behaviors and the design of health-behavior change interventions. (3) Finally, we discuss the advantages of a developmental perspective in health psychology.

## Broadening the Concept of Health Behaviors: The Exemplary Case of Social Participation as a Distal Health Behavior

Health behaviors comprise activities that avoid harm, enhance physical fitness, prevent disease [3], and thus prolong life expectancy. During the later part of the life course, individuals face a decline in health (also with the potential to lead to disability or conditions of multimor-



**Fig. 1.** Interplay of distal health behaviors with health behavioral and psychosocial pathways and health-related outcomes.

bidity) that often entails dramatic consequences for their functional capacity, range of social participation, and well-being. A core set of health behaviors has been identified that – ideally practiced regularly and throughout the life span – can delay the onset of age-related downturns in health [2]. Such health behaviors typically include regular physical activity, healthy nutrition, regular dental hygiene, accessing preventive health care services, and avoiding toxins, such as alcohol and cigarette smoking. We term these behaviors *proximal health behaviors* as they are either directly linked with physiological processes (e.g., physical activity, nutrition) or produce straightforward pathways to improved health (e.g., accessing preventive health care services).

Evidence now indicates that this set of proximal health behaviors, traditionally targeted by health promotion interventions, may need to be extended [4]. Here, we choose the term *distal health behaviors* to signify a group of more complex activities that entail a number of active ingredients and are linked to objective health-related outcomes via several pathways. These pathways are shown in figure 1. They include, but are not restricted to, proximal health behaviors themselves (see ‘Health behavioral pathways’ in fig. 1) or the reduction of negative emotions which are in turn related to objective health parameters [5] such as

decreases in physiological symptoms of distress (see ‘Psychosocial pathways’ in fig. 1). The solid arrows in figure 1 represent the indirect effects of distal health behaviors on health-related outcomes. In addition, the dashed arrows reflect any effects from health-related outcomes or proximal health behaviors on distal health behaviors.

An emerging set of distal health behaviors are facets of social participation, which can be defined as a ‘person’s involvement in activities providing interactions with others in society or the community’ [6, p. 2141]. Other examples of distal health behaviors may include lifelong learning [7] or planning for later life [8]. However, because to date there is comparatively more extensive evidence available for links between social participation and health outcomes, we will limit ourselves to this example of a distal health behavior.

Social participation comprises a number of complex activities (e.g., volunteering [9], maintaining social contact [10]) that may feature different active ingredients and be related to health-relevant outcomes via several pathways. Social participation activities are directly dependent on good a priori health, but may also be related to better future health. Potential health-enhancing qualities or active ingredients of social participation include regular social contact, being able to provide help to someone,

or potentially experiencing higher levels of social support. For these, there seem to be positive effects for most age groups [5, 11]. However, the effectiveness of social participation may become particularly evident during later life because it initiates or reactivates further processes. Social participation behaviors related to better health in old age (e.g., volunteering [12]) are likely to set forth proximal health behaviors (e.g., enhanced physical activity: see 'Health behavioral pathways' in fig. 1), but are also likely to increase the formation of new goals and opportunities to identify new roles in one's life (see 'Psychosocial pathways' in fig. 1). The latter may counteract or alleviate negative emotions and reduce physiological symptoms of distress [5] (see 'Health-related outcome' in fig. 1). It seems very reasonable that they are of added predictive value for health, especially in older age when the loss of roles and associated activities which had defined extensive periods of an individual's life (e.g., pursuing a profession, being a parent, a partner, or a friend) accumulates.

Coming back to figure 1, the following examples may illustrate the depicted pathways. For instance, meeting with others (social participation) and being distracted from ongoing worries may lead to reduced negative emotion (psychosocial pathway), and finally lowered physiological stress responses (health-related outcome). In a similar fashion, maintaining social contact could lead to a higher level of physical activity, which in turn is negatively related to functional decline (i.e., mediation via proximal health behaviors). A higher level of physical activity could also lead to a reduction of negative emotions, which in turn is related to a positive health-related outcome. Health-related outcomes could then have effects on both proximal and distal health behaviors. Reduced physiological symptoms of distress might free up motivational resources and prompt individuals to reorganize their hierarchy of personal goals, which might lead to the uptake of a proximal or distal health behavior. In a similar vein, the reduction of morbidity might stimulate individuals to invest even more in the proximal health behavior of physical activity, which might lead to more social contact (e.g., joining a hiking club) or volunteering (e.g., being the membership officer of the hiking club).

Furthermore, social participation behaviors as targets for health-behavior change interventions might be relevant to generate more positive aging stereotypes such as associating aging with developmental gains (e.g., even older adults can assume new roles; for a discussion of age-related motivational changes see the third section of our viewpoint article) [13]. In contrast, interventions foster-

ing mainly physical activity might support negative self-stereotypes in individuals with no history of (or negative experiences with) physical activity. They might associate physical activity interventions with the physical losses of aging (e.g., due to a decline in muscle strength older adults are not capable to engage in strenuous physical activities). Thus, this group of older adults (or those not responsive to direct appeals to increase physical activity) might be more inclined to engage in social participation behaviors such as volunteering rather than in physical activity behaviors. This is in line with the finding that a public health intervention embedded in a volunteering framework recruited older adults reporting that they were primarily motivated by generativity rather than by potential health benefits to take part in the intervention [14]. Thus, public health interventions embedded in a volunteering framework might recruit older adults who would not respond to direct health promotion measures. Note, however, that depending on the individual expectations of the outcome of a certain behavior, the actual outcomes of engaging in a behavior may lead to maintaining or disengaging from it [3]. Thus, if a person expects from a volunteering behavior to be stimulated by providing help that is valued by others, but mainly perceives stimulation in terms of physical activity, the person might disengage from this behavior (e.g., volunteering as a caregiver with limited valuation from others but with a high physical intensity).

While there are already intervention programs for older adults following the idea of embedding public health interventions in a volunteering framework (e.g., Baltimore Experience Corps Trial [15]) or extending central outcomes to include social participation (National Health Goal 'Healthy Ageing' in Germany, which focuses on health goals and specific public health activities to be implemented in domains such as social participation [16]), such approaches are still rare. In addition, not all interventions focusing on more distal health behaviors such as volunteering acknowledge or investigate the respective implications for health and rather only focus on the behavior per se.

As indicated above, it is also evident that determining predictive directions between health parameters and health behaviors (both distal and proximal) is bound to be a methodological challenge. The relations we observe between social participation and improved health in old age may in fact be third variable phenomena including better a priori health or sociodemographic factors. They may also be reduced to one main active component such as social contact [5]. It is also conceivable, however, that

new pathways will emerge, which make these more distal health-related behaviors very worthwhile targets for health-promoting interventions in later life (e.g., promoting volunteering in older adults with multimorbidity [9]). In this section of the viewpoint article, we have suggested a broad definition of health behaviors and have focused on pathways between distal health behaviors and health-related outcomes. In the following section, we concentrate on self-regulatory competencies that are needed to translate a health motivation into action.

### Process View of Health-Behavior Change

Health-behavior change (such as enhancing physical activity or social participation) requires a host of self-regulatory competencies that concern health behavior-related goal setting and goal pursuit. These competencies are identified by a number of well-investigated health-behavior change models that can be classified into stage models (e.g., Transtheoretical Model [17]) and continuous models (e.g., Theory of Planned Behavior [18]; for an overview see Schwarzer [3]). Stage models characterize the behavior change process as a number of sequential, qualitatively different stages for which distinct sets of predictors are assumed. An individual's stage of change will have to be identified and *stage-tailored interventions* will have to be delivered that aim at moving the individual to the next stage. Continuous models, on the other hand, assume one set of central variables that predict the probability of behavior change along a continuum. Changing this central set of predictors by means of interventions will change the likelihood of changing behavior for all individuals in the same way.

To illustrate one process view on health-behavior change, we have chosen the Health Action Process Approach (HAPA) [3] as an example because it is a hybrid model combining the advantages of stage models and continuous models. According to the HAPA, changing health behaviors such as physical activity involves an initial motivation process that results in intention formation and a subsequent self-regulation process addressing the pursuit of these goals. In the motivation phase in which a person develops an intention to act, risk perception sets the stage for further elaboration of thoughts about consequences (i.e., outcome expectancies: 'If I were physically active on a regular basis, then I would be doing something good for my health.') and competencies (i.e., self-efficacy: 'I am confident that I can resume my physical activity, even when feeling weak after an illness.'). After intention

formation, individuals enter the volition phase in which they pursue their goal by planning, trying to act, investing effort, possibly failing, and finally recovering or disengaging [3].

As evident in the example of the HAPA, health-behavior change can be understood as a complex process and thus can have multiple active components. Since there are differences in mechanisms of behavior regulation in younger and older adults [1], it seems fruitful in future studies to investigate these active components in younger, middle-aged, and older adults. For instance, even if individuals are aware of the beneficial nature and are motivated to engage in health behaviors, they might still face challenges in translating their intentions into action [3]. This gap between intentions and behavior can be bridged by planning concepts, such as *action planning* (i.e., plans entailing a specified cue on 'when', 'where', and 'how' to perform a behavior) and *coping planning* (i.e., plans on how to pursue a behavior in the face of obstacles) [19]. Whereas effortful controlled processes (e.g., recalling one's intention to be physically active) can be age impaired, automatic processes (e.g., physical activity is elicited automatically, i.e., without a conscious intention being required, as soon as a specified cue is encountered) seem to be largely age invariant [20]. Thus, planning interventions that strengthen those automatic processes might be a powerful tool to overcome volitional problems in older adults, especially in those older adults facing deficits in controlled processes.

Evidence suggests that there are age differences in planning and planning efficacy. For example, in a sample with cardiac rehabilitation patients (age range 38–82 years) who received a planning intervention to increase physical activity, older patients reported higher and unchanging levels of coping planning whereas younger patients' coping planning increased. Intervention effects on physical activity were mediated by increases in coping planning in this sample [21].

In terms of intervention design, it may also be vital to support planning interventions in an age-sensitive way. Here, age-by-treatment interactions are of special interest as it has been shown that certain delivery modes can be more effective for older adults. For example, older and middle-aged individuals undergoing orthopedic rehabilitation benefited more from interviewer-assisted planning of health-behavior change, while the younger individuals in this study benefited more from self-administered planning [22].

We argue that a theory-based process view on health-behavior change combined with an identification of age

differences or age-differential effectiveness in its predictors and interventions (e.g., age-differential effectiveness of intervention modes [22]) is a necessary starting point for designing more effective age-appropriate interventions. To date, this is not routinely done or not entirely effective because the translation of predictors into means of intervention is still very heterogeneous. When observational designs are used to inform interventions one has to bear in mind that correlational findings are not necessarily replicable in experimental studies. Whether findings from observational studies are replicable in interventions (or not) depends on the 'degree of isomorphy between the production of a behavior outcome and its modification' [23, p. 147]. This means that mechanisms being responsible for the spontaneous execution of a behavior and the factors that contribute to modifying a behavior in an intervention are not necessarily the same. Efforts towards standardization and a common theory-linked nomenclature of techniques to change health behavior are underway and currently being implemented [24]. These standardization efforts will set the stage for a more effective replication and cumulation of findings regarding the relations between chronological age and the process of health-behavior change both in observational studies as well as in interventions.

### **Developmental Perspective on Health-Behavior Change**

For a number of reasons, the field of health behaviors is a rewarding topic for research on aging as goals for health behaviors (e.g., focus on prevention vs. coping with disease [25]) change over time. In addition, health behaviors change over the life course in response to illness [26] or life transitions (e.g., retirement or widowhood [27]).

To integrate health- and geropsychological knowledge, Leventhal [28, p. 307] suggested that 'concepts such as optimization and compensation (...) and social-emotional selectivity (...) are relevant to our search for life span factors' that may impact health-behavior change. We agree with this proposal and argue that recommendations for improving health behaviors in old age should be embedded into frameworks for developmentally oriented interventions [28]. Such interventions should reflect the changing goals of aging individuals due to decreasing health resources [1, 25, 29], the impact of approaching endings in several domains of life and life itself [30], or changing perceptions on aging [31].

We recognize the methodological challenges that this broader developmental perspective on health behaviors and their interrelations with concurrent levels of health in old age will bring about. We thus offer thoughts on how to approach these challenges. The ideas we present are already part of theories such as selective optimization with compensation (SOC) [1] and socioemotional selectivity theory (SST) [30]. However, these theories are rarely used for interventions (especially in the domains of gero- and health psychology) and are also rarely used in observational studies in research on health behaviors.

#### *Motivation for Health-Behavior Change:*

##### *Chronological Age, Awareness of Aging and Endings*

Due to the assumption that aging can be captured by a measure of passed lifetime, chronological age serves as a primary design variable in many studies. However, if the emphasis is on the variability of aging, chronological age neither depicts the variance of aging in a unified way nor represents the source of all aging phenomena [32]. The concept *awareness of aging* [33] can be seen as an umbrella term capturing both implicit (age stereotypes) and explicit (e.g., self-perception of aging, subjective age, future time perspective) manifestations of subjective aging.

For instance, positive subjective aging perceptions and beliefs were shown to be associated with better functional health over time [31]. Moreover, prompting positive views on aging has also been reported to be an effective extension for interventions. Compared to a standard physical activity intervention (incorporating benefits of physical activity, mastery, goal setting, and planning) and a no-treatment control condition, in the condition in which positive views on aging were prompted, positive attitudes towards older adults were increased and subsequent change in physical activity was associated with change in these attitudes [13].

Another feature of awareness of aging is future time perspective (i.e., limited vs. expansive perceptions of remaining lifetime). Future time perspective is seen as a primary motivational space in human self-regulation [34] and is reflected in estimates of subjective life expectancy. This is in accordance with the notion that proximity to death should be a more important variable for the determination of adult age variance in several outcomes than distance from birth [35]. It is also in line with assumptions from SST [30]. According to SST, individuals monitor the temporal course of their lives. As they grow older and perceive their remaining time as more limited, they focus more on the present and less

on the distant future. This might also have an impact on health self-regulation. An expansive time perspective is assumed to lead to a preference for goals aimed at optimizing the future (e.g., engaging in health behaviors), whereas a limited time perspective is assumed to be related to a preference for emotionally meaningful goals, given their more immediate payoffs. Thus, it seems to be vital for developmental health-behavior change interventions to take into account age-related changes in goal orientation [29]. In contrast to chronological age, perceptions of future time can be targeted by interventions, which might be particularly beneficial for individuals with a more limited future time perspective. In addition, when changing their time perspective is no option, these persons might benefit from emotionally tailored support and information that meets their focus on emotionally meaningful goals. Within the SST framework, it might be useful for those with a more limited future time perspective to link health behaviors to emotionally meaningful goals (e.g., maintaining a close relationship).

Diehl et al. [33] argue that while nearly all developmental theories build on the awareness of aging, these processes are not incorporated into theories. Not surprisingly, there are relatively few interventions drawing on facets of awareness of aging.

### *Self-Regulatory Strategies*

In older age, individuals deal with rapidly changing developmental trajectories. Thus, when applying models of health self-regulation to design interventions for older age groups, we might need to broaden our theoretical focus [36] by combining theories from health psychology and geropsychology. We also need to bear in mind the complex interplay between individual differences in cognitive capacity and self-regulation of behavior [37] to yield optimal results in interventions.

The action-theoretical conceptualization of the model of SOC [1, 38] spells out the following four self-regulatory strategies for pursuing and maintaining personally relevant goals taking into account the shifting balance of gains and losses throughout the life span: (1) elective selection (i.e., developing a hierarchy of personal goals and committing to it); (2) optimization (i.e., engaging in goal-directed actions and means); (3) loss-based selection (i.e., changes in the goal or the goal system in response to loss), and (4) compensation (i.e., acquisition and use of means in response to loss). SOC strategy use is positively associated with indicators of successful aging [38] and can be used in coping-planning interventions fostering health-

behavior change (e.g., loss-based selection and compensation as sources for coping plans [22]). It has also been demonstrated that serious health events led to an increased use of SOC, which in turn was associated with higher self-rated health and life satisfaction. However, the association between health events and SOC was moderated by negative self-perceptions of aging, with negative self-perceptions of aging being associated with lower use of SOC [39].

SOC strategies can also be used as intervention techniques (either as stand-alone components or in combination). For example, in young, middle-aged, and older adults, coping-planning interventions increased plans detailing use of compensation and loss-based selection [22] and those coping plans were predictive for subsequent physical activity. Finally, in adults aged  $\geq 60$  years, a combination of a training to use SOC strategies combined with the reappraisal of physical activity as an emotionally meaningful goal (in line with SST) led to a higher maintenance of physical activity at a 6-month follow-up compared to a group who only received mastery and planning as intervention ingredients [40].

While SOC is associated with successful development, it also requires the use of physical, social, and cognitive resources and is effortful [38]. Given the age-associated decline of these resources and the fact that self-regulatory efforts (e.g., planning, output monitoring) also rely on cognitive resources, the importance of developmentally oriented health-behavior change interventions becomes evident.

### **Conclusions and Outlook**

First, when studying or fostering health behaviors in older adults, we recommend following a broad definition of health behaviors. Such an approach captures all aspects of active aging: proximal health behaviors (e.g., physical activity) and also more distal health behaviors including social participation behaviors, such as volunteering. One example for such an approach is the National Health Goal 'Healthy Aging' in Germany [16], which sets health goals and suggests specific public health activities to be implemented in domains with special relevance for healthy older adults and for those with specific illnesses or even multimorbidity or disabilities. Apart from intervention efforts, there is a continuing need for nationally representative surveys to support not only the development of national health goals, but also their refinement and monitoring.

Developmental interventions should be tailored to the specific challenges of aging such as multimorbidity and transitions in later life as informal caregiving, institutionalization, advanced old age, or widowhood. In the context of these challenges, it might be helpful not to approach individuals to do something for their health (e.g., engaging in physical activity), but rather to recommend engaging in a more meaningful activity (e.g., volunteering). Both can strengthen the social network and have further health benefits such as increased levels of physical activity. These interventions should not only be developed to support reactive coping for individuals who already have experienced the transition, but also to support anticipatory coping. Such an approach also allows for a fuller use of the strategies of selection, optimization and compensation; for example, by investing more effort to stay physically active (compensation) instead of restricting oneself to physical activities that can be pursued without effort (loss-based selection).

Second, by employing a theory-based process approach on health-behavior change, we can extend our knowledge about the interplay between health behaviors and their different predictors in aging populations. This approach will also yield further knowledge for effective intervention design for older adults. Due to changing population demographics with older outnumbering

younger adults [41], further work on and refinement of developmental approaches to foster health and health-behavior change throughout the whole life span are especially urgent [28].

Finally, when studying and intervening in health behaviors, we argue that a combination of theories from health psychology and geropsychology can further deepen our understanding of the health-behavior change process throughout the life span. Such a developmental approach can inform both observational as well as experimental research (including laboratory-based experiments and intervention trials in a field context). Our focus has been on health-behavior change in old age because this population is currently underrepresented in health psychological research. Health-behavior interventions often target young and middle-aged populations with the tacit assumption that they will also work for older adults. However, in this viewpoint article, we have argued that a developmental perspective (e.g., designing interventions to take into account specific challenges of aging) can yield better intervention outcomes.

To summarize, we believe that (1) employing a broad perspective for the definition of health behaviors (2) with a stronger orientation towards processes, and (3) putting this in a developmental perspective will advance our understanding of health-behavior change among older adults.

## References

- Baltes PB, Baltes MM: Psychological perspectives on successful aging: the model of selective optimization with compensation; in Baltes PB, Baltes MM (eds): *Successful Aging: Perspectives from the Behavioral Sciences*. New York, Cambridge University Press, 1990, pp 1–34.
- Fries JF, Bruce B, Chakravarty E: Compression of morbidity 1980–2011: a focused review of paradigms and progress. *J Aging Res* 2011;2011:261702.
- Schwarzer R: Health behavior change; in Friedman HS (ed): *Oxford Handbook of Health Psychology*. New York, Oxford University Press, 2011, pp 591–611.
- Anderson ND, Damianakis T, Kroger E, Wagner LM, Dawson DR, Binns MA, Bernstein S, Caspi E, Cook SL; BRAVO Team: The benefits associated with volunteering among seniors: a critical review and recommendations for future research. *Psychol Bull* 2014; 140:1505–1533.
- Berkman LF, Glass T, Brissette I, Seeman TE: From social integration to health: Durkheim in the new millennium. *Soc Sci Med* 2000;51: 843–857.
- Levasseur M, Richard L, Gauvin L, Raymond E: Inventory and analysis of definitions of social participation found in the aging literature: proposed taxonomy of social activities. *Soc Sci Med* 2010;71:2141–2149.
- Hung J, Lu K: Research on the healthy lifestyle model, active ageing, and loneliness of senior learners. *Educ Gerontol* 2014;40:353–362.
- Lin L-H, Lin L: An investigation of later-life planning by different generations in Taiwan. *Educ Gerontol* 2014;40:557–571.
- Warner LM, Wolff JK, Ziegelmann JP, Wurm S: A randomized controlled trial to promote volunteering in older adults. *Psychol Aging* 2014;29:757–763.
- Huxhold O, Fiori KL, Windsor TD: The dynamic interplay of social network characteristics, subjective well-being, and health: the costs and benefits of socio-emotional selectivity. *Psychol Aging* 2013;28:3–16.
- Holt-Lunstad J, Smith TB, Layton JB: Social relationships and mortality risk: a meta-analytic review. *PLoS Med* 2010;7:e1000316.
- Lum TY, Lightfoot E: The effects of volunteering on the physical and mental health of older people. *Res Aging* 2005;27:31–55.
- Wolff JK, Warner LM, Ziegelmann JP, Wurm S: What do targeting positive views on ageing add to a physical activity intervention in older adults? Results from a randomised controlled trial. *Psychol Health* 2014;29:915–932.
- Tan EJ, Tanner EK, Seeman TE, Xue Q-L, Rebok GW, Frick KD, Carlson MC, Wang T, Piferi RL, McGill S, Whitfield KE, Fried LP: Marketing public health through older adult volunteering: experience corps as a social marketing intervention. American Public Health Association, 2010.
- Tan EJ, Rebok GW, Yu Q, Frangakis CE, Carlson MC, Wang T, Ricks M, Tanner EK, McGill S, Fried LP: The long-term relationship between high-intensity volunteering and physical activity in older African American women. Oxford, Oxford University Press, 2009.
- Thelen M, Scheidt-Nave C, Schaeffer D, Blüher S, Nitsche-Neumann L, Sass AC, Herweck R: National health target ‘healthy ageing’. Medical, psychosocial and nursing care for elderly people (in German). *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2012;55:991–997.

- 17 Prochaska JO, DiClemente CC: Towards a comprehensive model of change; in Miller WR, Heather N (eds): *Treating Addictive Behaviors: Processes of Change*. New York, Plenum, 1986, pp 3–27.
- 18 Ajzen I: The theory of planned behavior. *Organ Behav Hum Decis Process* 1991;50:179–211.
- 19 Sniehotta FF, Schwarzer R, Scholz U, Schüz B: Action planning and coping planning for long-term lifestyle change: theory and assessment. *Eur J Soc Psychol* 2005;35:565–576.
- 20 Park D: Aging and the controlled and automatic processing of medical information and medical intentions. Processing of medical information in aging patients: cognitive and human factors perspectives. Mahwah, Lawrence Erlbaum Associates Publishers, 1999, pp 3–22.
- 21 Scholz U, Sniehotta FF, Burkert S, Schwarzer R: Increasing physical exercise levels: age-specific benefits of planning. *J Aging Health* 2007;19:851–866.
- 22 Ziegelmann JP, Lippke S, Schwarzer R: Adoption and maintenance of physical activity: planning interventions in young, middle-aged, and older adults. *Psychol Health* 2006;21:145–163.
- 23 Baltes PB, Willis SL: Toward psychological theories of aging and development; in Birren JE, Schaie KW (eds): *Handbook of the Psychology of Aging*. New York, Van Nostrand Reinhold, 1977, pp 128–154.
- 24 Abraham C, Michie S: A taxonomy of behavior change techniques used in interventions. *Health Psychol* 2008;27:379–387.
- 25 Heckhausen J, Wrosch C, Schulz R: A lines-of-defense model for managing health threats: a review. *Gerontology* 2013;59:438–447.
- 26 Newsom JT, Huguet N, McCarthy MJ, Ramage-Morin P, Kaplan MS, Bernier J, McFarland BH, Oderkirk J: Health behavior change following chronic illness in middle and later life. *J Gerontol B-Psychol* 2012;67B:279–288.
- 27 Das A: Spousal loss and health in late life: moving beyond emotional trauma. *J Aging Health* 2013;25:221–242.
- 28 Leventhal H: Health behavior and the elderly: how do we understand its determinants and their goals? In Schaie KW, Leventhal H, Willis SL (eds): *Effective Health Behavior in Older Adults Societal Impact on Aging*. New York, Springer, 2002, pp 301–312.
- 29 Freund AM: Age-differential motivational consequences of optimization versus compensation focus in younger and older adults. *Psychol Aging* 2006;21:240–252.
- 30 Lockenhoff CE, Carstensen LL: Socioemotional selectivity theory, aging, and health: the increasingly delicate balance between regulating emotions and making tough choices. *J Pers* 2004;72:1395–1424.
- 31 Levy BR, Slade MD, Kasl SV: Longitudinal benefit of positive self-perceptions of aging on functional health. *J Gerontol B Psychol Sci Soc Sci* 2002;57:P409–P417.
- 32 Wohlwill JF: The age variable in psychological research. *Psychol Rev* 1970;77:49–64.
- 33 Diehl M, Wahl H, Barrett AE, Brothers AF, Miche M, Montepare JM, Westerhof GJ, Wurm S: Awareness of aging: theoretical considerations on an emerging concept. *Dev Rev* 2014;34:93–113.
- 34 Ziegelmann JP, Lippke S, Schwarzer R: Subjective residual life expectancy in health self-regulation. *J Gerontol B Psychol Sci Soc Sci* 2006;61:P195–P201.
- 35 Bosworth HB, Warner Schaie K, Willis SL, Siegler IC: Age and distance to death in the Seattle longitudinal study. *Res Aging* 1999;21:723–738.
- 36 Willis SL: Methodology in behavioral intervention research; in Birren JE, Schaie KW (eds): *Handbook of the Psychology of Aging* San Diego, Academic Press, 2001, pp 78–108.
- 37 Brom SS, Schnitzspahn KM, Melzer M, Hagner F, Bernhard A, Kliegel M: Fluid mechanics moderate the effect of implementation intentions on a health prospective memory task in older adults. *Eur J Ageing* 2014;11:89–98.
- 38 Freund AM, Baltes PB: Life-management strategies of selection, optimization and compensation: measurement by self-report and construct validity. *J Pers Soc Psychol* 2002;82:642–662.
- 39 Wurm S, Warner LM, Ziegelmann JP, Wolff JK, Schüz B: How do negative self-perceptions of aging become a self-fulfilling prophecy? *Psychol Aging* 2013;28:1088–1097.
- 40 Gellert P, Ziegelmann JP, Krupka S, Knoll N, Schwarzer R: An age-tailored intervention sustains physical activity changes in older adults: a randomized controlled trial. *Int J Behav Med* 2014;21:519–528.
- 41 National Institute on Aging, World Health Organization: Global health and aging. 2012. [http://www.nia.nih.gov/sites/default/files/global\\_health\\_and\\_aging.pdf](http://www.nia.nih.gov/sites/default/files/global_health_and_aging.pdf).