

Control and Cognition: Contextual and Individual Differences in Cognitive Aging

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Abstract

Sense of control over one's life declines in the later portion of the lifespan, which is not surprising in the face of increased losses and decreased gains associated with aging.

Unfortunately, the maintenance of sense of control is a key indicator of successful aging while low control beliefs are a risk factor for poor aging-related outcomes, such as lower concurrent and subsequent cognitive functioning. The simultaneous focus on the person and the environment is an important characteristic of research with control beliefs. We synthesize the state of the field and its current understanding of the complex interplay of control beliefs and cognition. In addition, we propose that awareness of aging, which is the subjective interpretation of aging, may be an important future direction to elucidate the control-cognition relationships.

Keywords: perceived control, basic cognition, everyday cognition, awareness of aging

1. Control as a Multidimensional and Developmental Construct

Control beliefs represent the subjective perceptions that one can influence what happens in one's life and includes beliefs or expectations about the extent to which one's actions can bring about desired outcomes (Agrigoroaei & Lachman, 2010). This is different from objective control, reflecting that actual amount of control one may have. (Lachman, Neupert, & Agrigoroaei, 2011). Subjective perceptions are also different from beliefs held by society more generally, such as stereotypes about aging. In this chapter we focus on individual subjective perceptions, noting that in many cases the actual amount of control one has is unknown, and that it is the expectancies/beliefs that matter. Importantly, these beliefs can be general (e.g., "What happens in my life is often beyond my control"), domain-specific (e.g., "If I use my memory often I won't lose it"; see the Personality in Intellectual Contexts Inventory [PIC; Lachman, 1986; Lachman, Baltes, Nesselroade, & Willis, 1982] and the Memory Controllability Inventory [MCI; Lachman, Bandura, Weaver, & Elliott, 1995]), or task-specific (e.g., "How much control did you have over your performance on the memory task?").

Control is studied in many different forms with many different labels and subtle variations, including self-efficacy, sense of control, personal mastery, perceived constraints, perceived control, locus of control, and primary and secondary control, just to name a few (Lachman et al., 2011; Pearlin & Pioli, 2003; Rodin, 1990). The control beliefs construct first emerged as the locus of control, under the rubric of social learning theory (Rotter, 1966). This work focused on the sources of control, as either internal (e.g., abilities, effort) or external (e.g., chance, fate, powerful others) to the person. The internal-external distinction was a fruitful line of inquiry, but was limited due to the confound between the source of control and the degree of controllability (Lachman et al., 2011). Internal sources were assumed to be within the person's

control, yet some internal sources are not highly controllable (e.g., genetic influences). Another concern was that control was considered to be a general, stable individual difference variable that applied across domains, rather than acknowledging that control beliefs can vary across time (Eizenman, Nesselroade, Featherman, & Rowe, 1997; Neupert & Allaire, 2012) and specific areas of life (Lachman, 1986). The simultaneous focus on the person and the environment is an important characteristic of research with control beliefs. One of the most prolific control theories focuses on self-efficacy, or the perceived ability to carry out specific goals or tasks (Bandura, 1997). Self-efficacy and control beliefs play an important role in adaptation and regulate functioning through cognitive, motivational, affective and selection processes (Bandura, 1990). Lowered expectancies for self-efficacy and control likely have their origin in negative stereotypes about aging and are reinforced through experiences of loss and decline (Bandura, 1997).

Primary (change the environment) and secondary control (change the self) focus on control strivings and strategies for exercising control (Heckhausen, Wrosch, & Schulz, 2010). Mastery is often described in terms of one's judgments about his or her ability to achieve a goal, while perceived constraints refers to the extent to which people believe factors exist that interfere with goal attainment (Lachman & Weaver, 1998). Mastery and constraint could be differentially important across the adult life span. Based on prior research findings and socioemotional selectivity theory (Carstensen, Isaacowitz, & Charles, 1999), which argues that younger adults who are invested in establishing interpersonal relationships more often employ active problem-solving strategies to their daily interpersonal problems than older adults, perceived control (both constraints and mastery) has a stronger relationship with well-being (both emotional and physical) among younger adults than older adults (Neupert, Almeida, & Charles, 2007).

Control beliefs can also be divided into locus of control (LoC) and perceived competence (PC) (Eizenman et al., 1997). LoC refers to beliefs about whether outcomes are contingent on the individual's actions or determined by chance, fate, or powerful others (Rotter, 1966). PC describes the person's self-perceived ability to achieve the desired outcome (Bandura, 1977). Competence is also referred to as efficacy expectancies (Bandura, 1977) or agency beliefs (Skinner, Chapman, & Baltes, 1988), and it can function independently of LoC (Eizenman et al.). Previous research has shown that LoC and PC have different developmental trajectories (Lachman & Firth, 2004), and may be associated with different cognitive outcomes (Eizenman et al.; Neupert & Allaire, 2012). Specifically, internal LoC declines alongside cognitive function while PC remained relatively stable and unaffected (Lachman & Firth, 2004; Lachman et al., 2011). Therefore, merging the two concepts together (e.g., Gerstorf, Röcke, & Lachman, 2010; Infurna, Gerstorf, Ram, Schupp, & Wagner, 2011) or focusing on only one of the two (e.g., Drewelies, Wagner, Tesch-Römer, Heckhausen, & Gerstorf, 2017; Infurna & Okun, 2015) could be inaccurate and misleading.

The general pattern of research findings suggests that the sense of control over one's life declines in the later portion of the lifespan (Lachman & Firth, 2004; Lachman, Rosnick, & Röcke, 2009), which is not surprising in the face of increased losses and decreased gains associated with aging (Baltes, Lindenberger, & Staudinger, 2006). Unfortunately, the maintenance of sense of control is a key indicator of successful aging while low control beliefs are a risk factor for poor aging-related outcomes (Lachman et al., 2011). One key outcome is cognitive functioning, for which previous research tends to focus on control beliefs as a predictor of concurrent (e.g., Miller & Lachman, 2000) or subsequent (Neupert & Allaire, 2012) cognitive functioning. The goal of the current chapter is to synthesize the state of the field and its current

understanding of the complex interplay of control beliefs and cognition. In addition, we propose that awareness of aging, which is the subjective interpretation of aging, may be an important future direction to elucidate the control-cognition relationships.

2. Individual Differences

There is a great deal of evidence that individual differences in control beliefs are associated with key aging outcomes including cognitive functioning (Rowe & Kahn, 1997). Domain-specific control beliefs about memory and other cognitive abilities are linked to performance (Windsor & Anstey, 2008), behaviors such as strategy use (Hertzog, McGuire, & Lineweaver, 1998; Lachman & Andreoletti, 2006), and effectiveness of cognitive training (Rebok, Rasmusson, & Brandt, 1996). Sense of control is tied to better memory (Lachman & Agrigoroaei, 2012) and cognitive functioning (Infurna & Gerstorf, 2013), especially among older adults (e.g., Hertzog et al., 1998). Socioeconomic, cultural, and racial differences (and their potential interactions) are also important. Those with lower incomes typically have a lower sense of control, which likely reflects, at least in part, the reality of conditions tied to economic circumstances (Lachman, 2006). However, control beliefs can buffer the negative health effects of lower socioeconomic status; those with lower incomes who manage to develop and maintain a high sense of control have health similar to that of higher income groups (Lachman & Weaver, 1998). Kennedy, Allaire, Gamaldo, and Whitfield (2012) found that African Americans had significantly lower cognitive control beliefs than Whites. The relationship between control beliefs and cognition was moderated by both race and socioeconomic status (operationalized by education). Across cognitive abilities, better cognitive performance was related to higher control beliefs in African Americans with at least 13 years of education. Zahodne, Manly, Smith, Seeman, and Lachman (2017) found that African Americans had higher external locus of control

than Whites. In turn, higher external control beliefs were associated with lower scores on episodic memory and executive functioning composites.

There are also cultural variations in the nature and meaning of control (Ashman, Shiomura, & Levy, 2006). Thus, a contextual model of control that considers variations by culture as well as by race and ethnicity is critical (Lachman, 2006). Americans tend to report higher levels of control compared to citizens of other countries (Lachman, 2006). Asian Americans and Asians in Asia report lower levels of perceived control than non-Asians (Sastry & Ross, 1998). When comparing Western and Eastern cultures, it is not just the level of perceived control but the salience of control that varies by individualistic (Western) and collective (Eastern) cultures (Markus & Kitayama, 1991). The importance of personal control over outcomes is more closely linked to health and well-being in Western cultures (Markus & Kitayama, 1991). Primary control may be more central for achieving goals in Western cultures, whereas secondary control may be a more common strategy in Eastern cultures (Schulz & Heckhausen, 1999); both are ways to achieve control with different emphases, reflecting variations in cultural prescriptions for independence and interdependence (Ashman et al., 2006).

Most studies examining the relationship between control beliefs and cognition treat cognition as an outcome of control beliefs (e.g., Hahn & Lachman, 2015; Neupert & Allaire, 2012), with sense of control considered as providing motivational resources for strategy use and task engagement (Lachman, 2006; Lachman et al., 2011). However, declines in memory and reasoning might pose challenges for carrying out activities in everyday life, (Gamaldo & Allaire, 2016), which could undermine one's sense of control or enhance perceptions of internal constraints. In support of this idea, higher prior levels of everyday competence predicted higher subsequent levels of control beliefs (Willis, Jay, Diehl, & Marsiske, 1992). Moreover, Lachman,

et al. (2009) found that middle-age and older adults with higher levels of cognitive functioning declined less in control beliefs over 9 years. A cognitive training study found that baseline cognition predicted control beliefs 10 years after training, but not vice versa (Parisi, Gross, Marsiske, Willis, & Rebok, 2017). Using microlongitudinal data over 10 bi-monthly occasions, Bielak et al. (2007) found that exposure to cognitive tasks led to declines in older adults' general and memory-specific control beliefs. Therefore, it is likely that control beliefs and cognition influence each other bidirectionally.

Control is likely beneficial for cognitive performance by providing a necessary motivational resource for the development of effortful strategies used to compensate for age-related declines in cognitive slowing (deFrias, Dixon, & Bäckman, 2003; Miller & Gagne, 2005). Control may also aid cognitive performance because individuals who believe they can affect their memory performance are likely to devote effort to memory tasks (Bandura, 1977). The type of task may also be important; the extent to which beliefs are related to performance may depend on whether the outcomes are age-sensitive or age-insensitive (Miller & Lachman, 2000).

3. Developmental and Contextual Approaches

Although much of the work on control and cognition has been cross-sectional and correlational, there is longitudinal evidence that those who have higher control beliefs improve more on cognitive tests with practice and over time are less likely to show aging-related declines in cognitive functioning (Caplan & Schooler, 2003). Importantly, intraindividual variability or fluctuations in control and cognition are important to examine in order to understand control in developmental and contextual terms (Lachman, 1986; Lachman, 2006). An emerging body of research suggests that control has an important, dynamic aspect within-persons (e.g., Agrigoroaei, Neupert, & Lachman, 2013; Eizenman et al., 1997; Neupert & Allaire, 2012)

beyond its importance as an individual difference construct. For example, more variability in control beliefs within person over the course of weeks predicted subsequent mortality to a greater degree than individual differences in control (Eizenman et al., 1997).

Likewise, intraindividual variability in cognition provides additional, valuable information beyond individual differences in cognition. Intraindividual variability in cognition over the short term has been identified as a systematic source of individual differences (Martin & Hofer, 2004). Older adults show greater intraindividual variability than younger adults and that variability is negatively related to performance (Hultsch, MacDonald, & Dixon, 2002; Nesselroade & Salthouse, 2004). With a few exceptions (e.g., Allaire & Marsiske, 2005; Li, Aggen, Nesselroade, & Baltes, 2001; Neupert & Allaire, 2012), increased intraindividual variability is associated with lower overall cognitive functioning. In one of these exceptions (Neupert & Allaire, 2012), we examined the within-person relationship between control beliefs and cognition within a sample of older adults who completed measures of control beliefs and cognitive tests two times each day for 60 consecutive days. On occasions where participants' control beliefs were higher than their own average, performance on some cognitive tests (i.e., inductive reasoning) was also higher, and this pattern was especially pronounced among people who were typically low in their control beliefs. We also examined temporal patterns of the control-cognition relationship by using previous occasion control beliefs to predict subsequent cognition and then previous occasion cognition to predict subsequent control beliefs. We found more support for the control preceding cognition scenario, which supports the idea that control has an influence on subsequent performance through its impact on behavior, motivation, and affect (Lachman, 2006). Low control can be detrimental if it is associated with distress, anxiety,

inactivity, and giving up without expending the effort or using strategies needed to support optimal outcomes (Agrigoroaei & Lachman, 2010).

Beyond laboratory-based tests of cognition, previous work has examined control beliefs as a predictor of everyday memory problems, such as “tip of the tongue” failures and having trouble remembering someone’s name (Sunderland, Harris, & Baddeley, 1983; Neupert, Almeida, Mroczek, & Spiro, 2006; Whitbourne, Neupert, & Lachman, 2008). Hahn and Lachman (2015) examined whether experiences of low general perceived control in daily life were related to everyday memory problems reported in a weekly diary over 12 weeks. They also examined whether individuals with greater working memory decline over 10 years were particularly vulnerable to the negative effects of low perceived control. Results suggested that low general perceived control was predictive of a greater number of memory problems. In addition, participants with greater memory decline who used more strategies were significantly less vulnerable to the effects of low weekly perceived control than those who used fewer strategies. This emphasizes the idea that strategy use is an important ingredient in understanding the links between control beliefs and (everyday) cognition.

Moving from weekly to longer term longitudinal data, Lee (2016) examined levels and 10-year change in control beliefs as predictors of subjective memory complaints (e.g., “compared to other people your age, how would you rate your memory?”) in a large national sample (3,272) of participants in the Midlife in the US (MIDUS) project. Although subjective, memory complaints predict mild cognitive impairment (MCI; Caselli et al., 2014), dementia (Jessen et al., 2010) and Alzheimer’s disease (Geerlings, Jonker, Bouter, Ader, & Schmand, 1999). Higher perceptions of control (high mastery and low constraint) were associated with

lower subjective memory complaints at the concurrent timepoint, whereas increases in constraints over 10 years predicted higher memory complaints.

Although much work has focused on control beliefs as a predictor of cognition, we (Zhang, Gamaldo, Neupert, & Allaire, 2018) recently drew on Lachman's (2006; Miller & Lachman, 1999) integrative conceptual model of a multidirectional relationship between control beliefs and aging-related outcomes to examine the potential sources of intra- and inter-individual differences in older adults' control beliefs. We focused on the extent to which day-to-day fluctuations in cognition predicted daily control beliefs. Sense of control provides motivational resources for strategy use and task engagement (Lachman, 2006; Lachman et al., 2011). However, declines in memory and reasoning might pose challenges for carrying out activities in everyday life (Gamaldo & Allaire, 2016), which could undermine one's sense of control or enhance perceptions of internal constraints.

We used data from the MEDLI-NC (Mental Exercise for Daily Living with Independence in North Carolina) study, designed to examine intraindividual variability in cognition in older adults. The sample consisted of 205 participants (Mean age = 72, range 60-94, 60% women, 35% African American) recruited from local senior centers and church groups. Participants completed eight testing sessions within a 3-week period at the location where they were recruited. Each session contained a battery of measures administered on a computer for about 45 minutes. The measures include five basic cognitive ability measures (i.e., processing speed, inductive reasoning, episodic memory, psychomotor speed [simple and choice reaction time]) and a measure of everyday cognition (i.e., Daily Everyday Cognition Assessment [DECA; Gamaldo & Allaire, 2016]). Control beliefs (Eizenman et al., 1997) and memory failures (Neupert, Almeida,

Mroczek, & Spiro, 2006; Sunderland, Harris, & Baddeley, 1983) were measured before the computer-based cognitive battery.

We found significant interindividual differences in the relationships between memory failures, everyday cognition, and LoC, suggesting that fewer memory failures and better everyday cognition could be predictive of more internal LoC for some older adults (Zhang et al., 2018). Given that the older adult population typically exhibits a large range of variability in both LoC (e.g., Lachman 2006; Lachman et al., 2011) and cognition (e.g., Lindenberger & Ghisletta, 2009), it is not surprising that the association between the two constructs varied from person to person. It is also worth noting that basic laboratory-based cognitive performance, although having considerable overlap with everyday cognition (Gamaldo & Allaire, 2016), was not related to LoC. Therefore, it might be the saliency of the everyday context and real world implication that linked everyday cognition and memory failures with LoC. This underscores the notion that control beliefs are multidimensional and that keeping locus of control and perceived competence separate, especially within microlongitudinal designs, could be fruitful for uncovering within-person relationships in control and cognition. Taken together, these results show the importance of the everyday context in the link between cognition and control beliefs, and that individual differences in these relationships could be an important avenue for future research.

4. Future Directions

One such avenue that we would like to propose revolves around awareness of aging. Aging is not simply a matter of maturation, but a concept that is constructed and contemplated across time. The subjective interpretation of aging has important developmental implications across the lifespan (Montepare, 2009). For example, perceiving the self to be subjectively younger is associated with increased positive affect (Westerhof & Barrett, 2005), higher life

satisfaction (Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008), increased self-efficacy (Boehmer, 2007), and flourishing mental health (Keyes & Westerhof, 2012). Furthermore, subjectively perceiving the aging process in a more positive light is associated with higher levels of life-satisfaction (Brothers, Miche, Wahl, & Diehl, 2017), improved social networks (Menkin, Robles, Gruenewald, Tanner, & Seeman, 2017), and higher levels of well-being (Levy, 2003). Awareness of aging serves as a superordinate construct which encompasses the variety of constructs that have been used to assess and conceptualize subjective aging (Diehl et al., 2014). Underneath this superordinate construct are the constructs of subjective age (how old individuals feel), aging attitudes (feelings and beliefs regarding the aging process), and awareness of age-related change (AARC). AARC is a relatively new construct that includes “all those experiences that make a person aware that his or her behavior, level of performance, or ways of experiencing his or her life have changed as a consequence of having grown older (i.e., increased chronological age)” (Diehl & Wahl, 2010, p. 340). AARC exists when individuals subjectively perceive themselves to have changed or experienced an event differently due to an increase in chronological age. These experiences may underlie individuals’ subjective ages and aging attitudes.

We used daily diary data to examine the relationship between awareness of aging constructs and found a positive relationship between more positive views of aging and the experience of more AARC gains and fewer AARC losses (Neupert & Bellingtier, 2017). Although the correlational nature of the study precludes tests of directionality, the findings indicated that aging attitudes measured on Day 1 predicted not only concurrently assessed AARC gains and AARC losses, but also predicted subsequent reports of additional AARC gains and AARC losses across the remaining 8 study days. These relationships may function as

developmental cascades (Masten & Cicchetti, 2010) such that negative aging attitudes developed early in life predict subsequent awareness of age-related loss which then predict negative developmental outcomes across many domains (e.g., lower levels of well-being, health, and activity engagement) which further sour one's aging attitudes and so on.

An understanding of awareness of aging should be situated within an understanding of an individual's place in the life course including chronological age and objective age-related changes (Diehl et al., 2014). Awareness of aging is thought to influence important developmental outcomes such as health and longevity (Westerhof et al., 2014), psychological well-being (Mock & Eibach, 2011), activity engagement (Wolff, Warner, Ziegelmann, & Wurm, 2014), and successful aging (Shrira, Palgi, Ben-Ezra, Hoffman, & Bodner, 2016). This influence may be direct or indirect through its influence on self-regulatory developmental processes such as control (Diehl et al., 2014).

5. Perceived Control and Awareness of Aging

Models of perceived control (Lachman, 2006) and subjective perceptions of aging (Diehl et al., 2014; Levy, 2009) propose similar pathways linking these constructs to developmental outcomes. Lachman (2006) proposed that the association between control beliefs and age-related outcomes is mediated by physiological, behavioral, motivational, and affective variables. This is quite similar to Levy's (2009) stereotype embodiment model where aging stereotypes are thought to influence health and well-being via physiological, behavioral, and psychological pathways. Diehl and colleagues' (2014) model of Awareness of Aging suggested that awareness of aging constructs can influence developmental outcomes via self-regulatory processes including control. The extent to which control and subjective aging beliefs share variance in predicting developmental outcomes is not yet entirely clear.

Existing evidence suggests a concurrent relationship between awareness of aging and perceived control. At the bivariate and cross-sectional level, feeling younger was associated with a greater internal locus of control (Baum & Boxley, 1983; Hubley & Hultsch, 1994), but desiring to be younger was associated with a greater external locus of control (Hubley & Hultsch, 1994). Higher sense of personal mastery also predicts a younger subjective age (Bergland, Nicolaisen, & Thorsen, 2013; Infurna, Gerstorf, Robertson, Berg, & Zarit, 2010). At the within-person level, we recently found that older adults felt significantly younger on days with a greater sense of control than usual, but this effect was absent in younger adults (Bellingtier & Neupert, 2019).

It may be the case that attitudes and views on aging are made up largely of control beliefs (Heckhausen & Baltes, 1991), and that when control beliefs are accounted for, there is no longer a relationship between views of aging and health. Wurm, Tesch-Römer, and Tomasik (2007) used a longitudinal design to measure the predictive ability of views of aging whilst controlling for control beliefs and physical illness at Time 1. Time 2 physical illness was predicted by views of aging, but not by control beliefs. Thus when aging beliefs and control are pitted against each other aging beliefs are more predictive of health. However, this study did not test for mediation and did not examine cognition as an outcome.

A few studies have examined a possible mediational relationship whereby subjective aging constructs predict developmental outcomes via their influence on control beliefs. In support of this pathway, a longitudinal study by Levy, Slade, and Kasl (2002) found that aging attitudes predicted perceived control, which in turn predicted functional health. Likewise, Stephan, Caudroit, and Chalabaev (2011) found that a younger subjective age predicted greater memory-related control beliefs, which in turn predicted higher life satisfaction. However, in our

own work, we failed to find a mediational role for control in explaining the association of stress and subjective age on a daily level (Bellingtier, Neupert, & Kotter-Grühn, 2017).

Like control beliefs, cultural differences may also be important to consider. Using data from the US, Germany, and China, O'Brien et al. (2017) found cultural differences in subjective age in some domains, which were attenuated by domain-specific beliefs such as control. Given the multidimensionality of subjective aging and control belief constructs, it seems likely that both direct and indirect paths are necessary to account for their relationship with developmental outcomes.

6. Control Beliefs, Awareness of Aging, and Cognition

Similar to control beliefs, aging attitudes and other subjective aging processes are related to cognitive functioning (Westerhof et al., 2014). A more negative subjective aging experience, assessed via an individual's age stereotypes, subjective age, or aging attitudes, has been consistently associated with worse cognitive test performance and accelerated deterioration in cognitive functioning over time (Levy, Zonderman, Slade, & Ferrucci, 2012; Siebert, Wahl, & Schröder, 2016). For example, using longitudinal data from the Berlin Aging Study, a younger subjective age predicted both better memory performance, as well as reduced memory complaints, 6 years later. Similar to the findings of Bielak and colleagues (2007) regarding the link between exposure to cognitive testing and lowered control beliefs in older adults, research suggests that exposure to cognitive testing can also result in older adults feeling subjectively older (Hughes, Geraci, & De Forrest, 2013). Thus the relationship between self-perceptions of aging and cognition is likely similar to the relationship between control beliefs and cognition in its bidirectionality. Support for this also comes from research finding that self-perceptions of aging were bidirectionally related to processing speed across 3 years (Seidler & Wolff, 2017).

Although little empirical research has thus far studied all three concepts together, we are excited by initial work linking aging attitudes with control beliefs and cognition. Specifically, Siebert, Wahl, Degen, and Schröder (2018) found potential evidence for the contribution of control beliefs as a possible mediator of the relationship between aging attitudes and cognitive status. External control beliefs were linked to both attitudes and future cognitive status; those with more positive aging attitudes reported fewer external control beliefs, which in turn were associated with a reduced risk of MCI-AD 12 years later.

Underlying attitudes are important for outcome expectancies and provide information about the controllability of aging-associated outcomes (Lachman et al., 2011). In line with this idea, perceived control was found to be a significant mediator between aging attitudes and functional health (Levy et al., 2012; Wurm et al., 2007). Thus, the interplay of control beliefs and awareness of aging appears to be an area ripe for future research into cognitive aging.

Older adults who experience deteriorating cognitive fitness and attribute these changes to age rather than factors within their control may be less likely to expend personal effort to counteract the decline because of doubts that their efforts will be effective (Siebert et al., 2018). More positive aging attitudes are associated with less stress and more control which may foster physical health and promote healthier lifestyles which may in turn contribute to building a stronger cognitive reserve capacity and better cognitive scaffolding (Hertzog et al., 2008; Park & Reuter-Lorenz, 2009). There is a small but growing body of research testing underlying mechanisms of how variation in individuals' awareness of aging predicts memory function and cognitive impairment (Siebert et al., 2018; Stephan, Sutin, Caudriot, & Terracciano, 2016; Stephan, Sutin, Luchetti, & Terracciano, 2017).

Daily experiences can draw individuals' attention to age-related changes in their lives (Neupert & Bellingtier, 2017), so it may also be useful to consider the daily relationships between subjective perceptions of aging, control beliefs, and cognition. Experiencing AARC gains may boost daily control beliefs leading to improved daily cognitive performance. Likewise, AARC losses may be demoralizing and predict lower control beliefs and subsequently lowered cognitive performance. Between-person differences in aging attitudes (Bellingtier & Neupert, 2016) and control beliefs (Neupert et al., 2007) predict greater affective reactivity to daily stressors, however they have yet to be considered simultaneously. Future work could extend these findings by considering the relationship between aging attitudes and daily perceptions of control. It could be that having more positive aging attitudes is protective against heightened stressor reactivity even in the face of lower control beliefs.

7. Conclusion

Control beliefs are multidimensional with different developmental trajectories and implications for cognition. We are excited by work that acknowledges the important role of changing contexts by using within-person designs and domain-specific measures. In addition, we look forward to the possibility that future work with awareness of aging and control beliefs may uncover aging-related trends for basic and everyday cognition. Because control beliefs (Neupert & Allaire, 2012), awareness of aging (Neupert & Bellingtier, 2017), and cognition (Allaire & Marsiske, 2005) can vary from day-to-day, interventions targeting the contextual fluctuations in daily life may be a promising avenue for future research (Wahl, Iwarsson, & Oswald, 2012). For example, when individuals feel they must limit their daily activities or others assume they need assistance due to their age it takes a toll. Efforts to help older adults remain active (e.g.,

Aging^{PLUS}; Brothers & Diehl, 2016), boost control beliefs (Lachman et al., 2009), or that reduce societal ageist beliefs could improve cognitive functioning and well-being with age.

References

- Agrigoroaei, S., & Lachman, M.E. (2010). Personal control and aging: How beliefs and expectations matter. In J.C. Cavanaugh, C.K. Cavanaugh, J. Berry, & R. West (Eds.), *Aging in America, Vol 1: Psychological aspects*. (pp. 177-201). Santa Barbara, CA: Praeger.
- Agrigoroaei, S., Neupert, S.D., & Lachman, M.E. (2013). Maintaining a sense of control in the context of cognitive challenge: Greater stability in control beliefs benefits working memory. *GeroPsych The Journal of Gerontopsychology and Geriatric Psychiatry*, *26*, 49-59.
- Allaire, J.C., & Marsiske, M. (2005). Intraindividual variability may not always indicate vulnerability in elders' cognitive performance. *Psychology and Aging*, *20*, 390-401.
doi:10.1037/0882-7974.20.3.390
- Ashman, O., Shiomura, K., & Levy, B.R. (2006). Influence of culture and age on control beliefs: The missing link of interdependence. *International Journal of Aging and Human Development*, *62*, 143-157.
- Baltes, P.B., Lindenberger, U., & Staudinger, U.M. (2006). Life span theory in developmental psychology. *Handbook of Child Psychology: Theoretical Models of Human Development*, (6th ed), pp. 569-664. doi: 10.1002/9780470147658.chpsy0111.
- Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191. doi:10.1037/0033-295X.84.2.191
- Bandura, A. (1990). Perceived self-efficacy in the exercise of personal agency. *Journal of Applied Sport Psychology*, *2*, 128-163.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

- Baum, S.K., & Boxley, R.L., (1983). Age identification in the elderly. *The Gerontologist*, 23, 532-537.
- Bellingtier, J.A., & Neupert, S.D. (2016). Negative aging attitudes predict greater reactivity to daily stressors in older adults. *Journal of Gerontology: Psychological Sciences*. Advance online publication. doi: 10.1093/geronb/gbw086
- Bellingtier, J. A. & Neupert, S. D. (2019). Feeling young and in control: Daily control beliefs predict younger subjective ages. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*. Advance online publication. doi: 10.1093/geronb/gbz015
- Bellingtier, J.A., Neupert, S.D., & Kotter-Grühn, D. (2017). The combined effects of daily stressors and major life events on daily subjective ages. *Journal of Gerontology: Psychological Sciences*, 72, 613-621. doi: 10.1093/geronb/gbv101
- Bergland, A., Nicolaisen, M., & Thorsen, K. (2013). Predictors of subjective age in people aged 40-79 years: A five-year follow-up study. The impact of mastery, mental and physical health. *Aging and Mental Health*, 18, 653-661. doi: 10.1080/13607863.2013.869545
- Bielak, A.A.M., Hultsch, D.F., Levy-Ajzenkopf, J., MacDonald, S.W.S., Hunter, M.A., & Strauss, E. (2007). Short-term changes in general and memory-specific control beliefs and their relationship to cognition in younger and older adults. *The International Journal of Aging and Human Development*, 65, 53-71. doi: 10.2190/G458-X101-0338-746X
- Boehmer, S. (2007). Relationships between felt age and perceived disability, satisfaction with recovery, self-efficacy beliefs and coping strategies. *Journal of Health Psychology*, 12, 895-906. doi: 10.1177/1359105307082453
- Brothers, A., Miche, M., Wahl, H.-W., & Diehl, M. (2017). Examination of associations among three distinct subjective aging constructs and their relevance for predicting developmental

correlates. *Journal of Gerontology: Psychological Sciences*, 72, 547-560. doi:
10.1093/geronb/gbv085

Caplan, L.J., & Schooler, C. (2003). The roles of fatalism, self-confidence, and intellectual resources in the disablement process in older adults. *Psychology and Aging*, 3, 551-561. doi: 10.1037/0882-7974.18.3.551

Carstensen, L.L., Isaacowitz, D.M., & Charles, S.T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, 54, 165-181.

Caselli, R.J., Chen, K., Locke, D.E., Lee, W., Roontiva, A., Bandy, D.,...Reiman, E.M. (2014). Subjective cognitive decline: Self and informant comparisons. *Alzheimers Dementia*, 10, 93-98.

de Frias, C.M., Dixon, R.A., & Bäckman, L. (2003). Use of memory compensation strategies is related to psychosocial and health indicators. *Journals of Gerontology: Psychological Sciences*, 58B, P12-P22.

Diehl, M.K., & Wahl, H.-W. (2010). Awareness of age-related change: Examination of a (mostly) unexplored concept. *Journal of Gerontology: Social Sciences*, 65B, 340-350. doi: 10.1093/geronb/gbp110

Diehl, M., Wahl, H.-W., Barrett, A.E., Brothers, A.F., Miche, M., Montepare, J.M., & ... Wurm, S. (2014). Awareness of aging: Theoretical considerations on an emerging concept. *Developmental Review*, 34, 93-113. doi: 10.1016/j.dr.2014.01.001

Drewelies, J., Wagner, J., Tesch-Römer, C., Heckhausen, J., & Gerstorf, D. (2017). Perceived control across the second half of life: The role of physical health and social integration. *Psychology and Aging*, 32(1), 76. doi:10.1037/pag0000143

- Eizenman, D.R., Nesselroade, J.R., Featherman, D.L., & Rowe, J.W. (1997). Intraindividual variability in perceived control in an older sample: The MacArthur successful aging studies. *Psychology and Aging, 12*, 489-502.
- Gamaldo, A. A., & Allaire, J. C. (2016). Daily fluctuations in everyday cognition: Is it meaningful? *Journal of Aging and Health, 28*(5), 834-849.
doi:10.1177/0898264315611669
- Geerlings, M.I., Jonker, C., Bouter, L.M., Ader, H.J., & Schmand, B. (1999). Association between memory complaints and incident Alzheimer's disease in elderly people with normal baseline cognition. *American Journal of Psychiatry, 156*, 531-537.
- Gerstorf, D., Röcke, C., & Lachman, M. E. (2010). Antecedent–consequent relations of perceived control to health and social support: Longitudinal evidence for between-domain associations across adulthood. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 66*(1), 61-71. doi:10.1093/geronb/gbq077
- Hahn, E. A., & Lachman, M. E. (2015). Everyday experiences of memory problems and control: The adaptive role of selective optimization with compensation in the context of memory decline. *Aging, Neuropsychology, and Cognition, 22*(1), 25-41.
doi:10.1080/13825585.2014.888391
- Heckhausen, J., & Baltes, P.B. (1991). Perceived controllability of expected psychological change across adulthood and old age. *Journal of Gerontology: Psychological Sciences, 46*, P165-173.
- Heckhausen, J., Wrosch, C., & Schulz, R. (2010). A motivational theory of lifespan development. *Psychological Review, 117*, 32-60.

- Hertzog, C., McGuire, C.L., & Lineweaver, T.T. (1998). Aging, attributions, perceived control, and strategy use in a free recall task. *Aging, Neuropsychology, and Cognition*, *5*, 85-106.
- Hubley, A.M., & Hultsch, D.F. (1994). The relationship of personality trait variables to subjective age identity in older adults. *Research on Aging*, *16*, 415-439.
- Hughes, M.L., Geraci, L., & De Forrest, R.L. (2013). Aging 5 years in 5 minutes: The effect of taking a memory test on older adults' subjective age. *Psychological Science*, *24*, 2481-2488. doi: 10.1177/0956797613494853
- Hultsch, D. F., MacDonald, S. W. S., & Dixon, R. A. (2002). Variability in reaction time performance of younger and older adults. *Journals of Gerontology: Psychological Sciences*, *57B*, P101-P115.
- Infurna, F.J., & Gerstorf, D. (2013). Linking perceived control, physical activity, and biological health to memory change. *Psychology and Aging*, *28*, 1147-1163. doi: 10.1037/a00333327
- Infurna, F. J., Gerstorf, D., Ram, N., Schupp, J., & Wagner, G. G. (2011). Long-term antecedents and outcomes of perceived control. *Psychology and Aging*, *26*(3), 559. doi:10.1037/a0022890
- Infurna, F.J., Gerstorf, D., Robertson, S., Berg, S., & Zarit, S.H. (2010). The nature and cross-domain correlates of subjective age in the oldest old: Evidence from the OCTO study. *Psychology and Aging*, *25*, 470-476. doi: 10.1037/a0017979
- Infurna, F. J., & Okun, M. A. (2015). Antecedents and outcomes of level and rates of change in perceived control: The moderating role of age. *Developmental Psychology*, *51*(10), 1420. doi:10.1037/a0039530

- Jessen, F., Wiese, B., Bachmann, C., Eifflaender-Gorfer, S., Haller, F., Kölsch, H., ... Bickel, H. (2010). Prediction of dementia by subjective memory impairment. *Archives of General Psychiatry*, *67*, 414-422. doi: 10.1001/archgenpsychiatry.2010.30
- Kennedy, S.W., Allaire, J.C., Gamaldo, A.A., & Whitfield, K.E. (2012). Race differences in intellectual control beliefs and cognitive functioning. *Experimental Aging Research*, *28*, 247-264. doi: 10.1080/0361073X.2012.672122
- Kleinspehn-Ammerlahn, A., Kotter-Grühn, D., & Smith, J. (2008). Self-perceptions of aging: Do subjective age and satisfaction with aging change during old age? *The Journals of Gerontology: Series B: Psychological and Social Sciences*, *63B*, P377-P385. doi: 10.1093/geronb/63.6.P377
- Keyes, C.M., & Westerhof, G.J. (2012). Chronological and subjective age differences in flourishing mental health and major depressive episode. *Aging and Mental Health*, *16*, 67-74. doi: 10.1080/13607863.2011.596811
- Lachman, M.E. (1986). Locus of Control in aging research: A case for multidimensional and domain-specific assessment. *Psychology and Aging*, *1*, 34-40.
- Lachman, M.E. (2006). Perceived control over aging-related declines: Adaptive beliefs and behaviors. *Current Directions in Psychological Science*, *15*, 282-286.
- Lachman, M.E., & Agrigoroaei, S. (2012). Low perceived control as a risk factor for episodic memory: The mediational role of anxiety and task interference. *Memory and Cognition*, *40*, 287-296. doi: 10.3758/s13421-011-0140-x
- Lachman, M.E., & Andreoletti, C. (2006). Strategy use mediates the relationship between control beliefs and memory performance for middle-aged and older adults. *Journals of Gerontology: Psychological Sciences*, *61B*, P88-P94.

- Lachman, M.E., Baltes, P.B., Nesselroade, J.R., & Willis, S.L. (1982). Examination of personality-ability relationships in the elderly: The role of contextual (interface) assessment mode. *Journal of Research in Personality, 16*, 485-501.
- Lachman, M.E., Bandura, M., Weaver, S.L., & Elliott, E. (1995). Assessing memory control beliefs: The Memory Controllability Inventory. *Aging and Cognition, 2*, 67-84.
- Lachman, M. E., & Firth, K. M. (2004). The adaptive value of feeling in control during midlife. In O. G. Brim, C. D. Ryff, & R. Kessler (Eds.), *How healthy are we? A national study of well-being at midlife* (pp. 320-349). Chicago, IL: University of Chicago Press.
- Lachman, M.E., Neupert, S.D., & Agrigoroaei, S. (2011). The relevance of a sense of control for health and aging. In K.W. Schaie, & S.L. Willis (Eds.), *Handbook of the Psychology of Aging* (7th Edition). (pp. 175-190). San Diego, CA: Academic Press. doi:10.1016/B978-0-12-380882-0.00011-5
- Lachman, M.E., Rosnick, C.B., & Röcke, C. (2009). The rise and fall of control beliefs in adulthood: Cognitive and biopsychosocial antecedents and consequences of stability and change over nine years. In H.B. Bosworth & C. Hertzog (Eds.), *Aging and Cognition: Research methodologies and empirical advances* (pp. 143-160). Washington, DC: American Psychological Association.
- Lachman, M.E., & Weaver, S.L. (1998). The sense of control as a moderator of social class differences in health and well-being. *Journal of Personality and Social Psychology, 74*, 763-773.
- Lee, P.-L. (2016). Control beliefs level and change as predictors of subjective memory complaints. *Aging and Mental Health, 20*, 329-335. doi: 10.1080/13607863.2015.1008991

- Levy, B.R. (2003). Mind matters: Cognitive and physical effects of aging self-stereotypes. *Journal of Gerontology: Psychological Sciences, 58B*, P203-P211. doi: 10.1093/geronb/58.4.P203
- Levy, B. (2009). Stereotype embodiment: A psychosocial approach to aging. *Current Directions in Psychological Science, 18*, 332-336. doi: 10.1111/j.1467-8721.2009.01662.x
- Levy, B.R., Slade, M.D., & Kasl, S.V. (2002). Longitudinal benefit of positive self-perceptions of aging and functional health. *Journal of Gerontology: Psychological Sciences, 57B*, P409-P417.
- Levy, B.R., Zonderman, A.B., Slade, M.D., & Ferrucci, L. (2012). Memory shaped by age stereotypes over time. *Journal of Gerontology: Psychological Sciences, 67*, 432-436. doi: 10.1093/geronb/gbr120
- Li, S. Aggen, S.H., Nesselroade, J.R., & Baltes, P.B. (2001). Short-term fluctuations in elderly people's sensorimotor functioning predict text and spatial memory performance: The MacArthur Successful Aging Studies. *Gerontology, 47*, 100-116. doi: 10.1023/A:1010472-0100324X/01/0472-0100
- Lindenberger, U., & Ghisletta, P. (2009). Cognitive and sensory declines in old age: Gauging the evidence for a common cause. *Psychology and Aging, 24*(1), 1-16. doi:10.1037/a0014986
- Markus, H.R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*, 224-253.
- Martin, M., & Hofer, S.M. (2004). Intraindividual variability, change, and aging: Conceptual and analytical issues. *Gerontology, 50*, 7-11.
- Masten, A.S., & Cicchetti, D. (2010). Developmental cascades. *Development and Psychopathology, 22*, 491-495. doi: 10.1017/S0954579410000222

- Menkin, J.A., Robles, T.F., Gruenewald, T.L., Tanner, E.K., & Seeman, T.E. (2017). Positive expectations regarding aging linked to more new friends in later life. *Journal of Gerontology: Psychological Sciences, 72*, 771-781. doi: 10.1093/geronb/gbv118
- Miller, L.M.S., & Gagne, D.D. (2005). Effects of age and control beliefs on resource allocation during reading. *Aging, Neuropsychology, and Cognition, 12*, 129-148.
- Miller, L.M.S., & Lachman, M.E. (1999). The sense of control and cognitive aging: Toward a model of mediational processes. In T.M. Hess & F. Blanchard-Fields (Eds.), *Social Cognition and Aging* (pp. 17-41). New York: Academic Press.
- Miller, L.M.S., & Lachman, M.E. (2000). Cognitive performance and the role of control beliefs in midlife. *Aging, Neuropsychology, and Cognition, 7*, 69-85.
- Mock, S.E., & Eibach, R.P. (2011). Aging attitudes moderate the effect of subjective age on psychological well-being: Evidence from a 10-year longitudinal study. *Psychology and Aging, 26*, 979-986. doi: 10.1037/a0023877
- Montepare, J.M. (2009). Subjective age: Toward a guiding lifespan framework. *International Journal of Behavioral Development, 33*, 42-46. doi: 10.1177/0165025408095551
- Nesselroade, J. R., & Salthouse, T. A. (2004). Methodological and theoretical implications of intraindividual variability in perceptual-motor performance. *Journals of Gerontology: Psychological Sciences, 59B*, P49-P55.
- Neupert, S.D., & Altaire, J.C. (2012). I think I can I think I can: Examining the within-person coupling of control beliefs and cognition. *Psychology and Aging, 27*, 742-749. doi: 10.1037/a0026447

- Neupert, S.D., Almeida, D.M., & Charles, S.T. (2007). Age differences in reactivity to daily stressors: The role of personal control. *Journal of Gerontology: Psychological Sciences, 62B*, P216-P225. doi: 10.1093/geronb/62.4.P216
- Neupert, S.D., Almeida, D.M., Mroczek, D.K., & Spiro, A. (2006). Daily stressors and memory failures in a naturalistic setting: Findings from the VA Normative Aging Study. *Psychology and Aging, 21*, 424-429. doi: 10.1037/0882-7974.21.2.424
- Neupert, S.D., & Bellingtier, J.A. (2017). Aging attitudes and daily awareness of age-related change interact to predict negative affect. *The Gerontologist, 57* (S2), S187-S192. doi: 10.1093/geront/gnx055
- O'Brien, E.L., Hess, T.M., Kornadt, A.E., Rothermund, K., Fung, H., & Voss, P. (2017). Context influences on the subjective experience of aging: The impact of culture and domains of functioning. *The Gerontologist, 57* (Suppl 2), S127-S137. doi: 10.1093/geront/gnx015
- Parisi, J. M., Gross, A. L., Marsiske, M., Willis, S. L., & Rebok, G. W. (2017). Control beliefs and cognition over a 10-year period: Findings from the ACTIVE trial. *Psychology and Aging, 32*(1), 69. doi:10.1037/pag0000147
- Park, D.C., & Reuter-Lorenz, P. (2009). The adaptive brain: Aging and neurocognitive scaffolding. *Annual Review of Psychology, 60*, 173-196. doi: 10.1146/annurev.psych.59.103006.093656
- Pearlin, L.I., & Pioli, M.F. (2003). Personal control: some conceptual turf and future directions. In S.H. Zarit, L.I. Pearlin, & K.W. Schaie (Eds.), *Personal control in social and life course contexts* (pp. 1-21). New York: NY: Springer.

- Rebok, G.W., Rasmusson, D.X., & Brandt, J. (1996). Prospects for computerized memory training in normal elderly: Effects of practice on explicit and implicit memory tasks. *Applied Cognitive Psychology, 10*, 211-223.
- Rodin, J. (1990). Control by any other name: Definitions, concepts, and processes. In J. Rodin, C. Schooler, & K.W. Schaie (Eds.), *Self-directedness: Cause and effects throughout the life course* (pp. 1-17). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied, 80*, 1-28.
- Rowe, J.W., & Kahn, R.L. (1998). *Successful aging*. New York: Pantheon Books.
- Sastry, J., & Ross, C.E. (1998). Asian ethnicity and the sense of personal control. *Social Psychology Quarterly, 61*, 101-120.
- Schulz, R., & Heckhausen, J. (1999). Aging, culture, and control: Setting a new research agenda. *The Journals of Gerontology: Series B: Psychological Sciences, 54*, P139-P145. doi: 10.1093/geronb/54B.3.P139
- Seidler, A.L., & Wolff, J.K. (2017). Bidirectional associations between self-perceptions of aging and processing speed across 3 years. *Gero-Psych, 30*, 49-59. doi: 10.1024/1662-9647/a000165
- Shrira, A., Palgi, Y., Ben-Ezra, M., Hoffman, Y., & Bodner, E. (2016). A youthful age identity mitigates the effect of post-traumatic stress disorder symptoms on successful aging. *The American Journal of Geriatric Psychiatry, 24*, 174-175. doi: 10.1016/j.jagp.2015.07.006
- Siebert, J.S., Wahl, H.-W., Degen, C., & Schröder, J. (2018). Attitude toward own aging as a risk factor for cognitive disorder in old age: 12-year evidence from the ILSE study. *Psychology and Aging, 33*, 461-472. doi: 10.1037/pag0000252

- Siebert, J.S., Wahl, H.-W., & Schröder, J. (2016). The role of attitude toward own aging for fluid and crystallized functioning: 12-year evidence from the ILSE study. *Journal of Gerontology: Psychological Sciences*. Advance online publication. doi: 10.1093/geronb/gbw050
- Skinner, E.A., Chapman, M., & Baltes, P.B. (1988). Beliefs about control, means-ends, and agency: A new conceptualization and its measurement during childhood. *Journal of Personality and Social Psychology*, *54*, 117-133.
- Stephan, Y., Caudroit, J., & Chalabaev, A. (2011). Subjective health and memory self-efficacy as mediators in the relation between subjective age and life satisfaction among older adults. *Aging and Mental Health*, *15*, 428-436.
- Stephan, Y., Sutin, A.R., Caudroit, J., & Terracciano, A. (2016). Subjective age and changes in memory in older adults. *Journal of Gerontology: Psychological Sciences*, *71*, 675-683. doi: 10.1093/geronb/gbv010
- Stephan, Y., Sutin, A.R., Luchetti, M., & Terracciano, A. (2017). Feeling older and the development of cognitive impairment and dementia. *Journal of Gerontology: Psychological Sciences*, *72*, 966-973.
- Sunderland, A., Harris, J. E., & Baddeley, A. D. (1983). Do laboratory tests predict everyday memory? A neuropsychological study. *Journal of Verbal Learning and Verbal Behavior*, *22*(3), 341-357. doi:10.1016/S0022-5371(83)90229-3
- Westerhof, G.J., & Barrett, A.E. (2005). Age identify and subjective well-being: A comparison of the United States and Germany. *The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences*, *60B*, S129-136. doi: 10.1093/geronb/60.3.S129

- Westerhof, G.J., Miche, M., Brothers, A.F., Barrett, A.E., Diehl, M., Montepare, J.M., & ...
Wurm, S. (2014). The influence of subjective aging on health and longevity: A meta-analysis of longitudinal data. *Psychology and Aging, 29*, 793-802. doi: 10.1037/a0038106
- Whitbourne, S.B., Neupert, S.D., & Lachman, M.E. (2008). Daily physical activity: Relation to everyday memory in adulthood. *Journal of Applied Gerontology, 27*, 331-349.
- Willis, S. L., Jay, G. M., Diehl, M., & Marsiske, M. (1992). Longitudinal change and prediction of everyday task competence in the elderly. *Research on Aging, 14*(1), 68-91.
doi:10.1177/0164027592141004
- Windsor, T.D., & Anstey, K.J. (2008). A longitudinal investigation of perceived control and cognitive performance in young, midlife, and older adults. *Aging, Neuropsychology, and Cognition, 15*, 744-763. doi: 10.1080/1382558082348570
- Wolff, J.K., Warner, L.M., Ziegelmann, J.P., & Wurm, S. (2014). What do targeting positive views on ageing add to a physical activity intervention in older adults? Results from a randomized controlled trial. *Psychology and Health, 29*, 915-932. doi:
10.1080/08870446.2014.896464
- Wurm, S., Tesch-Römer, C., & Tomasik, M.J. (2007). Longitudinal finding aging-related cognitions, control beliefs, and health in later life. *Journal of Gerontology: Psychological Sciences, 62*, P156-P164. doi: 10.1093/geronb/62.3.P156
- Zahodne, L.B., Manly, J.J., Smith, J., Seeman, T., & Lachman, M.E. (2017). Socioeconomic, health, and psychosocial mediators of racial disparities in cognition in early, middle, and late adulthood. *Psychology and Aging, 32*, 118-130. doi: 10.1037/pag0000154
- Zhang, S., Gamaldo, A.A., Neupert, S.D., & Allaire, J.C. (2018). Predicting control beliefs in older adults. Manuscript submitted for publication.

