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Special Issue: Successful Aging

Role of Physical Activity in the Relationship Between Mastery and Functional Health

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Purpose of the Study: To examine the influence of mastery, physical activity levels, and subsequent trajectories of domains of functional health across the adult life course.
Design and Methods: We examined 8-year trajectories of physical functioning (handgrip strength) and functional health (physical [RAND PHC12], psychological [RAND MHC12], and cognitive [processing speed]) in a large Australian sample (n = 7,485 at baseline) of 3 cohorts (20–24, 40–44, and 60–64 years). Within- and between-person indirect effects of physical activity on the relationship between mastery and health were examined using multilevel structural equation models.
Results: Mastery was positively related to within-person change in physical and psychological health for all cohorts, and processing speed for the 60s. Between-person mastery was positively associated with all health domains across all cohorts. Physical activity indirectly influenced the between-person relationships between mastery and handgrip strength, physical health, and psychological health in all cohorts, and between mastery and processing speed for the 60s.
Implications: Psychological resources are important mechanisms for functional health as they may drive adaptive behaviors such as physical activity. The within-person association connecting mastery with physical and psychological health trajectories provides promise for interventions that foster or improve a sense of mastery. The findings contribute to the understanding of complex relationships between personal resources and behaviors that aid in successful aging across the life span.

Key words: Exercise, Health, Successful aging

Mastery is considered a central psychological resource for adaptation to age-related changes (Smith & Baltes, 1997). Defined as 'control over those circumstances that importantly bear on the life of the individual' (Pearlin, Nguyen, Schieman, & Milkie, 2007, p. 164), the concept of mastery is focused on successful actions or behaviors and is related to Bandura's construct of self-efficacy, where those with high self-efficacy believe that desired outcomes are achievable (Bandura, 1999).

Mastery is associated with health outcomes in later life. High mastery is related to a reduction in the rate of decline in mobility (Milaneschi et al., 2010), whereas low mastery is associated with functional decline (Kempen, Ranchor, Van Sonderen, Van Jaarsveld, & Sanderman, 2006) and increased risk of cardiovascular disease mortality (Surtees, Wainwright, Luben, & Wareham, 2010). Self-efficacy and mastery beliefs are also associated with cognitive and functional performance in older adults (e.g., Femia, Zarit, & Johansson, 1997), and there is preliminary evidence that mastery may moderate the relationship between physical functioning and institutionalization in later life (Cooper, Huisman, Kuh, & Deeg, 2011).

The mechanism through which mastery influences health has not yet been fully elucidated, but a logical avenue of thought is that with high mastery comes a higher likelihood of performing behaviors that allow the individual to control their environment and health trajectory (Lachman & Firth, 2004; Skaff, 2007). Mastery levels predict health behavior practice and physical activity (Scholz, Sniehotta, Schuz, & Obeberst, 2007), and is considered a personal resource for self-regulation of health and behaviors (Skaff, 2007).

Lifecourse Approach to Mastery, Health Behaviors, and Successful Aging

Regular physical activity is associated with many successful aging domains. Here, we are aligning the term of "successful aging" as it refers to Rowe and Kahn's (1997) original notion of high overall functioning and do not intend to imply moral or prerogative interpretations of "success." For example, in a recent cross-sectional study, Dogra and Stathokostas (2012) showed that middle-aged and older adults who performed walking for 30 min or more a day were more likely to be classified as "successful agers" in physical and cognitive functioning, emotional vitality, and psychological well-being. Compared with adults who do not meet physical activity requirements, adults who do meet requirements have increased strength and reduced frailty over time (Cooper et al., 2011; Dogra & Stathokostas, 2012), protection against physical health status decline (Sargent-Cox, Cherbuin, Morris, Butterworth, & Anstey, 2014), higher psychological health (Windle, Hughes, Linck, Russell, & Woods, 2010), and neurocognitive performance (Hamer & Chida, 2009).

There is debate in the literature regarding the trajectories of mastery across the life course (Skaff, 2007). At the population level, perceived control (Mirowsky & Ross, 2007) and mastery (Cairney & Krause, 2008) have a nonlinear relationship with age, increasing in early and mid-adulthood, and declining in later life. At the individual level, mastery has been shown to fluctuate with stressors outside of personal control, such as involuntary job loss (Avison, 2001). A life-span approach suggests that individuals high in mastery will enter later life with better health due to better proactive care of their health (Skaff, 2007). Perceptions of control and mastery are also considered to be accumulative across the life course (Pearlin et al., 2007), so mastery levels will be reflective of adaptation to personal experience with stressors encountered. There are also potential cohort effects in levels of mastery due to differences in, for example, education levels (Mirowsky & Ross, 2007). Together, this literature indicates that the investigation of mastery should be stratified by age.

What is not clear from the literature is how within-person changes in mastery affect health outcomes via health behaviors with aging. The study of developmental trajectories aims to understand how individuals reliably differ with age, as well as how individuals' trajectories may vary from normative change. Advances in longitudinal analysis provide greater complexity of modeling, including the isolation of within- and between-person variance in trajectories. Isolation of within-person change allows the direct examination of developmental processes, whereas isolation of between-person change evaluates relationships among predictors and outcomes between individuals and reflects population-level trends. Therefore, to explore mechanisms that are related to both intraindividual and interindividual change, it is important to separate within- and between-person effects. This will contribute to the current literature by investigating the adaptive or maladaptive effects of departures from initial levels of mastery for individuals with regard to health behaviors and outcomes.

The Present Study

The aim of this study is to explore the role of mastery in trajectories of functional health, as an important component of successful aging. Of particular interest is the accumulation of lifecourse influences and behaviors on health trajectories, which is especially important in late-life outcomes (Freund & Baltes, 1998). There is a paucity of research examining the determinants and mechanisms of successful aging components through young adulthood and middle age. To address this gap, we will examine trajectories of functional health in young adulthood and middle age, as well as in older adults.

To explore potential cohort differences in trajectories of mastery suggested in the literature, the models will be

stratified (early adults: 20–24 years at baseline; mid-adults: 40–44 years; older adults: 60–64). The functional health domains that we will investigate are as follows: (a) handgrip strength—an objective biomarker measure of physical functioning that is predictive of musculoskeletal reserves, disability, and frailty (Angst et al., 2010; Syddall et al., 2010); (b) self-reported physical health—a robust predictor of health outcomes (e.g., Ben-Ezra & Shmotkin, 2006; DeSalvo, Fan, McDonell, & Fihn, 2005; Emmelin et al., 2003); (c) self-reported mental health and well-being—an important component of functioning (Depp & Jeste, 2006; Rowe & Kahn, 1997) associated with health and mortality (e.g., Anstey, Burns, Von Sanden, & Luszcz, 2008; Chida & Steptoe, 2008); and (d) processing speed—an indicator of cognitive functioning (Finkel, Reynolds, McArdle, & Pedersen, 2007; Salthouse, 2000) and associated with health and mortality (Anstey, Luszcz, Giles, & Andrews, 2001; Anstey, von Sanden, & Luszcz, 2006). It is hypothesized that adults with high mastery will have better health across the age groups compared to those with low mastery. The second hypothesis proposes that the relationship between mastery and functional health outcomes will be indirectly influenced through physical activity levels. Within-person change in mastery will be explored, and the relationship between changes in mastery, physical activity, and functional health outcomes will be examined and compared with the average, between-person relationship among these variables. It is expected that on occasions when mastery levels are high, physical activity levels will also be high.

Methods

Participants

Participants were drawn from the PATH Through Life Study, a large 20-year longitudinal cohort study (20–24, 40–44, and 60–65 years at baseline) from the Canberra/Queanbeyan districts, Australia. The study design and sample have been fully described elsewhere (Anstey et al., 2012). In brief, random recruitment was conducted using the Australian electoral roll. Sampling through the electoral roll is considered to elicit a representative sample of the area as enrolment to vote is compulsory in Australia. Eligible participants were within the cohort age range on January 1 of the baseline year for each cohort (1999/2000 for 20–24 years, 2000/2001 for 40–44 years, and 2001/2002 for 60–64 years). Participation rates at baseline was 58.6% for the 20s cohort (n = 2,404, 48% males), 64.6% for the 40s cohort (n = 2,530, 47% males), and 58.3% for the 60s cohort (n = 2,551, 52% males). Cohorts were followed up every 4 years, and the present investigation uses data for the first three waves (20s: 2003/2004 [n = 2,139], 2007/2008 [n = 1,978]; 40s: 2004/2005 [n = 2,354], 2008/2009 [n = 2,182]; 60s: 2005/2006 [n = 2,222], 2009/2010 [n = 1,973]). Loss to follow-up from Wave 1 to Wave 3 included not contacted (20s: 4%; 40: 6%; 60s: 9%), refused (20s: 11.3%; 40s: 6%; 60s: 9%), death (60s: 3%), and not found (20s: 25; 40s: 1%; 60s: 1%).

Measures

Mastery

Mastery was measured at each wave using Pearlin and Schooler's (1978) 7-item scale. Items included "I have little control over the things that happen to me" and "I can do just about anything I really set my mind to do." Responses are on a 4-point Likert type scale from 1 (*strongly agree*) to 4 (*strongly disagree*). Items were summed, so a higher score indicated greater sense of mastery. The scale has shown good construct validity and internal consistency reliability (Pearlin, Menaghan, Lieberman, & Mullan, 1981; Pearlin, et al., 2007).

Physical Activity

Items adapted from the U.K. Whitehall II Study (Stafford, Hemingway, Stansfeld, Brunner, & Marmot, 1998) assessed physical activity. Frequency engaging in moderate (e.g., dancing, cycling) and vigorous (e.g., running, squash) physical activity was reported as three times a week or more (1), one to two times a week (2), one to three times a month (3), or never/hardly ever (4). Patterns of response for the moderate and vigorous physical activity were examined, and a score was calculated based on these patterns ranging from 0 to 7, with 0 indicating never/hardly ever doing physical activity and 7 representing those who reported both moderate and physical activity frequency three times a week or more.

Functional Health Domains

Handgrip strength was measured using a Smedley Hand Dynamometer (Model No PE7, Stoelting Co., Wood Dale, IL). Four trials were given for each hand, and the mean average score in kilograms of the left and right hands was used. The RAND-12 physical and mental health component scores were derived from the Short Form Health Survey (SF-12; Anstey, Windsor, Luszcz, & Andrews, 2006). Six items comprise the physical health score (RAND-PH) and measure physical functioning, physical role, bodily pain, and general health questions; and six other items measure psychological distress for the mental health component (RAND-MH). Higher scores indicate better physical and psychological health. Processing speed was assessed with the Symbol-Digit Modalities Test (Smith, 1982) which requires participants to find in a key the digit corresponding to a specific symbol and to complete as many symbol-digit pairs as possible in 90 s.

A higher score indicates faster processing speed, as measured by the number of correct symbol-digit pairs answered.

Covariates

Models were adjusted for gender and years of education at baseline. Time-varying covariates known to influence physical activity and health outcomes were included in the models including aggregate number of self-reported medical conditions (heart problems, cancer, arthritis, asthma, diabetes, and stroke), body mass index (BMI), self-rated health (SRH; 1 = *poor*, 5= *excellent health*), and current smoking status (smoker and nonsmoker). Alcohol consumption was measured using the first three items (frequency, number of drinks/day, and number of occasions where six drinks or more consumed) from the 10-item World Health Organization Alcohol Use Disorders Identification Test (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). To account for the u-shaped association between alcohol consumption and health outcomes (Ronksley, Brien, Turner, Mukamal, & Ghali, 2011), categories based on Australian Guidelines (National Health and Medical Research Council, 2001, 2009) were dummy coded into two variables: abstainers versus rest, and moderate drinkers versus rest.

Statistical Analysis

Mastery, physical activity, and outcome variables were standardized to a T-metric ($M = 50, SD = 10$), based on mean scores at baseline, in order to establish a common metric for comparative purposes. Multilevel structural equation modeling (MSEM) was used to examine direct and indirect effects in change in the outcomes (Preacher, Zyphur, & Zhang, 2010) using Mplus, version 5.1 (Muthén & Muthén, 2007). The model uses a maximum likelihood estimation (MLR) EM algorithm (with robust standard errors) to accommodate for missing data and unbalanced cluster sizes (i.e., number of observations over time for each person) (Muthén & Asparouhov, 2008). Participants data are included in the model if they have at least one wave of data with all independent variables. As described by Preacher and colleagues (2010), MSEM can overcome possible conflation or bias of the indirect effects at both the within- and between-effect levels, normality is not assumed, and robust estimates of asymptotic covariances of parameter are estimated.

Four indirect effects models were specified (handgrip, physical health, psychological health, and processing speed) with random intercepts and fixed slopes (except for each outcome slope over time; Preacher et al., 2010). Time-invariant variables (gender, cohort, and years of education at baseline) were included in Level 2 of the model, and time-varying variables (self-rated health smoking status, BMI, alcohol consumption, and number of medical conditions) were included at both levels of the model. Due to the number of tests and effects the p value was set at <.01. Figure 1 demonstrates a simplified version of the indirect model, where physical activity has an indirect effect on the relationship between mastery and health outcomes at both the between- and within-person levels.

Results

Description of Sample

Table 1 summarizes the raw (nonstandardized) scores for mastery, physical and psychological health, and processing speed. Unadjusted mixed linear models (see Figure 2) showed a significant increase in mastery over the 8 years for the 20s and 40s, but trended toward declining in the 60s (nonsignificant). Physical activity levels significantly decreased. Handgrip strength increased significantly for the 20s but declined in the 40s and 60s. Physical health declined across all cohorts. No significant change was found in the psychological health of 20s or 40s, but decline was found in the 60s. Processing speed showed a significant increase in the 20s over time, although significant slowing over time was found in older age cohorts.

All measures showed significant variance in slopes ($p < .001$), indicating individual differences in rates of change. Intraclass coefficients statistics for the 20s, 40s, and 60s, respectively, showed between-person variance in mastery (51.5%, 58.9%, 56.3%), physical activity (44.6%, 53.8%, 51.9%), handgrip (controlling for gender—60.9%, 64.7%, 58.4%), physical functioning (37.4% 56.2%, 62.6%), psychological functioning (45.5%, 52.1%, 56.6%), and processing speed (74.3%, 77.1%, 77.7%).

Direct Effects—Relationship Between Mastery and Functional Health Domains

Handgrip Strength

Table 2 shows the results for all MSEM models by cohort. For handgrip, there were no significant associations found at the within-person level. At the between-person level, direct effects were similar across cohorts. High average mastery was associated with higher average levels of physical activity and handgrip strength. In addition, high average physical activity levels were associated with stronger average handgrip.

Physical Health

At the within-person level, a significant direct effect between mastery and physical health was found for all cohorts, indicating that when mastery was high reporting of physical health was also high. A significant within-person direct effect between physical activity and physical health was also found. At the between-person level higher average mastery was associated with higher levels of physical activity and

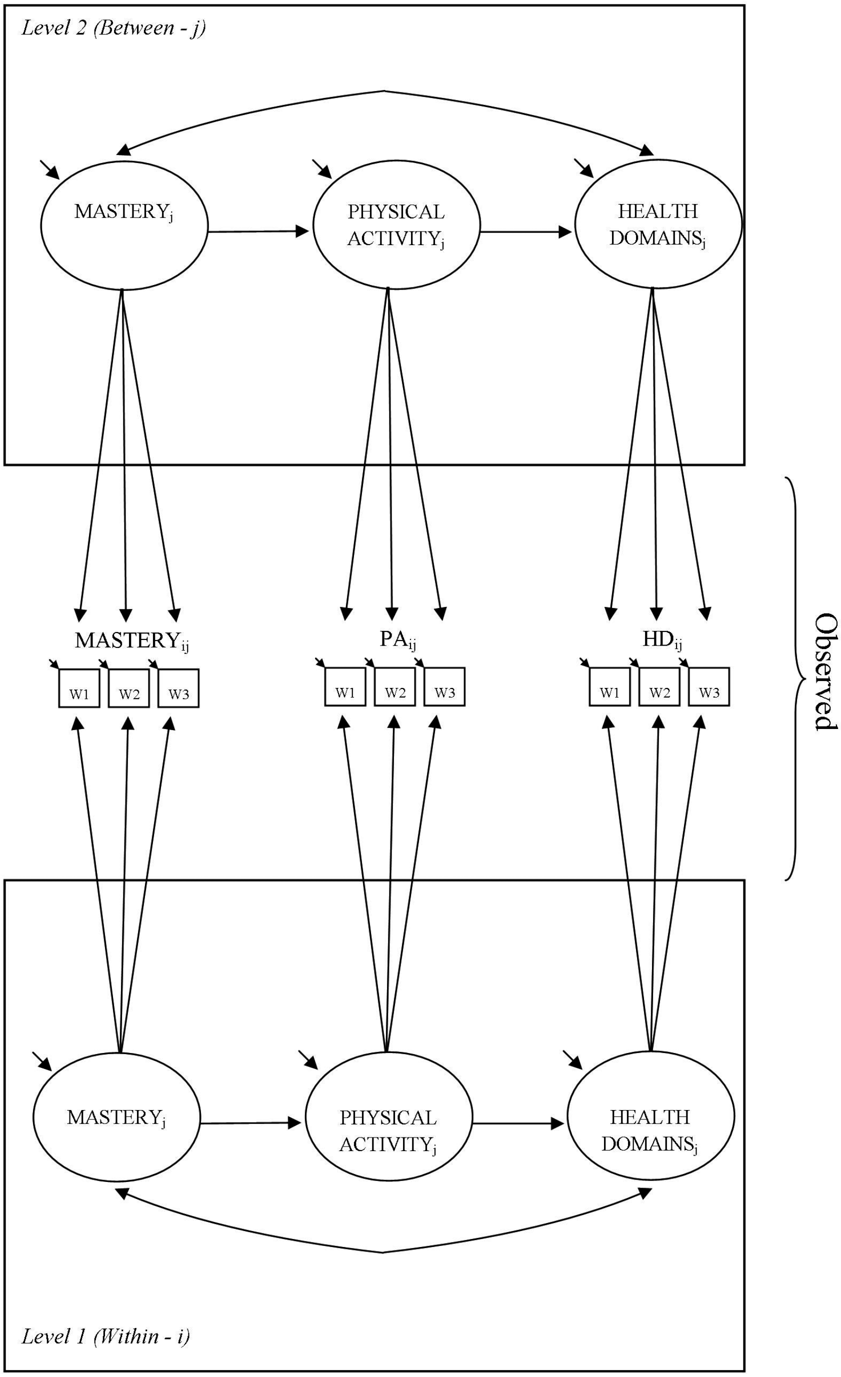

Figure 1. Graphical representation of multilevel structural equation (MSEM) model where the direct relationship between mastery and health domains is indirectly influenced by physical activity at the within- and between-person levels. Note: PA = physical activity; HD = health domains. Adapted from Preacher, K. J., Zyphur, M. J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods*, *15*, 209–233.

better physical health. A direct association was also found between physical activity levels and physical health.

Psychological Health

A significant within-person direct effect of mastery across cohorts indicates that when mastery was high, psychological health was also high. No direct within-person effects were found between mastery and physical activity, but direct effects between physical activity and psychological health was shown in all cohorts. At the between-person level, higher average mastery was significantly associated with higher average physical activity levels and psychological health for all cohorts, and the direct effect between physical activity and psychological health also indicated

Table 1. Descriptive Statistics Summaries for Three Measurement Occasions by Cohort

	20s Cohort			40s Cohort			60s Cohort		
	Baseline	Wave 2	Wave 3	Baseline	Wave 2	Wave 3	Baseline	Wave 2	Wave 3
Females, %	51.6%			52.8%			50.6%		
Years of education, *M* (*SD*)	14.6 (1.57)			14.62 (2.33)			13.84 (2.81)		
Mean age, *M* (*SD*)	22.61 (1.51)	26.72 (1.50)	30.69 (1.49)	42.62 (1.48)	49.59 (1.50)	50.66 (1.49)	62.51 (1.50)	66.60 (1.49)	70.60 (1.49)
Medical conditions, *M* (*SD*)	0.23 (0.45)	0.24 (0.48)	0.23 (0.48)	0.29 (0.56)	0.34 (0.62)	0.43 (0.67)	0.80 (0.89)	0.91 (0.92)	0.62 (0.61)
Self-rated health, *M* (*SD*)	3.68 (0.91)	3.63 (0.89)	3.58 (0.93)	3.71 (0.92)	3.64 (0.90)	3.54 (0.93)	3.64 (0.98)	3.63 (0.94)	3.57 (0.94)
Current smoker, %	31.1%	27.1%	20.7%	18.5%	16.4%	12.9%	10.4%	7.2%	5.4%
Alcohol consumption, %									
Abstain/occasional	31.8%	26.95	27.5%	27.2%	26.1%	21.95	29.8%	28.4%	28.1%
Light/medium	61.7%	66.8%	64.9%	67.0%	66.5%	69.9%	64.1%	66.6%	67.4%
Hazard/harmful	6.5%	6.3%	7.6%	5.9%	7.4%	8.2%	6.1%	5.0%	4.5%
BMI, *M* (*SD*)	23.59 (4.10)	24.78 (4.59)	25.81 (5.20)	26.35 (5.16)	26.88 (5.08)	27.44 (5.17)	26.84 (5.27)	26.59 (4.82)	26.68 (4.89)
Mastery, *M* (*SD*)	22.86 (3.43)	22.74 (3.46)	23.11 (3.54)	22.07 (3.58)	22.04 (3.62)	22.59 (3.75)	21.91 (3.57)	21.85 (3.42)	21.92 (3.40)
Physical activity, *M* (*SD*)	3.93 (2.32)	3.75 (2.38)	3.55 (2.43)	2.89 (2.17)	2.82 (2.17)	2.76 (2.20)	2.49 (1.91)	2.56 (1.94)	2.41 (1.99)
Handgrip, *M* (*SD*)	38.12 (11.26)	38.42 (11.34)	40.71 (13.24)	37.65 (11.49)	37.23 (12.18)	37.57 (12.84)	34.06 (10.81)	30.65 (9.96)	31.20 (11.78)
Physical health, *M* (*SD*)	51.57 (6.98)	51.54 (6.98)	51.05 (7.54)	51.03 (8.08)	50.75 (8.10)	49.99 (8.53)	48.70 (10.03)	48.73 (9.79)	47.86 (10.07)
Psychological health, *M* (*SD*)	47.40 (9.58)	47.28 (9.56)	47.51 (9.65)	49.10 (9.44)	49.14 (9.35)	49.64 (9.30)	53.07 (8.71)	52.85 (8.42)	52.72 (8.00)
Processing speed, *M* (*SD*)	64.13 (9.94)	65.79 (9.91)	66.02 (9.79)	60.04 (9.16)`	60.24 (8.72)	59.94 (8.89)	49.84 (9.65)	49.54 (9.38)	47.71 (9.25)

Note: N = 6,843 total across measurement occasions. N values vary by wave and variable to reflect those included in the final models. BMI = body mass index.

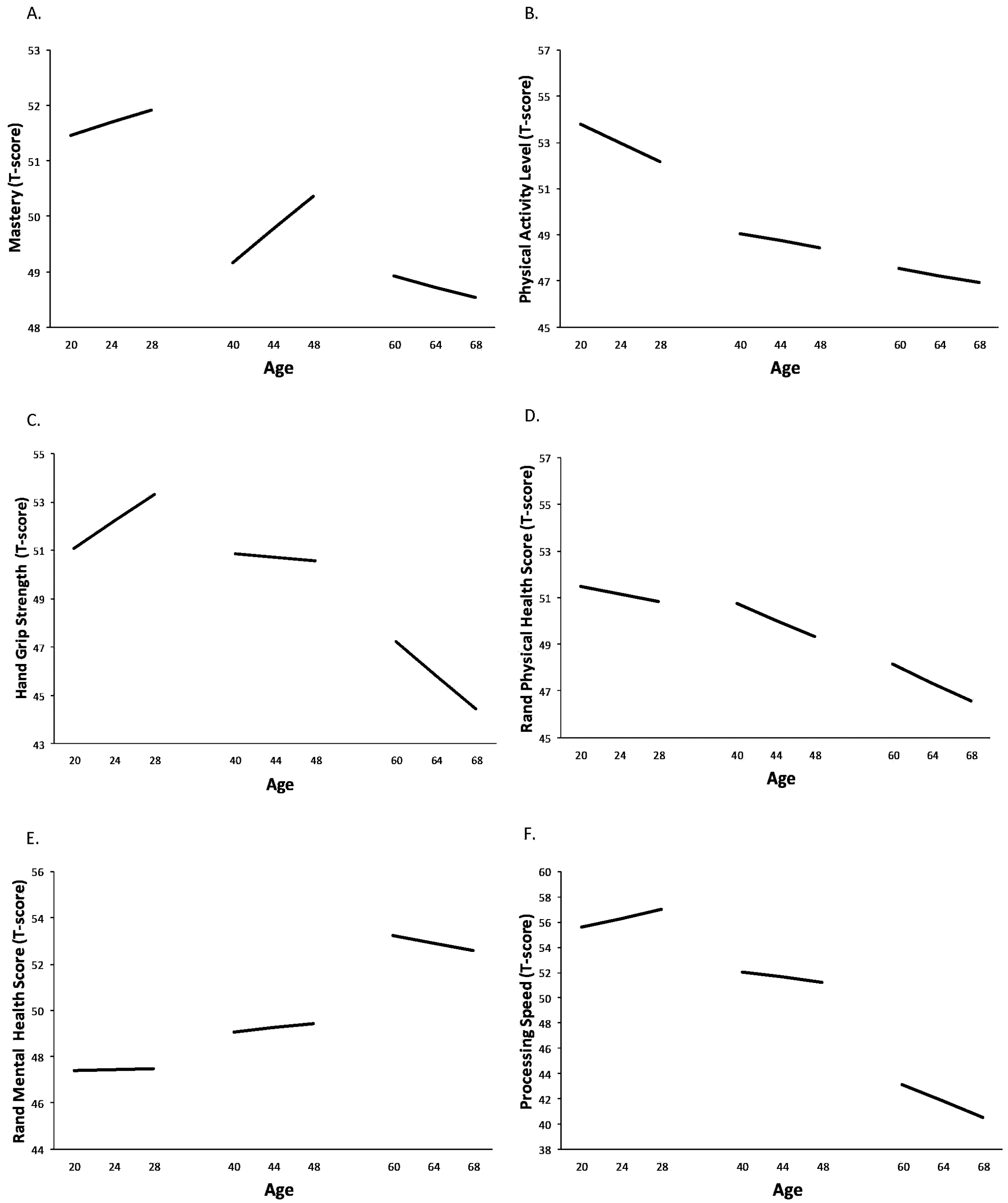

Figure 2. Average sample level trajectories for successful aging domains by cohort: (A) mastery, (B) physical activity, (C) handgrip strength, (D) physical health, (E) mental health, and (F) processing speed.

that higher average levels of physical activity was associated with higher levels of psychological health.

Processing Speed

A direct within-person relationship was found for the 60s for mastery and physical activity with processing speed. At the between-person level, higher average mastery was associated with higher physical activity and faster processing speed for all cohorts. For the 60s only, a direct between-person effect was found for physical activity and processing speed. The negative effect indicated that for this age group, higher average physical activity levels were associated with slower processing speed.

Indirect Effects of Physical Activity on the Relationship Between Mastery and Functional Health Domains

Within- and between-person indirect effects are also reported in Table 2. No evidence of within-person indirect

Table 2. Multilevel Structural Equation Mediating Models (SMEM) Predicting Direct and Indirect Effects of Mastery on Handgrip Strength, Physical Health, Psychological Health and Processing Speed, via Physical Activity Level (20s: N = 2,305; 40s: N = 2,339; 60s: N = 2,199)

	Direct effects						Indirect effects	
	Within-person (level 1) effects			Between-person (level 2) effects			Within-person	Between-person
	Mastery—outcome	Mastery—physical activity	Physical activity —outcome	Mastery—outcome	Mastery—physical activity	Physical activity—outcome		
	B (*SE*), *p*	*B* (*SE*), *p*	*B* (*SE*), *p*	*B* (*SE*), *p*	*B* (*SE*), *p*	*B* (*SE*), *p*	*B* (*SE*), *p*	*B* (*SE*), *p*
Handgrip strength								
20s	0.01 (0.01), .599	0.03 (0.02), .214	0.01 (0.01), .123	0.08 (0.02), <.001	0.36 (0.03), <.001	0.11 (0.02), <.001	0.00 (0.00), .327	0.04 (0.01), <.001
40s	0.01 (0.01), .110	0.02 (0.02), .264	0.01 (0.01), .259	0.08 (0.02), <.001	0.18 (0.02), <.001	0.10 (0.02), <.001	0.00 (0.00), .418	0.02 (0.00), <.001
60s	0.01 (0.01), .239	0.01 (0.02), .471	0.02 (0.01), .067	0.06 (0.02), .002	0.23 (0.03), <.001	0.10 (0.02), <.001	0.00 (0.00), .504	0.02 (0.01), <.001
Physical health								
20s	0.12 (0.02), <.001	0.03 (0.02), .209	0.12 (0.01),<.001	0.23 (0.02), <.001	0.36 (0.03), <.001	0.17 (0.02), <.001	0.00 (0.00), .214	0.06 (0.01), <.001
40s	0.07 (0.02), <.001	0.02 (0.02), .281	0.11 (0.02),<.001	0.36 (0.02), <.001	0.18 (0.02), <.001	0.17 (0.02), <.001	0.00 (0.00), .285	0.03 (0.01), <.001
60s	0.06 (0.02), .008	0.01 (0.02), .508	0.18 (0.02),<.001	0.34 (0.03), <.001	0.24 (0.03), <.001	0.39 (0.03), <.001	0.00 (0.00), .509	0.09 (0.01), <.001
Psychological health								
20s	0.36 (0.02), <.001	0.03 (0.02), .207	0.09 (0.02),<.001	0.57 (0.03), <.001	0.36 (0.03), <.001	0.12 (0.03), <.001	0.00 (0.00), .211	0.04 (0.01), <.001
40s	0.30 (0.02), <.001	0.02 (0.02), .253	0.09 (0.02),<.001	0.55 (0.02), <.001	0.18 (0.02), <.001	0.05 (0.02), .037	0.00 (0.00), .264	0.01 (0.00), .039
60s	0.17 (0.02), <.001	0.01 (0.02), .506	0.07 (0.02),<.001	0.49 (0.03), <.001	0.24 (0.03), <.001	0.18 (0.03), <.001	0.00 (0.00), .512	0.04 (0.01), <.001
Processing speed								
20s	-0.00 (0.01), .750	0.02 (0.02), .219	-0.01 (0.01), .482	0.17 (0.03), <.001	0.36 (0.03), <.001	0.00 (0.04), .989	0.00 (0.00), .542	0.00 (0.01), .989
40s	-0.01 (0.01), .378	0.02 (0.02), .264	0.01 (0.01), .419	0.12 (0.02), <.001	0.18 (0.02), <.001	-0.02 (0.03), .402	0.00 (0.00), .517	-0.00 (0.01). .405
60s	0.03 (0.01), .006	0.01 (0.02), .453	0.03 (0.01), .002	0.19 (0.03), <.001	0.23 (0.03), <.001	-0.12 (0.03), <.001	0.00 (0.00), .463	-0.03 (0.01), .001

Note: Models adjusted for gender and years of education at baseline, and time-varying smoking status, BMI, alcohol consumption, and number of medical conditions. Handgrip and processing speed models were also adjusted for self-rated health. BMI = body mass index.

effects were found. Significant between-person indirect effects were observed for handgrip strength, and physical and psychological health. This indicates that higher average mastery was associated with higher physical activity levels, which in turn was associated with stronger handgrip strength, and better physical and psychological health. An indirect between-person effect was found for the 60s for processing speed. The negative effect indicated that higher average mastery and faster processing speed were associated with lower levels of physical activity for this cohort.

Sensitivity Analysis

Sensitivity analysis was completed to examine effects of missing data on model outcomes. Compared with those who were not included (n = 642), those who included in the final models (n = 6,843) were younger, less likely to smoke or drink at harmful levels, have higher education, SRH, mastery, levels of physical activity, handgrip strength, physical and cognitive functioning scores, and lower BMI and number of medical conditions at baseline (all $p < .001$).

Models in Table 2 were reanalyzed using complete-case data (no missing data on any variables: n = 4,820) to compare potential effects of missing observations on dependent variables. Comparison of full data and complete-case analyses showed no significant differences in patterns of effects across cohorts.

Discussion

Our objective was to examine the relationship between mastery and outcomes commonly used as markers of successful aging. We were interested in the effects of changes in mastery and health outcomes as a consequence of mastery influencing levels of physical activity. A significant, novel contribution of this study is investigation of this indirect relationship at both the between- and within-person level comparing young adulthood, middle-aged adults, and older adults.

Our hypothesis of an indirect between-person relationship between mastery and health outcomes through physical activity was supported for handgrip strength, physical health, and psychological health. These findings are in line with previous research showing that high mastery levels are associated with good health in a large sample of adults aged 25–75 years, as well as being more likely to maintain health over a 9-year period (Gerstorf, Röcke, & Lachman, 2010). Our findings also correspond with notions in health psychology of individual differences in mastery influencing the likelihood of performing health behaviors and the consequences of these behaviors. Those with high sense of control are more likely to engage in behaviors to achieve goals and objectives, such as performing physical activity to maintain or increase health (e.g., Bandura, 1998).

We did not find support of within-person indirect effects of physical activity on any health outcomes. Within-person variance in mastery and physical activity was associated with change in physical and psychological health for all cohorts, and processing speed for the 60s cohort. We also found significant within-person change in mastery and physical activity, indicating that both of these constructs had significant variance, which is consistent with past research (Sargent-Cox, Anstey, & Luszcz, 2012). However, unlike at the between-person level, individual variation in mastery was not associated with corresponding changes in physical activity levels. There is little research on mastery change and accompanying effects on physical activity levels outside of intervention studies; therefore, it is difficult to refer our findings back to the literature. Nevertheless, our findings suggest an important distinction between trait and situational mastery in terms of physical activity levels. Pearlin and colleagues (2007) consider levels of mastery to be based on status, experiences, and perceptions of past mastery over the life course that can fluctuate depending on situations or difficult conditions. Our findings suggest that general levels of mastery are more strongly associated with general levels of physical activity, but that variability in mastery is not related to change in activity over time.

To the extent that we argue mastery influences participation in physical activity, it is possible that a more nuanced test of within-person association of mastery and physical activity is needed to understand this relationship. For example, a recent daily diary study showed that on days when greater activity was performed, subjective well-being was rated higher (Maher et al., 2013). Future research would benefit from examining within-person relationship between mastery and physical activity in more intensive repeated measures design, as well as using time-lag analysis. A further consideration is the notion of mastery within different contexts and domains. A domain-specific measure of task mastery over physical activity and outcomes may be more appropriate in determining the relationship between intraindividual change in mastery and performance of physical activity (Marks & Allegrante, 2005).

We did not find indirect effects at either within-person or between-person levels for the 20s and 40s cohort for processing speed. This is in contrast to a recent meta-analytic review showing physical activity associated with better processing speed in wide adult age ranges (Smith et al., 2010). Our measure of physical activity was broader, where respondents were asked to categorize activities into mildly, moderately, or vigorously energetic. Thus, self-reporting bias may be confounding and weakening associations here. A systematic review of observational (nonintervention) studies

showed an inverse relationship between broader measures of physical activity (frequency, time, and/or type) and risk of dementia. However, the majority (81%) of the 16 studies were conducted on adults aged older than 65, indicating a paucity of research on the association between physical activity and cognitive performance (other than dementia risk) in younger adults. There is a growing literature indicating that physical activity, particularly aerobic activity in midlife, may be protective of neurocognitive decline and dementia risk in later life (Ahlskog, Geda, Graff-Radford, & Petersen, 2011). Together with our lack of findings over an 8-year period for the young and middle-aged adults in the current study, it is suggested that the relationship between physical activity and cognitive functioning may be subtle and does not manifest until later life. Consideration should also be given to the small within-person variance in processing speed found here for the younger cohorts. Further research following younger adults for longer periods of time is needed to examine how physical activity may influence trajectories of other cognitive functioning measures known to be related to dementia and cognitive aging in later life.

In contrast, the 60s cohort did show direct within- and between-person effects of physical activity on cognitive functioning; however, the findings are difficult to interpret. At the within-person level, as would be expected, high physical activity level was associated with a corresponding higher score of processing speed. However, the between-person effect was of the opposite direction; that is, those with higher overall physical activity levels had lower processing speed scores. This is a surprising result based on previous research showing a positive relationship between physical activity and cognitive functioning in later life. It is possible that those with low processing speed, who were inactive, were more likely to drop out than those with high processing speed with low activity.

Although the PATH study boasts high retention rates (Anstey et al., 2012), longitudinal studies have inherent bias introduced through attrition over time. Maximum likelihood estimators with robust standard errors shift some way toward dealing with this bias (MLR; Collins, Schafer, & Kam, 2001; Schafer & Graham, 2002), although our sensitivity analysis suggested that attrition would not have altered the pattern of findings. A further consideration is the three waves of data limiting models to linear trajectories over time. Additionally, we examined directional hypothesis of change in mastery but did not evaluate lead-lag relationships. There is a notion of a reciprocal relationship between health and mastery where there is a dynamic connection across the life course both directly and indirectly (e.g., Lachman, 2006; Skaff, 2007). A recent study found that later life levels of perceived control influenced health trajectories, although initial levels of health did not influence control trajectories, suggesting that levels of control may be the driver of health rather than the other way around (Infurna, Gerstorf, & Zarit, 2011).

In conclusion, our study examined the physical, psychological, and cognitive functional health trajectories of young, mid, and older adults across 8 years to understand the influence of mastery and physical activity levels on health. We found high mastery was associated with better health outcomes, some of which can be attributed to greater physical activity levels. Successful aging and health promotion implications suggest that the construct of mastery is an important psychological resource across the life course. Nevertheless, the relationship between mastery, health behaviors, and successful aging is only helpful if mastery is a malleable construct or resource. Mastery is not considered to be a fixed trait, and its association with socioeconomic status and the exposure to stressors indicates that life experience plays an important role (Pearlin et al., 2007). The malleability of constructs of mastery and self-efficacy has been demonstrated, particularly in relation to interventions to build psychological capital (Luthans, Avey, & Patera, 2008), and our findings confirm that mastery fluctuates across time. This within-person variance in mastery indicates that interventions and training programs would benefit from building task mastery, particularly targeting health management and exercise (Marks & Allegrante, 2005). In the context of the current study, training and health promotion interventions that focus on increasing general and task-specific mastery could improve functional health across the life span through positive health behaviors.

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