

BRIEF REPORT

Tenacious Self-Reliance in Health Maintenance May Jeopardize Late Life Survival

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Although an active pursuit of health goals is typically adaptive, there may be circumstances in very late life when it is not. Our 10-year study of community-dwelling individuals ($n = 220$, 79–98 years-old) examined whether investing substantial effort into personal health (high selective primary control) in the absence of help-seeking strategies (low compensatory primary control) jeopardized survival for very old adults who varied in functional independence (low, high). Cox proportional hazard models showed selective primary control (SPC) predicted 10-year mortality risk for only those with low compensatory primary control (CPC) and high initial functional independence. For these individuals, each standard deviation increase in SPC predicted a 101% higher risk of death. Results are consistent with the lines-of-defense model (Heckhausen et al., 2013) and suggest that, for very old adults with little previous need for help-seeking strategies, tenacious self-reliance (high SPC, low CPC) may have life-shortening consequences.

Keywords: goal engagement, health and aging, mortality, primary control striving

Common wisdom suggests it is beneficial to actively pursue health goals. This perspective is supported by consistent evidence that shows health control behaviors (strategies) facilitate health and well-being for adults across the life span (e.g., Hall, Chipperfield, Heckhausen, & Perry, 2010; Hamm et al., 2015; Shane & Heckhausen, 2016; Wrosch & Schulz, 2008; see Chipperfield, Hamm, Perry, & Ruthig, 2017 and Heckhausen, Wrosch, & Schulz, 2010 for reviews). However, there may be some notable

exceptions to this rule. For instance, it may be counterproductive to invest substantial effort into personal health while disregarding help from others in advanced old age (Heckhausen, Wrosch, & Schulz, 2013; Robinson & Lachman, 2016).

As functional independence declines in late life, older adults may be challenged to adopt approaches to health maintenance that involve increased help-seeking in select areas of functioning rather than simple self-reliance in all domains. This premise is based on Heckhausen, Wrosch, and Schulz (2013) *lines-of-defense* model which posits that very old adults must adjust their use of health control strategies to what is realistic. This may involve changes in both selective and compensatory primary control striving. *Selective primary control* (SPC) refers to strategies that target personal behavioral resources to pursue valued goals (e.g., increase effort or time on task). *Compensatory primary control* (CPC) refers to strategies that target the recruitment of external resources to overcome personal limitations (e.g., seek help from others or use assistive devices).

Heckhausen et al. (2013) suggest that when people experience chronic disease or functional decline (as most very old adults do; Centers for Disease Control and Prevention, 2013), increased use of help-seeking CPC strategies can help prevent disease progression and functional disability. However, some older adults may be reluctant to resort to other people's help because doing so implies giving up (at least some) of their self-reliance and even their autonomy to make decisions about daily activities, both still highly valued in late life (Quirouette & Pushkar, 1999; Ryan & Deci, 2000; Schüz et al., 2016).

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For example, an older man who develops mobility problems is unlikely to seek help from others if a strong need for autonomy has fostered a tenaciously self-reliant approach to health maintenance comprised of high SPC and low CPC. Such an approach could be exacerbated by related cognitions and emotions. For instance, in the event of a fall-induced hip fracture, he may neglect to seek the advice of his doctor and family members, deny his risk of future falls, and insist on ambulating on his own. He may also experience misguided (unrealistic) hope for the future and disregard complimentary cognitive strategies that promote recovery after failure experiences and facilitate disengagement from unobtainable goals (e.g., downgrade the importance of being able to do household chores without assistance). Persevering with this approach could increase his risk of accidents (e.g., a fall that results in a serious hip fracture) and precipitate steep declines in functioning that are associated with reduced longevity (Menec, Chipperfield, & Perry, 1999; Saint Onge, Krueger, & Rogers, 2014).

Consistent with this perspective, previous research suggests there are detrimental consequences for older adults who fail to adapt their control striving and persist with self-reliant approaches to health maintenance. A study by Chipperfield, Perry, and Menec (1999) found very old adults who employed only SPC strategies reported lower health status and more severe chronic health conditions than those who used a combination of strategies. Similar findings emerged in a subsequent longitudinal study by Chipperfield and Perry (2006) that examined SPC in relation to an objective indicator of health care utilization. Their results showed that older men who persisted with self-reliant SPC strategies or disregarded help-seeking CPC strategies were more likely to be admitted to hospital over a 2-year period. These findings provide initial evidence that tenacious self-reliance in health maintenance (high SPC, low CPC) can impact critical health outcomes associated with increased mortality risk in late life (Chipperfield, Perry, Pekrun, Hamm, & Lang, 2017; Menec et al., 1999).

The present study examined the consequences of tenacious self-reliance in health maintenance (high SPC, low CPC) for late-life mortality. In doing so, we assessed whether CPC moderated the influence of SPC on 10-year mortality risk in a sample of very old ($M = 85$) community-dwelling adults drawn from a population-based study. Based on the preceding theory and evidence (Chipperfield et al., 1999, 2006; Heckhausen et al., 2013), we expected that an effort-based pursuit of health goals (SPC) may jeopardize survival for very old adults who were disinclined to seek help from others (low CPC). We examined whether this relationship was further moderated by functional independence since the lines-of-defense model posits that adapting to late life declines represents a major regulatory challenge for older adults (Heckhausen et al., 2013).

Few studies have considered functional independence as a moderator of health control strategies, and it is unclear whether tenacious self-reliance (high SPC, low CPC) should be more detrimental for those who begin late life with low or high functional independence (see Menec & Chipperfield, 1997 and Schilling et al., 2016). On one hand, tenacious self-reliance may be more maladaptive for those with low initial functioning since refusal to employ help-seeking CPC strategies could reflect a failure to adapt to current declines. These individuals may struggle to maintain their health with only effort-based SPC strategies if their preexisting functional limitations make this approach impractical (Heck-

hausen et al., 2010). On the other hand, tenacious self-reliance could be most detrimental for very old adults with high initial functioning who likely had little previous need to adapt their activities or rely on help from others. These highly independent individuals may be unwilling to seek help (even when needed) if a lifetime of autonomy has led to a health maintenance approach entrenched in self-reliance. As a result, they may struggle to adjust to declines in health and functioning when they ultimately occur and may be prone to risky and overambitious SPC striving despite its diminishing efficacy (Heckhausen et al., 2013).

Thus, we assessed a three-way $SPC \times CPC \times$ Functional Independence model to examine whether the association between SPC and mortality risk was moderated by CPC and functional independence. Tests of simple SPC slopes assessed our main hypothesis that effort-based SPC in the absence of help-seeking CPC strategies (tenacious self-reliance) would predict increased mortality risk for very old adults, depending on their functional independence. Additional tests of simple CPC slopes explored whether CPC in the presence of SPC (a combined approach) would predict reduced mortality risk for individuals with high initial functional independence, as implied by the lines-of-defense model (Heckhausen et al., 2013). This permitted a test of whether a more adaptive, combined approach to health maintenance (high SPC, high CPC) was associated with a lower mortality risk than a tenaciously self-reliant approach (high SPC, low CPC) for those with high initial functioning.

Supplemental analyses assessed several potential cognitive and affective correlates of tenacious self-reliance to consider the psychological mindset that may accompany this approach. We expected tenacious self-reliance to be characterized by dysfunctional cognitions (denial-of-risk, limited alternative strategies) and potentially misguided emotions (unrealistic hope).

Method

Participants and Procedures

The present study involved participants from the Aging in Manitoba (AIM) Project who also took part in the satellite Successful Aging Study (SAS; see Chipperfield, Campbell, & Perry, 2004 for a detailed description of SAS and AIM). AIM is one of the largest ($n = 8982$) and longest-running (1971–2006) population-based studies of aging (Chipperfield, Havens, & Doig, 1997). Participants were selected using stratified random sampling procedures and interviewed in 1971, with follow-up interviews conducted in 1983, 1990, 1996, 2001, 2005, and 2006. The SAS project involved conducting interviews with community-dwelling AIM participants (1996, 2003, 2006) to obtain more focused information on psychosocial and health-related variables. This research was approved by Manitoba Health's Health Information Privacy Committee and by the University of Manitoba's Education and Nursing Research Ethics Board.

The sample for the present study was restricted to individuals who participated in SAS 2003 ($n = 232$) because this was the first point at which data were obtained for all variables of interest. Data on the predictor variables and covariates were gathered during face-to-face interviews in 2001–2003. Mortality status was assessed from 2003–2013. Twelve cases were excluded from the analyses because of missing data on the predictor variables or unconfirmed mortality status. Our sample size after exclusions

($n = 220$) was appropriate for the study analyses based on Tabachnick and Fidell's (2013) recommended sample size of $n \geq 144$ in a Cox regression with 12 estimated parameters. Participants were 79–98 years old in 2003 ($M = 85.04$), and the majority were female (63%).

Predictor Variables

Selective primary control strategies (2003). The Health Engagement Control Strategies scale measured SPC (Wrosch, Schulz, & Heckhausen, 2002). Participants rated the extent to which they engaged in three health-related SPC strategies using a five-point scale (1 = *almost never true*, 5 = *almost always true*; $M = 11.77$, $SD = 2.42$, range = 5–15, $\alpha = .82$; e.g., “I invest as much time and energy as possible to improve my health”). See Table 1 for a summary of the study variables.

Compensatory primary control strategies (2003). The Health Engagement Control Strategies scale also measured CPC (Wrosch et al., 2002). Participants rated their use of three health-related CPC strategies using the same five-point scale (1 = *almost never true*, 5 = *almost always true*; $M = 11.62$, $SD = 2.60$, range = 4–15, $\alpha = .71$; e.g., “If I develop a new health problem, I immediately get help from a health professional [e.g., doctor, nurse]”).

Functional independence (IADL, 2001). Functional independence was measured (in AIM 2001) using participant reported capacity to independently perform 12 instrumental activities of daily living (0 = *no*, 1 = *yes*; e.g., doing light housework, preparing a hot meal, shopping). Responses were summed with higher scores indicating greater functional independence ($M = 9.30$, $SD = 2.03$, range = 1–12).

Demographic covariates (2003). Participants provided information on their age ($M = 85.04$, $SD = 4.35$, range = 79–98), gender (1 = *male*, 2 = *female*; 63% female), annual income ($M = 21331$, $SD = 10994$, range = 4800–60000), and years of education ($M = 10.46$, $SD = 2.64$, range = 3–21).

Health status covariate (2003). Participants indicated whether or not (no/yes) they experienced 22 common health conditions (e.g., arthritis, cancer, diabetes, etc.). Each condition was assigned a severity score based on the Seriousness of Illness Rating Scale—Revised (SIRS-R; Rosenberg, Hayes, & Peterson, 1988). A modified approach

was used to arrive at a score for several conditions that did not exist in the SIRS-R (see Chipperfield & Perry, 2006). Participants' scores were summed ($M = 393.55$, $SD = 194.28$, range = 2–965), with higher scores indicating greater severity of chronic conditions and therefore worse health status.

Outcome Variables and Correlates

Mortality (2003–2013). Ten-year mortality status (0 = *alive*, 1 = *deceased*) and date of death was determined from provincial Manitoba Health Registry records and from obituary searches of provincial newspapers and funeral homes that confirmed participants' names, gender, and date of birth. Fifty-five percent (120/220) of participants died between 2003 and 2013.

Denial-of-risk (2003). Denial-of-risk was assessed using a scenario that had participants report the perceived risk of suffering a hip fracture for themselves and for a similar other. The scenario created opportunity for denial-of-risk by asking participants to imagine they experienced a fall that resulted in hospitalization for a serious hip fracture. Participants were then told by a physician in the scenario that, because of uncontrollable factors, the chance of a future fracture was very low. Participants subsequently estimated their own and a similar other's risk of suffering another hip fracture.

Consistent with previous research (Chipperfield et al., 2016), denial-of-risk was assessed by comparing participants' estimates of their own risk (0% = *no chance*, 100% = *100% chance*; $M = 40.10$, $SD = 26.24$, range = 0–100) to the risk of another person in the same situation (0% = *no chance*, 100% = *100% chance*; $M = 46.34$, $SD = 21.92$, range = 0–100). A difference score was calculated by subtracting one's own estimated risk from another's estimated risk (other's risk—own risk). A positive score that reflected seeing less risk for the self than another was interpreted as more denial-of-risk ($M = 5.05$, $SD = 22.07$, range = –70 to 75).

Self-consoling strategy use (2003). Participants were asked to indicate their endorsement of a self-consoling cognitive strategy used in response to general life challenges (0 = *strongly disagree*, 6 = *strongly agree*; $M = 4.28$, $SD = 1.09$, range = 1–6; “When

Table 1
Descriptive Statistics and Correlations

Variables	<i>M</i> or %	<i>SD</i>	Actual range	α	1	2	3	4	5	6	7	8	9	10	11	12
1. Age ^b	84.04	4.35	79–98	—	—											
2. Female ^b	63%	—	1–2	—	.04	—										
3. Income ^b	21,331	10,994	4,800–60,002	—	–.11	–.39*	—									
4. Education ^b	10.46	2.64	3–21	—	–.08	.04	.42*	—								
5. Poor health status ^b	393.55	194.28	2–965	—	.05	.02	–.07	–.11	—							
6. SPC ^b	11.77	2.42	5–15	.82	.04	.07	–.05	.02	–.03	—						
7. CPC ^b	11.62	2.60	4–15	.71	.01	.14*	–.05	.09	.01	.54*	—					
8. IADL ^a	9.30	2.03	1–12	—	–.33*	–.17*	.13	.17*	–.38*	.11	.04	—				
9. Denial-of-risk ^b	5.05	22.07	–70 to 75	—	.06	–.07	.05	.10	–.04	.04	.06	.09	—			
10. Self-consoling strategy ^b	4.28	1.09	1–6	—	–.01	–.05	.07	.16*	–.11	.01	.01	.23*	.12	—		
11. Hope ^b	2.89	1.96	0–6	—	–.09	–.05	.08	.06	–.07	.20*	.07	.22*	.16*	–.04	—	
12. 10-year mortality ^c	55%	—	0–1	—	.21*	–.10	–.02	.00	.17*	.04	–.07	–.18*	.00	–.06	–.04	—

Note. SPC = selective primary control; CPC = compensatory primary control; IADL = instrumental activities of daily living (functional independence).

^a 2001 measure. ^b 2003 measure. ^c 2013 measure.

* $p \leq .05$ (two-tailed tests).

I have not accomplished something important, I console myself by thinking about areas where I had more success”).

Hope (2003). Participants were asked to indicate how often they felt hopeful during the past two days with a single item (0 = *never*, 6 = *very often*; $M = 2.89$, $SD = 1.96$, range = 0–6).

Results

Descriptive statistics and correlations are reported in Table 1. Mortality was positively associated with age ($r = .21$) and poor health status ($r = .17$), and negatively associated with high initial IADL functioning (IADLs; $r = -.18$). As expected, SPC and CPC were positively correlated ($r = .54$). Frequent experiences of hope were associated with higher denial-of-risk scores ($r = .16$) and greater use of self-reliant SPC strategies ($r = .20$).

Main Analyses

Cox proportional hazard regression models were conducted using Mplus 7 to assess whether CPC and IADL functioning moderated the association between SPC and 10-year mortality risk (Cox, 1972; Muthén & Muthén, 1998–2015). Tests of proportional hazards indicated the proportional hazards assumption was met. Because predictor variables were z standardized (except gender), hazard ratios represent effect sizes in standard deviation units. Gender was left in its original metric to facilitate interpretation (1 = *male*, 2 = *female*; see Hayes, 2013). Results indicated that increasing age ($HR = 1.32$, CIs = 1.069–1.625, $p = .010$), being male ($HR = 0.61$, CIs = 0.386–0.952, $p = .030$), having more education ($HR = 1.24$, CIs = 1.048–1.479, $p = .013$), and poor health status ($HR = 1.29$, CIs = 1.039–1.599, $p = .021$) were related to higher mortality risks (see Table 2). Most relevant to our research question, the predicted SPC \times CPC \times IADL interaction was significant ($HR = 0.76$, CIs = 0.651–0.880, $p < .001$).¹

Table 2
Hazard Ratios for 10-Year Mortality

Predictor variables	Hazard ratio	95% CI
Age	1.32**	1.069, 1.625
Female	0.61*	0.386, 0.952
Income	0.90	0.729, 1.109
Education	1.24**	1.048, 1.479
Poor health status	1.29*	1.039, 1.599
SPC	1.24*	1.009, 1.535
CPC	0.81*	0.658, 0.986
IADL	0.99	0.764, 1.282
SPC \times CPC	0.87	0.729, 1.033
SPC \times IADL	1.06	0.867, 1.288
CPC \times IADL	0.81	0.617, 1.064
SPC \times CPC \times IADL	0.76**	0.651, 0.880
Log likelihood	–1,053	
Akaike information criterion	2,132	
n (n event)		220 (120)

Note. All predictors are z standardized with the exception of gender, which has been left in its original metric to facilitate interpretation (1 = male, 2 = female). SPC = selective primary control; CPC = compensatory primary control; IADL = instrumental activities of daily living (functional independence).

* $p \leq .05$. ** $p \leq .01$ (two-tailed tests).

Simple-simple slope analyses probed the interaction by assessing SPC effects at low ($-1 SD$) and high ($+1 SD$) values of CPC and IADLs (Cohen, Cohen, West, & Aiken, 2003; Hayes, 2013). Results supported the main hypothesis and showed SPC predicted mortality risk when CPC was low and initial IADL functioning was high ($HR = 2.01$, CIs = 1.421 to 2.832, $p < .001$). For these individuals, each standard deviation increase in SPC corresponded to a 101% increase in risk of death. This suggests tenacious self-reliance (high SPC, low CPC) may have jeopardized survival for those with high initial IADLs, as illustrated in the Figure 1 survival curves. Figure 1 shows that a tenaciously self-reliant approach (*high SPC*, low CPC; Figure 1 bottom curve) was associated with reduced survival times relative to a low engagement approach (*low SPC*, low CPC; Figure 1 middle curve) for those who began the study with high IADLs. Older adults with high initial IADL functioning who invested substantial effort into personal health (high SPC) in the absence of help-seeking strategies (low CPC) had the shortest survival times.²

SPC did not predict mortality risk when both CPC and initial IADL functioning were low ($HR = 1.03$, CIs = 0.726 to 1.453, $p = .878$). Thus, no evidence was found to suggest that tenacious self-reliance jeopardized survival for those who began the study with low IADL functioning. SPC was also unrelated to mortality risk for older adults with high CPC and low IADLs ($HR = 1.35$, CIs = 0.873 to 2.092, $p = .177$) or high CPC and high IADLs ($HR = 0.86$, CIs = 0.614 to 1.214, $p = .396$).

Additional simple-simple slope analyses probed the three-way interaction by assessing CPC effects at low ($-1 SD$) and high ($+1 SD$) values of SPC and IADLs. The purpose of these analyses was to examine whether CPC in the presence of SPC (a combined approach) predicted reduced mortality risk for individuals with high initial functional independence. This permitted a test of whether a more adaptive, combined approach to health maintenance (high SPC, high CPC) was associated with a lower mortality risk than a tenaciously self-reliant approach (high SPC, low CPC) for those with high initial IADL functioning. As expected, results showed CPC predicted mortality risk only when SPC and initial IADLs were high ($HR = 0.43$, CIs = 0.261 to 0.705, $p = .001$). For these individuals, each standard deviation increase in CPC corresponded to a 57% decrease in risk of death. As depicted in

¹ Although our primary hypotheses concerned how CPC and IADLs should moderate the association between SPC and mortality risk (i.e., a 3-way SPC \times CPC \times IADL interaction was expected), we also anticipated that CPC would moderate the SPC-mortality association independent of the IADLs (i.e., a 2-way SPC \times CPC interaction was expected). The 2-way SPC \times CPC interaction was not significant at $p < .05$. This suggests the SPC-mortality association was not moderated by CPC alone and that future research based on the lines-of-defense model (Heckhausen et al., 2013) should take into account the conjoint influence of CPC and IADLs on relationships between SPC and late life health outcomes.

² Supplemental Cox regression analyses probed the SPC \times CPC \times IADL interaction using a traditional subgroups approach that contrasted participants characterized by low (below median) or high (above median) SPC, CPC, and IADLs. Results of this subgroups approach were consistent with those from the continuous simple-simple slope Cox regressions. SPC (low vs. high) predicted mortality risk for only older adults with low CPC and high IADLs: Risk of death for the *high SPC*-low CPC-high IADL subgroup ($n = 22$) was nearly five times higher ($HR = 4.97$, $p = .001$) than for the *low SPC*-low CPC-high IADL subgroup ($n = 32$). SPC was unrelated to mortality risk for older adults with other combinations of CPC and IADLs (p range = .399 to .948).

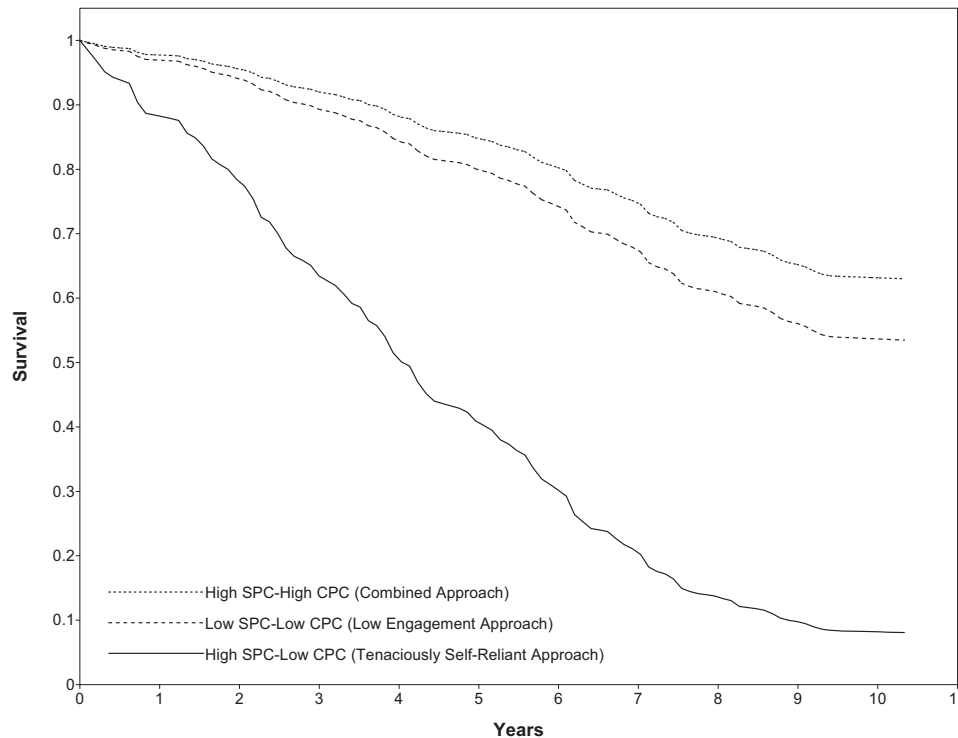


Figure 1. Ten-year survival curves for very old adults with high initial functional independence (IADLs) who combined high selective primary control (SPC) with high compensatory primary control (CPC; combined approach), low SPC with low CPC (low engagement approach), or high SPC with low CPC (tenaciously self-reliant approach). The Cox regression model controlled for age, gender, education, income, and health status.

Figure 1, this suggests that a combined approach (high SPC, high CPC; Figure 1 top curve) was associated with prolonged survival relative to a tenaciously self-reliant approach (high SPC, low CPC; Figure 1 bottom curve) for those with high initial IADLs. Older adults with high initial IADL functioning who combined personal effort (high SPC) with help-seeking (high CPC) had the longest survival times.

Supplemental Analyses

Supplemental OLS regression analyses examined whether tenacious self-reliance was characterized by potentially maladaptive cognitions and emotions. Thus, we assessed whether CPC and initial IADL functioning moderated the influence of SPC on denial-of-risk, self-consoling strategy use, and hope. Results confirmed the SPC \times CPC \times IADL interaction for denial-of-risk ($\beta = -.24$, $SE = .088$, $p = .007$) and self-consoling strategy use ($\beta = .22$, $SE = .067$, $p = .001$) and revealed a marginal interaction for hope ($\beta = -.12$, $SE = .068$, $p = .090$; see Table 3). As expected, simple-simple slope analyses showed SPC predicted marginally more denial-of-risk ($\beta = .30$, $SE = .155$, $p = .057$), less use of self-consoling strategies ($\beta = -.33$, $SE = .133$, $p = .013$), and more frequent experiences of hope ($\beta = .40$, $SE = .134$, $p = .003$) when CPC was low and initial IADL functioning was high.^{3,4}

Discussion

Our study shows that increased (selective primary) control striving for health goals is not always beneficial. Particularly in very late life, tenaciously self-reliant control striving may undermine adaptation to changing realities that call for approaches to health maintenance that combine active goal pursuit with the acceptance

³ SPC was unrelated to these outcomes for older adults with other combinations of CPC and IADLs (p range = .146 to .704) with the exception of individuals with high CPC and high IADLs, for whom SPC predicted increased use of self-consoling strategies ($\beta = .26$, $SE = .134$, $p = .047$).

⁴ Exploratory logistic regression analyses assessed a SPC \times CPC \times IADL model to examine whether SPC predicted objective 4-year functional declines (personal care home admission) for those with low CPC and high initial IADLs. Personal care home entry can be considered an objective indicator of functional decline since admission is restricted to older adults who require significant assistance with everyday activities (e.g., those with a physical disability; see Martens et al., 2003; Thomeer, Mudrazija, & Angel, 2015). Results of the logistic regression model indicated the SPC \times CPC \times IADL interaction was significant ($OR = 0.42$, $p = .011$). Consistent with our main findings, simple-simple slope analyses that probed the interaction showed SPC predicted higher odds of care home admission only when CPC was low and initial IADL functioning was high ($OR = 2.98$, $p = .027$). This suggests tenacious self-reliance (high SPC, low CPC) may have undermined functional independence for those who began the study with high IADLs. SPC was unrelated to care home admission status for older adults with other combinations of CPC and IADLs (p range = .105 to .484).

Table 3
Regression Coefficients for Denial-of-Risk, Self-Consoling Strategy Use, and Hope

Predictor variables	Denial-of-risk		Self-consoling strategy		Hope	
	Estimate	SE	Estimate	SE	Estimate	SE
Age	.11	(.078)	.07	(.070)	-.03	(.071)
Female	-.13	(.177)	-.09	(.154)	.02	(.156)
Income	-.02	(.092)	-.02	(.080)	.06	(.081)
Education	.13	(.084)	.09	(.076)	.02	(.077)
Poor health status	.01	(.079)	.04	(.071)	.03	(.072)
SPC	.01	(.086)	-.03	(.079)	.21**	(.080)
CPC	.08	(.086)	-.01	(.080)	-.03	(.080)
IADL	.23*	(.096)	.07	(.092)	.27**	(.093)
SPC × CPC	.02	(.075)	.08	(.066)	-.06	(.067)
SPC × IADL	.06	(.084)	.00	(.077)	.02	(.078)
CPC × IADL	-.08	(.090)	.09	(.086)	-.11	(.088)
SPC × CPC × IADL	-.24**	(.088)	.22**	(.067)	-.12 [†]	(.068)

Note. All predictors are z standardized with the exception of gender, which has been left in its original metric to facilitate interpretation (1 = male, 2 = female). SPC = selective primary control; CPC = compensatory primary control; IADL = instrumental activities of daily living (functional independence).
[†] $p \leq .10$. * $p \leq .05$. ** $p \leq .01$ (two-tailed tests).

and use of others' help (Heckhausen et al., 2013). Supporting this premise, effort-based goal striving (high SPC) in the absence of help-seeking strategies (low CPC) predicted higher 10-year mortality risk for very old adults with high initial functional independence: Each standard deviation increase in SPC predicted a 101% higher risk of death for those with low CPC and high initial functioning.

These findings are consistent with past studies that show self-reliant control striving in late life is associated with lower health status, more severe chronic health conditions, and increased risk of hospital admissions (Chipperfield et al., 1999; Chipperfield & Perry, 2006; see also Hamm et al., 2014). Results also provide indirect support for the lines-of-defense model (in relation to objectively assessed mortality status) that posits very old adults who experience chronic disease or functional losses need to adapt their control striving to what is realistic (Heckhausen et al., 2013).⁵ Such an approach typically includes increased use of help-seeking CPC strategies which can help prevent disease progression and functional losses.

Our supplemental results provide some initial insight into the psychological mindset that may accompany tenacious self-reliance. For those who began late life with high functional independence, tenacious self-reliance (high SPC, low CPC) was characterized by dysfunctional cognitions (denial-of-risk, few alternate strategies) and potentially misguided emotions (unrealistic hope). This mindset may sustain reliance on effort-based SPC strategies despite their declining efficacy and result in older adults neglecting to seek needed assistance from family members and medical professionals. Such an approach may also increase the risk of accidents and acute health events (e.g., fall-induced hip fractures; cf., Chipperfield & Perry, 2006) that can precipitate steep functional declines and lead to earlier mortality (Menec et al., 1999; Saint Onge et al., 2014). However, further research is needed to systematically examine psychological and behavioral process variables that mediate the effects of tenaciously self-reliant control striving on late life mortality.

Factors that contribute to the development of tenacious self-reliance also warrant further scrutiny. Our finding that tenaciously self-reliant SPC striving increased mortality risk for only very old

adults with high initial functional independence suggests that autonomy may play a role (see Fiske & O'Riley, 2016). Extended functional independence may foster a strong need for autonomy that becomes increasingly difficult to relinquish in very late life (even in part). An exaggerated need for autonomy may in turn contribute to an overly self-reliant approach to health maintenance that disregards seeking help from others at all costs (O'Riley & Fiske, 2012). Older adults who experience earlier functional losses may be less prone to develop or persist with such a tenaciously self-reliant approach if having already given up some independence makes them more open to help-seeking when it is most needed in very late life. This logic is consistent with our finding that, for those with low initial functional independence and low CPC, self-reliant SPC striving did not predict dysfunctional cognitions (denial-of-risk, few alternate strategies) and potentially misguided emotions (unrealistic hope) that may sustain this approach.

Although our study shows that tenacious self-reliance in very late life has detrimental consequences, it also points to the benefits of a more tempered form of self-reliance. Specifically, individuals with high initial functioning who combined personal effort (high SPC) with help-seeking (high CPC) had the longest survival times (see Figure 1). These findings are consistent with the lines-of-defense model that highlights the need for combined approaches to health maintenance in very late life (Heckhausen et al., 2013). Results are also in line with previous research that suggests such combined approaches are associated with less depressive symptoms, decreased chronic conditions, and reduced diurnal cortisol secretion for older adults (Wrosch & Schulz, 2008; Wrosch et al., 2007).

⁵ Repeated assessments of the health engagement control strategies (SPC and CPC) were not available in the SAS study. Hence, support for the lines-of-defense model was indirect because we were not able to examine theoretical propositions that concern the step-by-step process of how older adults adapt their SPC and CPC in relation to losses in functional independence.

Strengths, Limitations, and Future Directions

Our study has several strengths. First, the lines-of-defense model that informed our study is situated within the motivational theory of life span development (Heckhausen & Schulz, 1995; Heckhausen et al., 2010), which is based on over two decades of empirical evidence. Second, our SAS sample was drawn from the population-based AIM study that contains data from a representative sample of very old community-dwelling adults, which enhances the generalizability of our findings. Third, our objective outcome measure (mortality) was based on highly reliable records from the provincial Manitoba Health Registry that tracked participants over a 10-year period.

One limitation of our study was that the cross-sectional psychological correlate measures did not lend themselves to tests of mediation. As described above, future research is needed to examine psychological and behavioral process variables that mediate the effects of tenaciously self-reliant control striving on late life mortality. A second limitation of our study was that repeated assessments of the health engagement control strategies (SPC and CPC) were not available in the SAS study (i.e., only 2003 data were available). Thus, we were not able to test certain propositions from the lines-of-defense model (Heckhausen et al., 2013) that concern the step-by-step process of how very old adults adapt their SPC and CPC in relation to losses in functional independence.

Future research should assess concurrent changes in these measures over time. This would provide insight into whether highly independent older adults who rely on only effort-based SPC strategies fail to seek needed help (increase CPC) when functioning begins to decline. Initial research in this area suggests that, for older adults with macular degeneration, functional losses trigger a decrease in effort-based SPC strategies and an increase in help-seeking CPC strategies (Schilling et al., 2013; Wahl et al., 2007). Such shifts in control striving should be adaptive according to the lines-of-defense model (Heckhausen et al., 2013), but research is needed to test this proposition. If empirical evidence supports this premise, theory-based interventions to promote combined approaches to health management (e.g., increase SPC and CPC) could be developed and administered to very old adults at the onset of functional decline.

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