I Think I Can – The Association Between Control Beliefs and Activity Engagement in the Second Half of Life

by

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Abstract

Activity engagement, for example, participation in social, physical, and mental activities, is often considered a hallmark of successful ageing and is associated with a range of positive outcomes in emotional, cognitive, and physical domains. Despite the benefits of remaining active in later life, activity engagement tends to decline with age. A comprehensive understanding of the factors that correlate with activity is required as a first step in developing interventions to facilitate engagement. Control beliefs, a type of psychological resource that includes perceived control and self-efficacy, may play an important role in protecting against age-related activity decline. Individuals with greater control beliefs have greater confidence in their ability to achieve outcomes and may be more likely to choose difficult activities, show persistence, and employ strategies to overcome barriers to activity. This thesis used secondary analysis of three datasets and primary data from a cross-sectional survey to examine whether reliable associations exist between control beliefs and activity in midlife and older adults. The research addresses gaps in the literature and makes an original contribution to knowledge by using multiple time scales, examining non-physical (and physical) activity, and examining possible processes underlying the control–activity associations.

The first study used cross-lagged autoregressive modelling with data from the German Ageing Survey to examine reciprocal longitudinal associations between perceived control and social activity. Perceived control was shown to significantly predict social activity 3 years later. Reciprocally, social activity predicted perceived control 3 years later. The influence of perceived control on social activity was greater than the influence of social activity on perceived control.

The second study used multilevel growth curve modelling with data from the Australian Longitudinal Study of Ageing to examine whether perceived control moderated the effects of functional limitation on 18-year trajectories of social activity. Results indicated that having greater baseline functional limitation was associated with less social activity and greater decline in social activity for those with lower perceived control, but not for those with higher perceived control.

The third study complements longitudinal research by using daily diary data from a sample of midlife and older adults to examine short-term within-person covariation between self-efficacy and activity. Results from multilevel modelling analyses indicated that participants reported engaging in more social and physical (but not mental) activity on days when self-efficacy was higher.

The fourth and final study used structural equation modelling with data from a new cross-sectional survey to examine perceived ease of activity and use of selection, optimisation, and compensation (SOC) strategies as possible mechanisms underlying the relationship between self-efficacy and activity in midlife and older adults. Perceived ease of activity, but not SOC strategies, was found to mediate the associations of self-efficacy with social and physical (but not mental) activity.

This thesis helps to build a comprehensive understanding of the association between control beliefs and activity in older adults. The findings suggest that control beliefs may play an important role in enabling older adults to maintain more activity as they age and have the potential to inform the development of programs aimed at promoting active ageing.

Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed…………………………

Rachel G. Curtis

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CHAPTER

1

INTRODUCTION

1.1 Background

Population ageing has become increasingly evident worldwide over recent decades. Lower fertility and declining mortality rates have caused the growth rate of the population aged 60 or older to exceed that of the total population (Australian Bureau of Statistics, 2012; United Nations, 2015). This demographic shift was first observed across developed countries in the late nineteenth and early twentieth centuries, and has since been occurring in many developing nations (United Nations, 2015). Globally, the proportion of adults aged over 60 years was one in 15 in 1950, one in 10 in 2000, and one in eight in 2015 (United Nations, 2002, 2015). This trend is set to continue, as older adults are projected to account for one in six people by 2030, and one in five by 2050, presenting one of the most significant social issues of this century (United Nations, 2015). Such developments are also occurring in Australia. Between 1995 and 2015, the proportion of Australia's population aged 65 years and over increased from 12% to 15%, while the proportion of the population aged 85 years and over increased from 1% to 2% (Australian Bureau of Statistics, 2015). It is projected that the proportion of the population aged 65 years and over could rise to 22% in 2061 and 25% in 2101, while the proportion of the population aged 85 years and over could rise to 5% in 2061 and 6% in 2101 (Australian Bureau of Statistics, 2012).

Population ageing offers various benefits for individuals and the community. For example, individuals are not only living longer, but are also enjoying better health than previous cohorts (e.g., Manton, Gu, & Lamb, 2006; Manton, Gu, & Lowrimore, 2008) and often experience greater emotional well-being than their younger counterparts (e.g., Carstensen et al., 2011; Mead & Cummin, 2008), at least prior to the few years preceding death (Gerstorf, Ram, Rocke, Lindenberger, & Smith, 2008). In addition, older adults represent an increasing pool of volunteers and provide both formal and informal caring and other supportive and productive services (e.g., de Vaus, Stanton, & Gray, 2003; Wilkinson & Bittman, 2002). Nonetheless, an increase in the number of older adults in the population increases demand for the prevention and treatment of age-related disease and disability. This has the potential to put significant strain on health care systems, particularly since the number of workers per older person declines in an ageing population (United Nations, 2015). An increased focus of public policy on understanding and reducing the impact of population ageing can be seen in the development of broad policy frameworks such as 'active ageing' that aims to promote a holistic approach to enhancing quality of life for older adults through optimizing opportunities for health, community participation, and financial and physical security (World Health Organization [WHO], 2002).

A key theme across recent policy discourse is the need for older adults to continue participation in their activities. Although focus has typically been on maintaining labour force participation, there is increasing recognition of the importance of social participation and leisure activity for maintaining well-being in older age (see Avramov & Maskova, 2003; Boudiny, 2013 for discussion). Employment can provide opportunities for engagement that contribute to health and well-being, for example, social integration and goal-striving in personally meaningful roles; however, these opportunities may be lost after the transition to retirement (see e.g., Jonsson, Josephsson, & Kielhofner, 2001; M. Wang, Henkens, & van Solinge, 2011 for discussion). With individuals living longer after retirement, engagement in alternative activities becomes even more important for maintaining health and well-being; however, research shows that older adults tend to participate in less activity as they age (see 1.2.3 Age-Related Trends in Activity). A comprehensive understanding of the factors that correlate with activity is required as a first step in developing interventions to promote engagement in older adults.

This thesis argues that perceived control is an important psychological resource that has the potential to promote adaptive beliefs and behaviours and increase activity engagement in older adults. This chapter outlines (a) the definition of, benefits of, and age-related trends in activity; (b) the definition of perceived control and mechanisms through which it might promote activity engagement; (c) previous research exploring associations between perceived control and activity in older adults; and (d) the research objectives. Chapters 2 to 5 use secondary analysis of three existing datasets and primary data from a new cross-sectional survey to examine how control beliefs are associated with activity. The final chapter discusses the overall conclusions and implications of the thesis, and suggests avenues for future research.

1.2 Activity Definition, Benefits, and Trends

1.2.1 Definition of Activity

Activity can be defined as goal-directed actions or behaviours that are pursued in order to fulfil needs or to attain broader life goals, aspirations, and life satisfaction (Chapin, 1971; Horgas, Wilms, & Baltes, 1998). In activity and ageing research, activities are commonly classified as either obligatory or discretionary (e.g., M. M. Baltes, Mayr, Borchelt, Maas, & Wilms, 1993; Horgas et al., 1998; Moss & Lawton, 1982). This distinction has a long history in the social sciences, and broadly reflects the degree of choice people have in performing the activity (e.g., Chapin, 1971; Chapin & Brail, 1969). Obligatory activity is that which is required for basic personal maintenance such as sleeping and personal care, as well as instrumental activities such as work, housework, and grocery shopping (Chapin & Brail, 1969). Conversely, discretionary activity is characterized by a greater degree of choice, and can include leisure activity such as physical and social activities, hobbies, and other recreation, as well as volunteering and religious activities (e.g., Chapin & Brail, 1969; Moss & Lawton, 1982). Whereas obligatory activities are necessary for daily living, active engagement with discretionary pursuits is often considered a hallmark of successful ageing and is associated with numerous positive outcomes for older adults (see 1.2.2 Benefits of Activity). This research therefore focusses on discretionary activity, examining social, physical, and mental activities. Throughout the thesis, the term 'activity' refers generally to all discretionary activity. Types of activity (i.e., social, physical, and mental activity) are specified as required.

1.2.2 Benefits of Activity

Over the past few decades, a number of theories have aimed to describe developmental changes in activity engagement that occur with ageing, and how activity participation (or non-participation) contributes to older adults' ability to adapt to the challenges of growing older. One of the earliest theories of activity, disengagement theory, suggested that older adults withdraw from society and decrease their social interaction over time in a universal process that promotes acceptance and life satisfaction in the lead up to death (Cumming & Henry, 1961). According to disengagement theory, age-associated losses in personal resources and abilities make it difficult for older adults to maintain norms and obligations in their social roles. By gradually withdrawing from these roles, older adults are freed from increasingly unattainable expectations and are better able to maintain their self-image and morale and engage in positive self-reflection (Cumming & Henry, 1961). As one of the first formal attempts at describing patterns of engagement in older adults, disengagement theory was highly influential; however, it was widely criticized for ignoring individual variability in patterns of activity and being contrary to evidence that many older adults remain engaged in activities into later life (see e.g., Achenbaum & Bengtson, 1994; Hochschild, 1975).

In direct contrast to disengagement theory, activity theory suggests that remaining actively engaged is key to well-being in older age (Havighurst, 1961). It is argued that individuals should strive to maintain their activities for as long as possible. When activities or social roles must be relinquished (i.e., due to changes associated with ageing), individuals can maintain a positive self-image by engaging in alternative activities and interests (Havighurst, 1961). Continuity theory (an extension of activity theory) also posits that active engagement is important for satisfaction in late life, but emphasizes the benefits of role continuity between middle and older age. Although some change in activity over time is not considered maladaptive, it is thought that older adults generally strive to modify or closely replace activities in order to maintain similar activity patterns and preserve longstanding social roles and relationships (Atchley, 1989). This continuity fosters a consistent self-identity, which helps individuals adapt to physical and cognitive changes associated with ageing, and promotes purpose in life and life satisfaction (Atchley, 1989).

Theories of activity and ageing continue to develop, with innovation theory recently suggesting that engaging in new activities after retirement through processes of self-preservation innovation and self-reinvention innovation may help to maintain or restore a sense of meaning and purpose that can be lost after this major life transition (Nimrod & Kleiber, 2007). Self-preservation innovation occurs when individuals engage in activities that are consistent with earlier interests and experiences, such as beginning new activities that are closely related to relinquished activities, or developing the skills or alternative pathways required to maintain an old activity. Conversely, self-reinvention innovation occurs when individuals participate in new types of activity and experiences. Both forms of innovation are thought to be adaptive and to promote meaning in later life (Nimrod & Kleiber, 2007), though the use of self-preservation innovation has been shown to be more closely related to having a larger leisure repertoire and greater life satisfaction (Nimrod, 2016).

The view that continued activity and social engagement are important in older age is reflected in a number of conceptually overlapping paradigms such as active ageing (e.g., WHO, 2002), positive ageing (e.g., Gergen & Gergen, 2001), ageing well (e.g., Fries, 1989), and successful ageing (e.g., Rowe & Kahn, 1997), and has resulted in considerable research highlighting relationships of activity with specific positive outcomes. For example, research has shown that greater overall activity is related to better psychological well-being in older adults, including greater life satisfaction and happiness (Menec, 2003; Menec & Chipperfield, 1997) and fewer symptoms of depression (Herzog, Franks, Markus, & Holmberg, 1998). In addition, greater activity is associated with a reduced risk of cognitive decline (Bosma et al., 2002), dementia (see Fratiglioni, Paillard-Borg, & Winblad, 2004 for review), physical limitation (Hicks & Siedlecki, 2017), and mortality (Menec, 2003; Paganini-Hill, Kawas, & Corrada, 2011).

Research has also demonstrated relationships of specific types of activity with positive outcomes. For example, research has shown that individuals who report greater social activity tend to report greater happiness, life satisfaction, and positive affect (Huxhold, Miche, & Schüz, 2014; Menec, 2003), and show reduced rates of motor decline (Buchman et al., 2009), disability (James, Boyle, Buchman, & Bennett, 2011), cognitive decline (James, Wilson, Barnes, & Bennett, 2011), and dementia (H.-X. Wang, Karp, Winblad, & Fratiglioni, 2002). Similarly, individuals who report greater physical activity tend to report greater life satisfaction (Kim, Lee, Chun, Han, & Heo, 2016; Menec & Chipperfield, 1997) and better psychological well-being (Kim et al., 2016; Ruuskanen & Ruopilla, 1995) and self-rated health (Ruuskanen & Ruopilla, 1995). Participation in mental activity is also associated with better cognitive functioning (Lin, Heffner, Mapstone, Chen, & Porsteisson, 2014) and a reduced risk of dementia (Verghese et al., 2003). Furthermore, social, physical, and mental activities are all associated with reduced rates of mortality in older adults (Glass, Mendes de Leon, Marottoli, & Berkman, 1999; Jacobs, Hammerman-Rozenberg, Cohen, & Stessman, 2008). Unsurprisingly, older adults highly value maintaining an active lifestyle and view social and other leisure activity as a central component to well-being in old age (e.g., Bowling, 2008; Knight & Ricciardelli, 2003; Reichstadt, Sengupta, Depp, Palinkas, & Jeste, 2010).

1.2.3 Age-Related Trends in Activity

Although a vast literature highlights the potential benefits of remaining active, both cross-sectional (e.g., Horgas et al., 1998; Paillard-Borg, Wang, Winblad, & Fratiglioni, 2009) and longitudinal research (e.g., Agahi, Ahacic, & Parker, 2006) suggest that overall activity participation declines at older ages. In addition, research has shown age-related declines in specific activities. For example, physical activity is lower at older ages (Ruuskanen & Ruopilla, 1995; Sims et al., 2014) and tends to decline over time (e.g., Bijnen, Feskens, Caspersen, Mosterd, & Kromhout, 1998; Janney, Cauley, Cawthon, & Kriska, 2010). Although some studies suggest social activity is relatively stable (Hoppmann, Gerstorf, & Luszcz, 2008; Hultsch, Hertzog, Small, &

Dixon, 1999), others suggest social activity does decline (Aartsen, Smits, van Tilburg, Knipscheer, & Deeg, 2002; Stanley & Freysinger, 1995; P. A. Thomas, 2011), particularly in the oldest-old (e.g., Bukov, Maas, & Lampert, 2002; Janke, Davey, & Kleiber, 2006).

Reductions in activity can occur due to a range of factors such as functional limitation (Janke et al., 2006), reduced mobility (Agahi et al., 2006), sensory impairment (Marsiske, Klumb, & Baltes, 1997; Viljanen, Törmäkangas, Vestergaard, & Andersen-Ranberg, 2014), or driving cessation (Marottoli et al., 2000). Although significant functional loss may not be considered a part of normal ageing, risk factors for declining activity cannot always be prevented. Some decline in activity is therefore expected, particularly in fourth age (or oldest old) when limitations in psychological, cognitive, and physical resources tend to become more evident (P. B. Baltes & Smith, 2003). Nonetheless, understanding protective factors that facilitate activity in older adults is important for developing interventions to promote active ageing and enable older adults to maintain activity as much as possible in older age.

Research suggests a range of factors have the potential to promote activity engagement in older adults, such as lower age, a higher level of socioeconomic status, better cognitive functioning, and better health and physical functioning (e.g., Agahi et al., 2006; Buchman et al., 2009; Janke et al., 2006; Paillard-Borg et al., 2009); however, these factors are not readily modifiable. Perceptions of control represent a specific type of potentially modifiable psychological resource that may play an important role in protecting against age-related declines in activity. Perceived control is suggested to have important consequences for health, functioning, and adaptation to the challenges associated with ageing through a range of affective, behavioural, motivational, and physiological processes (see 1.3.2 Rationale for the Relationship between Control Beliefs and Activity). Through these processes, control beliefs may also facilitate activity participation amidst the changes and challenges experienced in older age.

1.3 Control Beliefs

1.3.1 Definition of Control Beliefs

Research related to perceptions of control has a long history in sociology and psychology, with belief in one's ability to control the environment represented by a range of constructs over the last few decades (see Lachman, Neupert, & Agrigoroaei, 2011; Skinner, 1995 for review). Early research argued that humans have an intrinsic motivation to create effects on and control their environment, proposing concepts including effectance motivation (R. W. White, 1959), the need for competence (Deci, 1975; Deci & Ryan, 1985), and mastery motivation (Harter, 1981; Morgan & Harmon, 1984). Initial conceptions of control beliefs describe beliefs about whether reinforcement, or positive outcomes, are contingent on one's own behaviour (internal control) or are caused by external forces and thus independent of one's behaviour (external control; e.g., Lefcourt, 1966; Rotter, 1966). An important distinction was later drawn between beliefs of personal control, reflecting perceived ability to exercise control in one's life, and control ideology, which describes beliefs about the role of internal and external forces in determining the attainment of positive outcomes (Gurin, Gurin, & Morrison, 1978).

Contemporary approaches to studying control beliefs describe more nuanced relationships between the self (agent), behaviours (means), and desired outcomes (ends; Skinner, 1996). There exist a number of conceptually overlapping constructs representing beliefs about specific relations between these components. Agent–ends beliefs refer to the perceived ability to intentionally produce desired outcomes, encompassing constructs such as perceived control (Skinner, 1995), sense of control (Abeles, 1991), and personal control (Gurin et al., 1978; see Skinner, 1996 for discussion). Agent–ends beliefs do not typically refer to beliefs about one's means or ability to perform the specific behaviour required to achieve the outcome, although such beliefs could perhaps be inferred. In contrast, agent–means beliefs describe expectations about the extent to which one possesses the required means (e.g., is able to successfully perform the behaviour) to produce the desired outcome, encompassing constructs such as self-efficacy (Bandura, 1977) and perceived competence (Weisz & Stipek, 1982; see Skinner, 1996 for discussion).

Control beliefs can also refer exclusively to means–ends beliefs, which are expectations about the extent to which certain behaviours produce outcomes (Skinner, 1996). This is conceptually akin to locus of control beliefs (Rotter, 1966) and the ideology component of control beliefs identified by Gurin et al. (1978). Although means–ends beliefs are somewhat intertwined with agent–means and agent–ends beliefs, it has been suggested that means–ends beliefs do not affect behaviour in the same way as agent–means and agent–ends beliefs (Gurin et al., 1978; Skinner, 1996). Means–ends beliefs, or contingency beliefs, reflect an individual's views of the world but not of themselves. Even if the individual believes that a behaviour will produce a desired outcome, they are unlikely to attempt to perform the behaviour without positive beliefs about their own capability (Bandura, 1977). Conversely, beliefs that one can produce desired outcomes (agent–ends beliefs) or perform behaviours required to produce desired outcomes (agent–means beliefs) imply perceived contingency between the behaviour and outcome, and are more powerful predictors of behaviour than means–ends beliefs alone (Skinner, 1996). This thesis therefore focusses on perceptions of personal control, viewing agent–means and agent–ends beliefs as factors that have the potential to influence activity in older adults. The terms self-efficacy and perceived control are used to reflect these beliefs, as they are most commonly used in the literature. Although there are nuanced differences between self-efficacy and perceived control, the terms can be considered somewhat interchangeable in the context of this thesis. It is argued that both self-efficacy and perceived control affect older adults' activity engagement in a similar, positive way (see 1.3.2 Rationale for the Relationship between Control Beliefs and Activity). In addition, measures used to examine control beliefs often include a combination of agent–means beliefs and agent–ends beliefs, and a distinction is not always clear in the construct labels used to describe them (this limitation of research on control beliefs is further discussed in Chapter 6). When previous research is discussed, the terminology employed by the relevant study is used.

It is important to distinguish between perceived, or subjective, and objective control. Objective control refers to actual control, or one's true ability to achieve outcomes (Skinner, 1996). Objective control can have considerable influence on individuals' activity; for example, severe functional limitation can prevent activities that require considerable physical resources. This thesis examines only perceived control as a potentially modifiable psychological resource that is suggested to have antecedents and consequents that are independent of objective control, and to be a more important predictor of outcomes than objective control (see e.g., Skinner, 1996 for discussion). There is considerable focus on control beliefs in the gerontological literature, with perceived control shown to be associated with a variety of positive outcomes (e.g., Lachman et al., 2011), as described below.

1.3.2 Rationale for the Relationship between Control Beliefs and Activity

Perceived control is suggested to have important consequences for health, functioning, and adaptation to the challenges associated with ageing through a range of affective, behavioural, motivational, and physiological processes (see e.g., Lachman, Agrigoroaei, & Rickenbach, 2015; Lachman et al., 2011; Robinson & Lachman, 2017). For example, research indicates that individuals with greater control beliefs experience a reduced physiological response to certain stressors (Neupert, Almeida, & Charles, 2007) and are more effective at eliciting social support, as compared to individuals with lower control (Gerstorf, Röcke, & Lachman, 2011). There is an extensive body of research linking sense of control with positive outcomes such as life satisfaction (Berg, Hassing, Thorvaldsson, & Johansson, 2011; Gerstorf et al., 2014), morale, self-esteem (Luszcz, 1996), cognitive ability (Lachman & Andreoletti, 2006; Windsor & Anstey, 2008), physical health and functioning, (e.g., Gerstorf et al., 2011; Infurna & Gerstorf, 2014), and longevity (Anstey, Luszcz, & Andrews, 2002; Infurna, Gerstorf, Ram, Schupp, & Wagner, 2011).

In addition, perceived control has been found to protect against the negative effects of stress on emotional well-being in older adults (Roberts, Dunkle, & Haug, 1994), and the negative effects of low socioeconomic status on health, life satisfaction, and depressive symptoms in adults aged 25 to 75 years (Lachman & Weaver, 1998a).

Perceived control may also play an important role in facilitating older adults' activity participation. Social cognitive theory suggests that self-efficacy is a major determinant of behaviour because individuals are more likely to choose behaviours that they believe they are capable of, engaging in challenging behaviours if they believe they can cope with them and avoiding situations that they interpret as threatening (Bandura, 1977, 1997). Similarly, the theory of planned behaviour asserts that, along with positive attitudes towards the behaviour and subjective norms (i.e., perceived attitudes and pressure from others), perceived behavioural control is a strong predictor of behavioural intentions, which in turn predict actual behaviour (Ajzen, 1991). Individuals with higher perceived control tend to evaluate their goals as challenges rather than threats and experience more positive emotional states during goal-related activity than individuals with lower perceived control (Snyder et al., 1991). Perceptions of task difficulty; a construct shown to be related to but distinct from self-efficacy (Rodgers, Conner, & Murray, 2008), are based on the congruence between perceived task demands and personal abilities and resources (Klumb, 2001). As individuals with higher self-efficacy perceive greater personal abilities, they may anticipate that desired activities will be achievable and therefore be more likely to engage in these activities. In addition, the broaden and build theory of positive emotions suggests that positive emotional states prompt individuals to engage with the environment, to explore, and to consider and pursue novel and spontaneous experiences (Fredrickson, 1998). Together, these theories suggest that older adults with higher perceived control may choose to participate in a greater range of activities, including difficult and unfamiliar activities, while those with lower perceived control may view challenging or unfamiliar activities as threats to avoid.

Perceived control may be particularly relevant for older adults who experience barriers to activity participation because it promotes effective self-regulation through the use of adaptive strategies (Lachman, 2006). The theory of selective optimization with compensation (SOC) suggests that successful coping and adaptation involves 1) selecting and prioritizing goals and activities, 2) optimizing means or resources using strategies such as increasing time or effort, and 3) compensating using alternative means or resources to achieve goals when previous means become limited (P. B. Baltes & Baltes, 1990). Perceptions of control affect how individuals utilize existing resources (Skinner, 1995), influencing how much effort they expend, how long they persist, and how they solve problems and devise strategies to overcome challenges (Ajzen, 1991; Bandura, 1997; Snyder et al., 1991). Individuals with high perceived control initiate goal-directed behaviour, show effort, persistence, and optimism, and recover more quickly from setbacks, whereas individuals with low perceived control are more likely to withdraw from difficult situations (Bandura, 1997; Skinner, 1996). Therefore, individuals with higher perceived control may engage in more effective optimization and compensation by increasing their effort or finding alternative ways to enable activity participation when faced with challenges such as declines in physical functioning.

Finally, it is important to distinguish between domain-specific and general perceived control. Measures of domain-specific control beliefs examine beliefs related to one's ability to control a specific aspect of their life (e.g., cognition or health) or perform a specific behaviour (e.g., exercise or social activity; Lachman & Andreoletti, 2006; Lachman & Weaver, 1998b; Perkins, Multhaup, Perkins, & Barton, 2008). In contrast, measures of general control beliefs address broader beliefs about one's ability to achieve goals and solve problems (see Schwarzer & Jerusalem, 1995 for example). It is argued that control beliefs are most predictive of outcomes when measurement items are specifically related to the behaviour or goal (e.g., Bandura, 1997; Lachman, 1986). This thesis uses general measures of self-efficacy and perceived control and might therefore be expected to show relatively weaker associations between perceived control and activity in older adults. However, if general perceived control is found to be related to activity, this suggests the possibility that interventions targeting general perceived control may be effective for promoting engagement in multiple types of activity. General perceived control therefore represents a possible target for intervention that has the potential to be more effective in increasing activity engagement than interventions targeting domain-specific control; increases in general perceived control are likely to have positive effects across multiple domains of functioning, whereas domain-specific control beliefs may have positive effects in only one domain. This is further discussed in Chapter 6.

1.4 Literature Review

This section describes previous research on the relationship between control beliefs (self-efficacy and perceived control) and activity in older adults. Studies included in the review are grouped by research design; cross-sectional, longitudinal, and microlongitudinal. Strengths and limitations of the research are discussed, and directions for future enquiry are outlined.

1.4.1 Cross-Sectional Research on Control Beliefs and Activity

Analyses of cross-sectional data support the notion that perceptions of control are related to activity in older adults. General self-efficacy and perceived control have been shown to be related to social (M. M. Baltes, Wahl, & Schmid-Furstoss, 1990; Jopp & Hertzog, 2007) and physical activity (Infurna & Gerstorf, 2014; Langan & Marotta, 2000). Research has also shown associations of domain-specific perceptions of control with relevant activities. For example, social self-efficacy and self-efficacy for physical activity have been found to be related to social and physical activity, respectively (e.g., Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Cerin, Vandelanotte, Leslie, & Merom, 2008; Conn, 1998; Mullen, McAuley, Satariano, Kealey, & Prohaska, 2012; Orsega-Smith, Payne, Mowen, Ho, & Godbey, 2007; Perkins et al., 2008; Resnick, Orwig, Magaziner, & Wynne, 2002; Thornton et al., 2017). Although this research tends to use self-report measures of activity, exercise self-efficacy and perceived control for physical activity have also been found to be associated with total physical activity measured objectively by actigraphy (Hansen, Ommundsen, Holme, Kolle, & Anderssen, 2014; Jefferis et al., 2014).

Despite considerable cross-sectional research linking control beliefs with activity in older adults, studies linking perceived control and activity at a single moment in time do not provide evidence for the proposed direction of influence (i.e., that perceived control influences activity participation). In fact, there are good reasons to suggest that the observed associations reflect the influence of activity engagement on older adults' perceived control. Social cognitive theory suggests that mastery experiences (i.e., performance accomplishments and goal attainments that reinforce control-directed efforts), particularly where there are obstacles to achieving one's goal, are a significant predictor of perceived control (Bandura, 1977). Similarly, it has been suggested that prior performance experiences influence individuals' perceived control over ageing-related decline (Lachman, 2006). Performance attainment such as engaging in difficult physical activity, learning a new hobby or skill, or engaging in goal-directed social interactions may therefore increase older adults' perceived control. Longitudinal research has the potential to provide stronger support for the notion that perceived control influences activity in older adults by examining change over time.

1.4.2 Longitudinal Research on Control Beliefs and Activity

To date, longitudinal research examining the effects of control beliefs on older adults' activity has focussed primarily on physical activity, utilizing measures of exercise-specific control beliefs. Research suggests that exercise self-efficacy may predict adherence to exercise programs in middle-aged and older adults (T. Duncan & McAuley, 1993; Lucidi, Grano, Barbaranelli, & Violani, 2006; see, however, Aparicio-Ting, Farris, Courneya, Schiller, & Friedenreich, 2015). Further observational studies have shown that baseline exercise self-efficacy can predict future physical activity. For example, baseline self-efficacy has been found to be related to physical activity 3 weeks later in older Costa Rican adults (Fernández, Montenegro, Knoll, & Schwarzer,

2014) and 6 months later in German older adults with chronic conditions (Warner, Schüz, Knittle, Ziegelmann, & Wurm, 2011). Among previously sedentary older adults who participated in a 6-month exercise trial, frequency of participation during the trial was positively related to exercise self-efficacy at the end of the trial (McAuley, Jerome, Marquez, Elavsky, & Blissmer, 2003). In turn, reporting greater exercise self-efficacy at the completion of the trial was related to reporting greater physical activity at 6 and 18-month follow-ups (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003). Additionally, individuals who reported greater exercise self-efficacy at the 18–month follow-up showed less decline in physical activity over the following 2 years (McAuley, Morris, Motl, et al., 2007). Similarly, among older adults who participated in a 6-month resistance training trial, higher exercise self-efficacy at the conclusion of the trial was linked to continued resistance training 9 and 12 months later (Neupert, Lachman, & Whitbourne, 2009).

Research specifically examining the theory of planned behaviour in older adults has also shown exercise-specific perceived control to be related to concurrent intentions to exercise, which in turn were related to exercise behaviour after 3 years (Courneya, Nigg, & Estabrooks, 1998). A similar study examined the theory of planned behaviour among middle-aged and older adults who recently began exercise classes and found that perceived control over exercise predicted exercise frequency one month later, but not after 3 or 9 months (Brenes, Strube, & Storandt, 1998). Although perceived control predicted intentions to exercise, intentions did not predict exercise frequency. The authors suggest there may not have been sufficient variability to predict antecedents of exercise, given that 89% of participants who intended to exercise continued to exercise 9 months later. In a similar vein, a test of social cognitive theory showed that sources of self-efficacy (mastery experience, self-persuasion, and reduction in negative affective states) predicted self-efficacy for physical activity and, in turn, physical activity among older adults (Warner, Schuz, et al., 2014).

We are aware of two studies that have used measures of general control beliefs in examining relationships between control beliefs and longitudinal change in physical activity in older adults.

Drewelies and colleagues (2016) examined the dyadic effects of mastery, defined as "people's beliefs about their ability to influence and change life circumstances"(p. 2), on participation in light, moderate, and vigorous activities in older couples. They found that that individuals with higher mastery at baseline reported greater total baseline activity. Baseline mastery was positively associated with change in light activity over 6 years, but was negatively associated with 6-year change in moderate activity. Furthermore, having a partner with high mastery beliefs was also associated with participation in more physical activity. One study examining whether physical activity mediated the relationship between general control beliefs and episodic memory in midlife and older adults found that reporting higher perceived control at baseline was related to higher levels and more positive 2-year changes in physical activity (Infurna & Gerstorf, 2013).

The above studies indicate that between-person differences in self-efficacy are related to future exercise behaviour, providing some support for the notion that perceived control promotes physical activity in older adults; however, physical activity and self-efficacy were not examined at all time points. These studies were therefore unable to examine effects in both directions (i.e., the effect of perceived control on future activity levels, and the effect of activity levels on future perceived control) in order to identify a unique or independent influence of perceived control on activity. A number of studies have, however, examined both self-efficacy and physical activity at multiple time points and shown correlated change. Research based on social cognitive theory showed that 18-month and 4-year change in exercise self-efficacy were related to 18-month (Resnick, 2004) and 4-year change (S. M. White, Wójcicki, & McAuley, 2012) in physical activity, respectively. Other studies have taken an opposite conceptual standpoint, suggesting that physical activity influences self-efficacy. In a sample of older women, changes in exercise self-efficacy partially mediated the positive effect of change in physical activity (assessed with a composite including leisure, household, and occupational activities) on change in functional limitation over 2 years (McAuley, Morris, Doerksen, et al., 2007). Supplementary cross-lagged analyses did not show significant associations of baseline physical activity with change in self-efficacy, or baseline self-efficacy with change in physical activity. Similarly, in a study of middle-aged and older adults, 18-month change in exercise self-efficacy partially mediated the effects of change in physical activity on life satisfaction (Phillips, Wójcicki, & McAuley, 2013). Supporting the notion that self-efficacy influences activity, however, was the finding that model fit was significantly improved by including a path between baseline exercise self-efficacy and physical activity at 18 months. Additional research using multiple time points to examine cross-lagged associations would be useful in further elucidating the likely order of effects.

Numerous intervention studies aimed at improving self-efficacy for physical activity provide further support for the notion that control beliefs promote physical activity in older adults (see French, Olander, Chisholm, & Mc Sharry, 2014 for review). For example, among inactive older adults with arthritis who participated in a 20-week lifestyle physical activity program, change in exercise self-efficacy was associated with change in physical activity (Sperber et al., 2014). Similarly, among older adults with mild to moderate hypertension, those who were randomized to receive a six-month walking self-efficacy intervention showed greater improvements in exercise self-efficacy and walking than control participants who received usual primary care (Lee, Arthur, & Avis, 2007). Some intervention studies have, however, shown unexpected results. Among older adults engaged in a 12-week trial during cardiac rehabilitation, there were no effects of the intervention on self-efficacy for physical activity or physical activity behaviour, with participants in the self-efficacy coaching and control groups showing increases in self-efficacy (M. J. Allison & Keller, 2004). Similarly, during a 16-week functional circuit/walking pilot study that included a self-efficacy component, older sedentary women showed associations of physical activity with self-efficacy, however, physical activity increased and self-efficacy decreased (Gallagher, Clarke, & Carr, 2016). The authors suggest this may be because sedentary individuals overestimate their ability to perform physical activity and adjust their evaluations after experiencing barriers to activity (Gallagher et al., 2016).

Whereas considerable research has examined longitudinal associations of control beliefs with physical activity, there is a dearth of research examining longitudinal relationships of control beliefs with other types of activity. Specifically, there does not appear to be research examining the relationship between perceived control and mental activity in older adults, and little research on the association between perceived control and social activity in older adults. In one study, Infurna and colleagues showed that, among participants aged 16 to 97 years, having greater baseline social activity and more favourable 11-year change in social activity was associated with higher perceived control at 11 year follow-up (Infurna, Gerstorf, Ram, et al., 2011). However, the effect of perceived control on subsequent social activity was not examined. After a recent intervention that included activities targeting self-efficacy, such as focusing on past success and watching a film with an older person as a role model, participants in the self-efficacy intervention group showed greater increases in volunteering after 6 weeks than those in the active or waitlist control groups (Warner, Wolff, Ziegelmann, & Wurm, 2014). Though perceived control was not directly measured, this study suggests that perceived control could be important for stimulating engagement in activity other than physical activity. Social and mental activities are related to a number of positive outcomes, as outlined above (1.2.2 Benefits of Activity), and it has been argued that activities requiring less physical exertion, such as social activity, may confer benefits to older adults comparable to those related to physical activity (e.g., Glass et al., 1999). It is therefore important that research move beyond physical activity to consider whether change in perceived control influences change in social and mental activity. Longitudinal studies with both activity and perceived control measured at multiple time points are needed to facilitate examination of the possible direction of effects by allowing observation of temporal sequencing of variable associations, which is one necessary prerequisite for establishing potential causation (Selig & Little, 2012).

1.4.3 Microlongitudinal Research on Control Beliefs and Activity

Cross-sectional and longitudinal research provide insight into the association between levels of control beliefs and activity participation in older adults, but are limited by the implicit assumption that control beliefs are relatively static. A number of psychological attributes that are often considered to be stable over time in fact show substantial within-person variability (see Nesselroade & Ram, 2004 for discussion). Perceived control has typically been conceptualized as a relatively stable construct that shows long-term developmental change due to an accumulation of life experiences, with longitudinal studies typically showing declines in perceived control in older age (e.g., Krause, 2007; Lachman, Rosnick, & Röcke, 2009; Mirowsky & Ross, 2007). However, perceived control can also be considered to be a dynamic self-regulatory process that is influenced by context, including momentary events (Eizenman, Nesselroade, Featherman, & Rowe, 1997). This distinction parallels the description of personality as comprising both trait structure and state process levels (Hooker & McAdams, 2003). Research supporting the conceptualization of state control has shown short-term within-person change in self-efficacy across weeks and days (Eizenman et al., 1997; Neupert & Allaire, 2012).

It is important to consider short-term variability in conjunction with longitudinal studies of perceived control. Using widely spaced time points can obscure short-term fluctuations in perceived control that might underlie longer-term developmental changes in both control beliefs and other consequential outcomes (Sliwinski, 2008). Differences in perceived control scores can occur because individuals always have higher or lower scores compared to each other (between-person variability), or because individuals temporarily feel more or less efficacious at the time of measurement (within-person variability). Utilizing repeated measures on a daily or momentary basis allows examination of individual variability in response to short-term within-person variation in predictor variables (Sliwinski, 2008). This approach can explore momentary temporal associations (Sliwinski, 2008) and whether variables covary across short intervals of time (e.g., Neupert & Allaire, 2012). Within-person variability in perceived control may explain why an individual performs more or less activity on some days compared to other days, for example, engaging in more activity on days when they feel more capable of meeting activity-related goals. Such associations would provide additional support for the notion that perceived control may influence activity in older adults.

A small number of studies using microlongitudinal designs have reported positive within-person associations of perceived control with physical activity. In a sample of adults aged over 50 years who were assessed four times per day for 2 weeks, when participants reported a greater degree of confidence that they could engage in physical activity for at least 10 minutes during the next few hours, they were more likely to report greater physical activity during the following assessment period (Dunton, Atienza, Castro, & King, 2009). Similarly, in a small sample of middle-aged and older adults who were assessed twice per day for 8 weeks as part of an intervention program, when participants reported greater confidence in their ability to engage in physical activity before the next assessment, they were likely to report more walking during the subsequent period (Hekler et al., 2012). We know of no studies examining the association of short-term fluctuations in perceived control with other types of activity. This emerging area of research represents an avenue of enquiry with the potential to provide valuable information on older adults' daily activity choices.

1.4.4 Mechanisms Governing the Relationship between Control Beliefs and Activity

Although emerging research suggests that control beliefs may promote activity in older adults', the mechanisms behind these relationships are not well understood. As outlined above (1.3.2 Rationale for the Relationship between Perceived Control and Activity), self-efficacy may influence older adults' activity because individuals choose to engage in difficult behaviours if they believe they are capable of performing them (Bandura, 1997). Individuals with higher perceived control tend to evaluate their goals as challenges rather than threats (Snyder et al., 1991) and may anticipate that complex or demanding activities will be easier for them to do. In addition, individuals with greater control beliefs tend to invest more effort, persist, and use adaptive strategies to overcome challenges (Bandura, 1997; Snyder et al., 1991), and may therefore engage in more effective SOC to enable activity participation in the face of difficulties. Research that examines potential processes underlying control–activity associations, such as perceived ease of activity and SOC, is an important preliminary step in considering the characteristics of interventions that might be most effective in promoting activity. A limited number of studies have assessed these possible mediators in the context of links between self-efficacy and activity engagement (outlined below).

1.4.4.1 Perceived ease of activity. Research has shown that older adults with higher self-efficacy tend to report their daily activities (including self-care, productive, and leisure activities) as easier on average than those with lower self-efficacy (Klumb, 2001). In addition, midlife and older adults who reported greater difficulty in their daily activities were more likely to report a decrease in activity over time and lower intentions for future activity (though not at all time points; Rousseau, Pushkar, & Reis, 2005). Midlife and older adults have also been shown to rate as more difficult the activities they had reduced participation in, as compared to the activities they had increased or maintained participation in (Pushkar, Arbuckle, Conway, Chaikelson, & Maag, 1997; Rousseau et al., 2005). Relatedly, the relationship between general self-efficacy and apathy (a reduction in voluntary goal-directed behaviours as reported by a close relative) has been shown to be mediated by subjective task demand (a composite rating of task difficulty and mobilized effort during a memory task; Esposito, Gendolla, & Van der Linden, 2014). We are, however, aware of no studies that specifically examine whether the relationship between self-efficacy and activity is mediated by perceived ease of the activity.

1.4.4.1 SOC. As with control beliefs, SOC measures can be domain-general (measuring general strategies for adaptation and goal striving) or domain-specific (e.g., strategies used for activity engagement; P. B. Baltes, Baltes, Freund, & Lang, 1999). Research has shown a significant correlation between general perceived control and general SOC in midlife and older adults (Hahn & Lachman, 2015). General SOC has also been shown to be associated with mastery (the perceived ability to manage one's life and environment; Freund & Baltes, 2002) and leisure-time physical activity in midlife and older adults (Son, Kerstetter, Mowen, & Payne, 2009). In addition, research has a shown associations of leisure-based SOC with leisure repertoire (the number of activities reported; Janke, Son, Jones, Payne, & Anderson, 2015) and physical expenditure during leisure in midlife and older adults with arthritis (Son & Janke, 2015). In studies utilizing qualitative methods, older adults experiencing chronic health conditions (Hutchinson & Nimrod, 2012) or rehabilitation following an acute health event (Hutchinson & Warner, 2014) have described using adaptive strategies to enable them to continue their activities.

Few studies have examined simultaneous associations of SOC with both self-efficacy and activity engagement in older adults, and we are aware of no studies examining whether SOC mediates the association between self-efficacy and activity. Among young and older adults engaged in orthopaedic rehabilitation, exercise self-efficacy was shown to correlate with SOC and physical activity goal attainment 12 months after discharge (Ziegelmann & Lippke, 2007a). In addition, SOC predicted physical activity goal attainment. In the same sample, maintenance self-efficacy (confidence in engaging in physical activity on a long-term basis) was correlated with SOC and exercise frequency, and SOC predicted exercise frequency (Ziegelmann & Lippke, 2007b). However, the study did not assess whether SOC mediated the influence of exercise self-efficacy and maintenance self-efficacy on physical activity goal attainment and exercise frequency, respectively. One mediation study indicated that, among adults aged 50 years and older, use of self-regulation strategies to promote exercise partially mediated the association between exercise self-efficacy and physical activity (Umstattd, Wilcox, Saunders, Watkins, & Dowda, 2008). Although the strategies were not SOC-specific, this study supports the notion that self-efficacy may affect activity engagement by influencing older adults' use of adaptive strategies. We are aware of no mediation studies concerned with activity engagement in later life that examine SOC-specific strategies or non-physical activity.

1.5 Research Objectives

The above literature review identifies a number of directions for future research that would improve our understanding of the relationship between control beliefs and activity in older adults. In sum, longitudinal studies with a greater number of time points would facilitate examination of the possible direction of effects by allowing observation of temporal sequencing of variable associations. This is particularly important for non-physical activities that have not previously been the focus of longitudinal research. In addition, microlongitudinal studies would enable examination of how short-term fluctuations in perceived control relate to day-to-day activity choices, providing further support for the possible influence of perceived control on activity. Research examining the proposed mechanisms underlying the association between perceived control and activity in older adults (i.e., difficulty of activity and selection, optimization and compensation strategies) is an important preliminary step in considering the possible characteristics of interventions that might be most useful in promoting activity. This thesis makes an original contribution to knowledge by addressing these suggestions in four studies, as outlined below (1.5.1 Aims), using secondary analysis of three existing datasets and primary data from one questionnaire. Each study was written as a stand-alone paper and is formatted as a chapter according to Flinders University requirements. Some repetition of content, particularly in chapter introductions, can therefore be expected. Citations and author contributions can be found at the beginning of each chapter.

1.5.1 Aims

1.5.1.1 Examine reciprocal longitudinal relationships between perceived control and social activity in older adults. An initial aim of the thesis was to address the dearth of longitudinal research examining the association between perceived control and non-physical forms of activity, and to inform our understanding of whether perceived control is likely to influence subsequent activity engagement or vice versa. To this end, Chapter 2 examines reciprocal longitudinal relationships between perceived control and social activity using data from the German

Ageing Survey (Deutscher Alterssurvey; DEAS); a population-based survey of community-dwelling middle-aged and older adults undertaken by the German Centre of Gerontology (Deutsches Zentrum für Altersfragen; DZA; Engstler & Schmiade, 2013). This study examines temporal sequencing of variable associations by using cross-lagged autoregressive modelling (e.g., Selig & Little, 2012) to simultaneously examine (1) whether social activity was influenced by perceived control 3 years prior, and (2) whether perceived control was influenced by social activity 3 years prior. The use of an accelerated longitudinal design (Willett, Singer, & Martin, 1998) enables examination of these associations across 40 years. This is the first study we are aware of to examine this reciprocal association and demonstrate whether perceived control has an effect on social activity that is independent of the effect of social activity on perceived control.

1.5.1.2 Examine perceived control as a moderator of the effects of functional limitation on longitudinal trajectories of social activity in older adults. Perceived control influences how much effort individuals expend, how long they persist, and how they devise and implement strategies to overcome challenges (Ajzen, 1991; Bandura, 1997; Snyder et al., 1991). Whereas the study described in Chapter 2 examines direct associations of perceived control with social activity, Chapter 3 examines moderation effects; i.e., whether the negative effect of functional limitation–a significant risk factor for declining activity–on social activity is less evident in older adults with higher perceived control. This study uses multilevel modelling with data from the Australian Longitudinal Study of Ageing (ALSA); a population-based study of older adults conducted by the Flinders Centre for Ageing Studies (Luszcz et al., 2016), to examine whether perceived control moderates the association of functional limitations with 18-year trajectories of social activity. This is the first study we are aware of to examine whether higher perceived control relates to shallower declines in social activity among those with higher levels of functional disability.

1.5.1.3 Examine short-term covariation between perceived control and activity in older adults. Chapter 4 uses microlongitudinal (daily diary) data from a sample of middle-aged and older adults to examine short-term covariation between perceived control and activity. Specifically, this study examined whether participants reported engaging in more physical, social, and mental activity on days of higher self-efficacy. Examining intraindividual variability provides information that is complementary to examining long-term change, providing insight into how daily variations in perceived control relate to daily activity. This chapter contributes to the literature by expanding on the limited research examining associations of within-person fluctuation in control beliefs and is the first study we are aware of to examine within-person coupling of self-efficacy with activities other than physical activity. This chapter also examines within-person coupling of pain and physical symptoms with activity. Though not directly relevant to the thesis research question, inclusion of these analyses enables examination of whether the within-person effects of self-efficacy on activity are independent of the within-person effects of pain and physical symptoms.

1.5.1.4 Examine perceived ease of activity and selection, optimisation, and compensation strategies as mediators of the relationship between perceived control and activity in older adults. Whereas Chapters 2, 3, and 4 aimed to examine whether perceived control was reliably associated with activity in older adults, Chapter 5 aimed to inform our understanding of why these associations may occur. Chapter 5 uses mediation structural equation modelling with data from a cross-sectional survey to examine whether perceived ease of activity and selection, optimisation, and compensation strategies account for the relationship between self-efficacy and activity in older adults. Once reliable associations are established between control beliefs and activity engagement (Chapters 2–4), research examining the processes governing the association between control beliefs and activity is an important next step in considering the possible characteristics of interventions that have the potential to promote activity in older adults.

1.5.2 Implications

This thesis helps to build a comprehensive knowledge base on the association between control beliefs and activity engagement in older adults by addressing some of the gaps in the current literature. Specifically, it examines associations of perceived control with non-physical (as well as physical) forms of activity, short-term within-person fluctuations in control and activities, and mechanisms underlying the association between perceived control and activity. Although the thesis uses observational data and therefore cannot indicate firm causal conclusions, observation of positive relationships between perceived control and activity would suggest that perceived control may play an important role in enabling older adults to maintain their activity as much as possible as they age. Knowledge of protective resources is particularly important in the context of intervention for age-related losses, such as functional decline, that are not always preventable. For example, some health conditions cannot be completely resolved and physical decline may be unavoidable for some individuals. Although perceived control also tends to decline in older age (Robinson & Lachman, 2017), previous research has shown control beliefs to be modifiable (e.g., Lachman, Weaver, Bandura, Elliot, & Lewkowicz, 1992; Scult et al., 2015). If changes in perceived control are positively associated with changes in activity engagement, interventions aimed at increasing perceived control may be effective in increasing activity. If perceived ease of activity or the use of selection, optimization and compensation strategies mediate the association between perceived control and activity in older adults, this finding could inform the design of such programs. The use of general perceived control in this thesis also raises the possibility that single interventions targeting general perceived control could be useful in promoting more than one type of activity. Interventions that increase activity have the potential to improve quality of life and health for older adults and to reduce the burden on healthcare systems that may become greater due to population ageing.

CHAPTER

2

PERCEIVED CONTROL AND SOCIAL ACTIVITY IN MIDLIFE AND OLDER AGE: A RECIPROCAL ASSOCIATION? FINDINGS FROM THE GERMAN AGEING SURVEY

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2.1 Abstract

Objectives: Perceived control may promote social activity in older adults because individuals with greater perceived control have greater confidence in their ability to achieve outcomes and are more likely to choose difficult activities, show persistence, and employ strategies to overcome challenges. Cross-sectional research has linked perceived control with social activity in lifespan and older adult samples but provides little insight into the direction of influence. We examined reciprocal associations between perceived control and social activity in order to establish temporal sequencing, which is one prerequisite for determining potential causation.

Method: Participants were 14126 midlife and older adults from the German Ageing Survey (DEAS). Using cross-lagged autoregressive modelling with age as the time metric (40 to 87 years), we examined reciprocal 3-year lagged associations between perceived control and social activity, while controlling for concurrent associations.

Results: Perceived control significantly predicted social activity 3 years later. Reciprocally, social activity significantly predicted perceived control 3 years later. The influence of perceived control on social activity was greater than the influence of social activity on perceived control.

Discussion: The finding that perceived control significantly predicts future social activity has potential implications for developing interventions aimed at promoting social activity in midlife and older adults.

2.2 Introduction

Older adults and researchers alike consider social engagement to be an important aspect of active and successful aging (e.g., Bowling, 2008; Rowe & Kahn, 1997). This is not surprising, since higher social activity has been shown to be associated with greater psychological well-being, including happiness, life satisfaction, and positive affect in older adults (Huxhold et al., 2014; Menec, 2003). Participation in social activity also appears to be a key factor in maintaining cognitive and physical well-being. For example, greater social activity has been found to be associated with reduced rates of normative and pathological cognitive decline (Bosma et al., 2002; H.-X. Wang et al., 2002), motor decline (Buchman et al., 2009), disability (James, Boyle et al., 2011), and mortality (Infurna, Gerstorf, Ram, et al., 2011). Although it seems important that individuals maintain their social activity as much as possible as they age, social activity tends to decline with age, particularly in the oldest-old (e.g., Bukov et al., 2002). This could occur due to, for example, poor health (e.g., Bukov et al., 2002), sensory loss (Viljanen et al., 2014), fear of falling (van der Meulen, Zijlstra, Ambergen, & Kempen, 2014), driving cessation (Marottoli et al., 2000) or loss of social network members (Huxhold, Fiori, & Windsor, 2013). Identification of factors that are positively associated with social activity is an important first step in developing interventions to promote social activity in older adults.

Perceived control is a potentially modifiable psychological resource that could play an important role in helping older adults participate in social activity. Perceived control refers broadly to one's beliefs about their ability to realize desired outcomes and is reflected in various constructs including personal control, mastery, and self-efficacy (Lachman et al., 2011). Social cognitive theory and the theory of planned behaviour suggest that individuals choose behaviours that they perceive to be within their capability (Ajzen, 1991; Bandura, 1977, 1997). Individuals with higher perceived control tend to evaluate their goals as challenges rather than threats and experience more positive emotional states during goal-related activity (Snyder et al., 1991). They may therefore choose to participate in a greater range of social activities, including challenging or unfamiliar activities. In addition, perceived control influences how much effort individuals expend and how they persist and use adaptive strategies to overcome challenges (Ajzen, 1991; Bandura, 1997; Lachman, 2006; Snyder et al., 1991), and may therefore be a key resource for adjusting to age-related changes such as functional decline that could impact social activity. According to the theory of selective optimization with compensation (SOC), successful coping and adaptation involves selecting and prioritizing goals, optimizing means or resources using strategies such as increasing time or effort, and compensating using alternative strategies to achieve goals when previous means become limited (P. B. Baltes & Baltes, 1990). Among older adults experiencing memory decline, having higher perceived control is associated with greater use of SOC strategies, which in turn predict fewer everyday memory problems (Hahn & Lachman, 2015). Similarly, individuals with higher perceived control may engage in more effective optimization and compensation by increasing their effort or finding alternative ways to enable social activity participation when faced with challenges such as increasing functional limitations, driving cessation, or social losses.

Supporting these arguments, cross-sectional research has shown that general and domain-specific perceived control are positively related to social activity (M. M. Baltes et al., 1990; Jopp & Hertzog, 2007; Perkins et al., 2008); however, conclusive empirical evidence that perceived control influences social activity participation is lacking, with cross-sectional studies providing little insight into the direction of influence. Indeed, the observed associations may exist because performance experiences and goal attainments, which could include goal-directed social interactions or participating in new social activities, are significant predictors of perceived control (Bandura, 1977; Lachman 2006). In addition, fulfilling social roles can increase feelings of control over one's life (Thoits, 2011), whereas loss of social opportunities arising from, for example, death of social network members or retirement, can reduce perceived control (Rodin, 1986). Longitudinal research examining both directions of effects (i.e., perceived control influencing social activity and vice versa) is therefore needed in order to evaluate whether perceived control may have an independent influence on social activity. A recent study using data from the Australian Longitudinal Study of Ageing showed that having greater baseline functional limitation was associated with greater 18-year decline in social activity for older adults with lower baseline perceived control, but not for those with higher perceived control (see Chapter 3; Curtis, Windsor, & Luszcz, 2017). Similarly, Infurna and colleagues found that, among participants aged 16 to 97 at baseline, having greater baseline social activity and more favourable 11-year change in social activity was associated with higher perceived control at 11 years (Infurna, Gerstorf, Ram, et al., 2011). However, neither study examined the effect of perceived control on subsequent social activity.

2.2.1 The Present Study

The aim of this study was to use longitudinal data to examine the reciprocal effects of perceived control and social activity in a large representative sample of middle-aged and older adults assessed on up to four measurement occasions. Using cross-lagged autoregressive modelling with age as the time metric, we simultaneously examined (1) whether social activity was influenced by perceived control 3 years prior, and (2) whether perceived control was influenced by social activity 3 years prior. Inclusion of autoregressive effects controls for previous levels of the outcome variable and allows examination of temporal sequencing of variable associations, which is one necessary prerequisite for establishing potential causation (Selig & Little, 2012). Furthermore, by using age as the time metric of our analyses, we were able to model the dynamic interactions between perceived control and social activity across a time span of over 40 years. Combining longitudinal information from people measured at different ages in order to estimate a single developmental age trajectory has been termed an accelerated longitudinal design (Willett et al., 1998) and has been shown to be able to closely approximate true longitudinal change (S. C. Duncan, Duncan, & Hops, 1996).

Although this study was primarily interested in the associations between perceived control and social activity in older adults, we included midlife adults in order to examine whether the strength of the associations increased with age. Associations between perceptions of control and aging-related outcomes may be stronger in old age as perceived control promotes adaptation to losses such as functional decline that increase with age (Lachman et al., 2011). Perceived control may become increasingly important as a protective psychological resource that enables older adults to overcome barriers to social activity such as poor health, sensory loss, and driving cessation, while providing less of a compensatory role for middle-aged adults experiencing fewer of these ageing-related changes.

We also examined whether relationships between perceived control and social activity remained after controlling for dynamic associations with health, which could potentially account for observed relationships. Lachman's (2006) conceptual model of control beliefs suggests that health is both an antecedent and outcome of perceived control. Having greater perceived control can promote adaptive health behaviours (Lachman et al., 2011). Reciprocally, those experiencing better health may perceive fewer constraints and feel more able to effect control in their lives (Infurna, Gerstorf, Ram, et al., 2011). Indeed, a bidirectional association between control beliefs and health has been shown across adulthood (Gerstorf et al., 2011). In addition, higher social activity has been shown to predict less functional decline (e.g., Huxhold et al., 2013) and better health has been shown to predict less decline in social activity (Bukov et al., 2002). We therefore controlled for (1) the effects of health on social activity and perceived control 3 years later, and (2) the effects of social activity and perceived control on health 3 years later. We used self-rated health because it reflects a summary of information including objective biological states (e.g., disease presence and severity) and subjective health experiences, and is a unique predictor of outcomes including mortality (Jylhä, 2009).

2.3 Methods

2.3.1 Participants and Design

The data for this study were drawn from the scientific release of the German Ageing Survey (DEAS), provided by the Research Data Centre of the German Centre of Gerontology (DZA). Sampling and design of DEAS have been described in detail elsewhere (see Engstler & Schmiade, 2013). In brief, DEAS is a representative, population-based study of community-dwelling adults aged over 40 years. DEAS has a cohort-sequential longitudinal design with four available waves to date. At 1996, 2002, and 2008, new baseline samples were drawn, stratified by age (40−54, 55−69, and 70−85), gender, and location (East/West Germany). At 2002, 2008 and 2011, all willing participants from previous waves were re-interviewed. There were 4838 participants at 1996, 5194 participants at 2002 (3084 new, 1524 re-interviewed), 8200 participants at 2008 (6205 new, 1995 re-interviewed) and 4855 participants at 2011 (0 new, 4855 re-interviewed). Data were collected through home-based interviews and self-complete questionnaires.

This study included participants who provided any valid data on perceived control, social activity, or self-rated health (n = 14126). Inclusion of all available data reduces estimation bias that can occur using data only from participants who completed all assessments (P. D. Allison, 2003). To assess longitudinal selectivity, we examined the extent to which individuals who participated in at least one follow-up assessment (n = 6089) differed from the full 14126-participant sample at their first assessment. Effect size was calculated as the difference in standard deviation (*SD*) units, using *SD*s of the full sample pooled across each cohort's first assessment as reference values (see Lindenberger, Singer, & Baltes, 2002). Only a low level of positive selectivity was evident. Participants who completed at least one follow-up interview were a little younger and reported slightly higher levels of perceived control, social activity, and self-rated health at their first assessment, as compared to the full sample, but selectivity effects ranged only from 0.05 to 0.25

*SD*s. We used full information maximum likelihood (FIML) to counter potential biases of our parameter estimates due to selective attrition (Graham, 2009).

2.3.2 Measures

2.3.2.1 Social activity. Social activity was measured with eight items previously used to measure social activity engagement (Huxhold et al., 2013, 2014). Participants were asked how often they engaged in the following activities, thinking back over the past 12 months: 1) visiting friends or inviting them over; 2) visiting cultural events (e.g., concerts, museums); 3) attending sport events; 4) attending classes or lectures; 5) going for walks; 6) doing sports; 7) artistic work (e.g., painting, music); and 8) board games, cards, or puzzles. Response options were (0) *never*, (1) *less than once a month*, (2) *1−3 times a month*, (3) *once a week*, (4) *several times a week*, and (5) *daily*. Except for item 1 (i.e., meeting with friends), participants also reported whether they usually did the activity alone or with their partner, relatives, friends, a club, or others. If participants reported usually doing the activity alone, they received a score of 0 for that activity. We conducted a confirmatory factor analysis to ensure that the items loaded on a single social activity factor and that measurement properties were similar across the four occasions. A strong factorial invariance model (see L. K. Muthén & Muthén, 1998−2012 for details) fit the data well (χ^2 (500) = 2006.22, $p < .001$; CFI = .96; RMSEA = .02). Standardized regression weights ranged from .29 to .62. A social activity variety score (range 0 to 8) was computed as the total number of activities reported. A social activity frequency score (range 0 to 40) was computed by summing the frequency scores for each activity. Both scores have previously been shown to decline with age, be positively associated with network size, contact frequency, and potential social support, and positively predict outcomes including positive affect, life satisfaction, and health (Huxhold et al., 2013).

2.3.2.2 Perceived control. Perceived control was measured with the Dispositional Hope Scale (Snyder et al., 1991). Hope is defined as the generalized perception that goals can be met (Snyder et al., 1991) and has been operationalized and validated as a measure of perceived control in previous studies (e.g., Schöllgen, Huxhold, Schüz, & Tesch-Römer, 2011; Wurm, Tesch-Römer, & Tomasik, 2007). The Hope Scale has two 4-item subscales: agency, which represents the belief that the individual can achieve their goals, and pathways, which represents the belief that the individual has the required means or strategies to achieve their goals (Snyder et al., 1991). These subscales are suggested to be conceptually akin to efficacy expectation and outcome expectation, respectively, within the concept of self-efficacy (Snyder et al., 1991). Participants rated the extent to which they agreed with statements such as "I meet the goals that I set for myself (agency)" and "I can think of many ways to get out of a jam" (pathways) on a scale ranging from (1) *strongly agree* to (4) *strongly disagree*. Items were reversed, and subscale scores were calculated as the mean of four items. Internal consistency of each subscale was acceptable (e.g., at 1996 agency $\alpha = .77$; pathways $\alpha = .79$). The Hope scale showed convergent validity; total scores correlated highly with scores on the widely-used Generalized Self-Efficacy Scale (Schwarzer & Jerusalem, 1995), which was included in the DEAS at 2008 ($r = .80$) and 2011 ($r = .77$). Test-retest reliability of the Hope Scale has previously been found to be high (e.g., 3 week $r = .85$; see Snyder et al., 1991 for discussion).

2.3.2.3 Self-rated health. Consistent with standard approaches (e.g., Jylhä, 2009), participants rated their present state of health on a scale from (1) *very bad* to (5) *very good*.

2.3.3 Data Preparation and Preliminary Analysis

In order to enable comparison between the measures, scores for the social activity and perceived control subscales and self-rated health were converted to standardized t-scores ($M = 50$, $SD = 10$), using the 1996 cohort as the reference group. To enable examination of change across age from middle to older adulthood, we structured the data using participants' age at the time of measurement. To simplify the analyses and facilitate convergence of statistical models, age was defined using 3-year age groups. Data for older adults aged 88 to 95 years were too sparse for reliable estimation and were excluded. Age groups therefore ranged from 41 (40 to 42 years) to 86 (85 to 87 years). Table 2.1 shows the total number of observations and descriptive statistics for each age group.

In order to reduce measurement error, social activity and perceived control were represented by latent factors, each comprising two subscales as outlined above (2.3.2 Measures). We established measurement invariance over age groups by contrasting Comparative Fit Indices (CFIs) and root mean squared errors of estimation (RMSEAs) of nested models, because χ^2 difference test are too sensitive to large sample sizes (Chen, 2007). It is suggested that an absolute change in CFI smaller than .005 combined with an absolute change in RMSEA smaller than .010 is indicative of invariant factor loadings (Chen, 2007). Comparison of an autoregressive model with free factor loadings to a model with factor loadings equal across age segments indicated acceptable measurement invariance for social activity ($|\Delta CFI| <= .001$; $|\Delta RMSEA| <= .001$). An equivalent comparison for perceived control indicated that the loadings for perceived control were also invariant across age ($|\Delta CFI| <= .001$; $|\Delta RMSEA| <= .001$). Consequently, invariance constraints for factor loadings were retained for the cross-lagged autoregressive models.

2.3.4 Analysis

A series of cross-lagged autoregressive models examined the relationship between perceived control and social activity (see e.g., Newsom, 2015; Selig & Little, 2012). Figure 2.1 shows the statistical model that forms the basis of the analysis. Observed variables are enclosed in boxes and latent variables in ellipses. Dotted paths indicate that autoregressive and cross-lagged effects are assumed to be equal across all ages, with model constraints included accordingly (except where examining age differences, as described below). Stability coefficients (β_1 and β_2) indicate the degree to which social activity and perceived control are predicted by their own values 3 years earlier (autoregression) and describe the relative stability of individual differences from one measurement occasion to the next. The autoregressive effect also accounts for stable individual differences that are likely to be influenced by time-invariant variables such as gender[1]. Coefficients for the cross-lagged effects (β_3 and β_4) indicate the regression of social activity on perceived control at the previous time point and vice versa. As prior levels of the outcome are controlled for, cross-lagged effects are not due to associations at concurrent time points and represent the prediction of change in the respective outcome variable (Newsom, 2015; Selig & Little, 2012). A first-order autoregressive error covariance structure was specified to account for the interdependence of adjacent observed variables and reduce overestimation of stability that can occur due to repeated measurements (Newsom, 2015).

A series of model contrasts using χ^2 difference tests examined the cross-lagged effects. All models specified paths for cross-lagged effects in both directions, as per Figure 2.1, with constraints as described below. To examine the significance of each effect, we compared a model with the effect constrained to be zero to a model with the effect estimated. To compare the relative strength of the cross-lagged effects, we compared a model with both effects estimated but constrained to be equal to a model with the effects estimated and allowed to differ in magnitude. Next, we examined whether the association between perceived control and social activity varied across age. For each cross-lagged effect, we compared a model that allowed the effect to show linear change across age with a model that constrained the effect to be equal across age (for each model, the reciprocal effect was constrained to be equal across age).

In a final model, we controlled for self-rated health by including it as third time-varying autoregressive variable. We specified stability coefficients to account for the degree to which self-rated health is predicted by its own value 3 years earlier and specified cross-lagged effects to and from perceived control and social activity (see Figure 2.2). All analyses were performed using Mplus 7.11.

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[1] Additional analyses (not shown), confirmed that inclusion of gender and education in the model did not change the pattern of results; therefore, these time-constant covariates were not included in the models

Table 2.1

Descriptive Statistics and Number of Observations (n) by Age Group

Age		Self-Rated Health			Perceived Control						Social Activity					
					Agency			Pathways			Variety			Frequency		
Group	(Range)	*n*	*M*	(*SD*)	*n*	*M*	(*SD*)	*N*	*M*	(*SD*)	*n*	*M*	(*SD*)	*n*	*M*	(*SD*)
41	(40−42)	911	55.16	(8.84)	700	49.58	(8.77)	697	50.56	(8.68)	867	57.01	(9.68)	867	55.83	(9.82)
44	(43−45)	1112	53.97	(9.00)	868	49.75	(8.62)	867	50.90	(8.34)	1071	56.77	(9.91)	1071	54.45	(9.76)
47	(46−48)	1380	53.34	(9.33)	1078	49.76	(8.80)	1072	50.75	(8.44)	1335	56.17	(9.99)	1335	53.66	(9.85)
51	(49−51)	1500	52.95	(9.48)	1205	50.17	(8.54)	1200	50.65	(8.53)	1452	55.43	(9.81)	1452	52.87	(9.71)
53	(52−54)	1665	51.80	(10.12)	1352	50.26	(8.56)	1350	50.69	(8.51)	1624	55.00	(10.01)	1624	52.41	(9.50)
56	(55−57)	1739	50.93	(9.77)	1389	50.04	(8.83)	1387	50.41	(8.39)	1686	54.28	(10.14)	1686	52.27	(9.88)
59	(58−60)	1779	50.42	(10.35)	1451	50.15	(8.64)	1448	50.27	(8.50)	1727	53.59	(10.16)	1727	52.07	(9.77)
62	(61−63)	1710	50.74	(9.77)	1439	50.49	(8.77)	1424	50.68	(8.62)	1659	53.27	(10.20)	1659	52.57	(10.46)
65	(64−66)	1594	50.68	(9.56)	1332	50.61	(8.26)	1326	50.30	(8.00)	1550	53.16	(10.15)	1550	53.34	(10.86)
68	(67−69)	1701	50.11	(9.66)	1422	50.55	(8.46)	1414	49.94	(8.13)	1660	52.01	(10.31)	1660	52.43	(10.87)
71	(70−72)	2004	49.27	(9.62)	1627	50.14	(8.87)	1614	49.61	(8.58)	1957	50.67	(10.18)	1957	51.25	(10.71)
74	(73−75)	1817	47.91	(10.00)	1470	49.89	(9.21)	1467	48.77	(9.19)	1769	49.28	(9.78)	1769	49.84	(10.47)
77	(76−78)	1364	46.90	(10.22)	1101	49.21	(9.58)	1097	48.54	(9.24)	1321	47.12	(9.55)	1321	47.77	(9.89)
80	(79−81)	1049	46.37	(10.48)	817	48.88	(9.71)	814	47.76	(9.48)	1025	45.27	(9.82)	1025	46.26	(10.28)
83	(82−84)	768	45.41	(10.46)	587	47.96	(9.97)	575	46.97	(9.76)	753	44.06	(9.06)	753	45.19	(9.26)
86	(85−87)	260	45.20	(10.24)	191	48.67	(8.77)	189	46.80	(9.16)	258	43.33	(8.58)	258	44.28	(8.86)

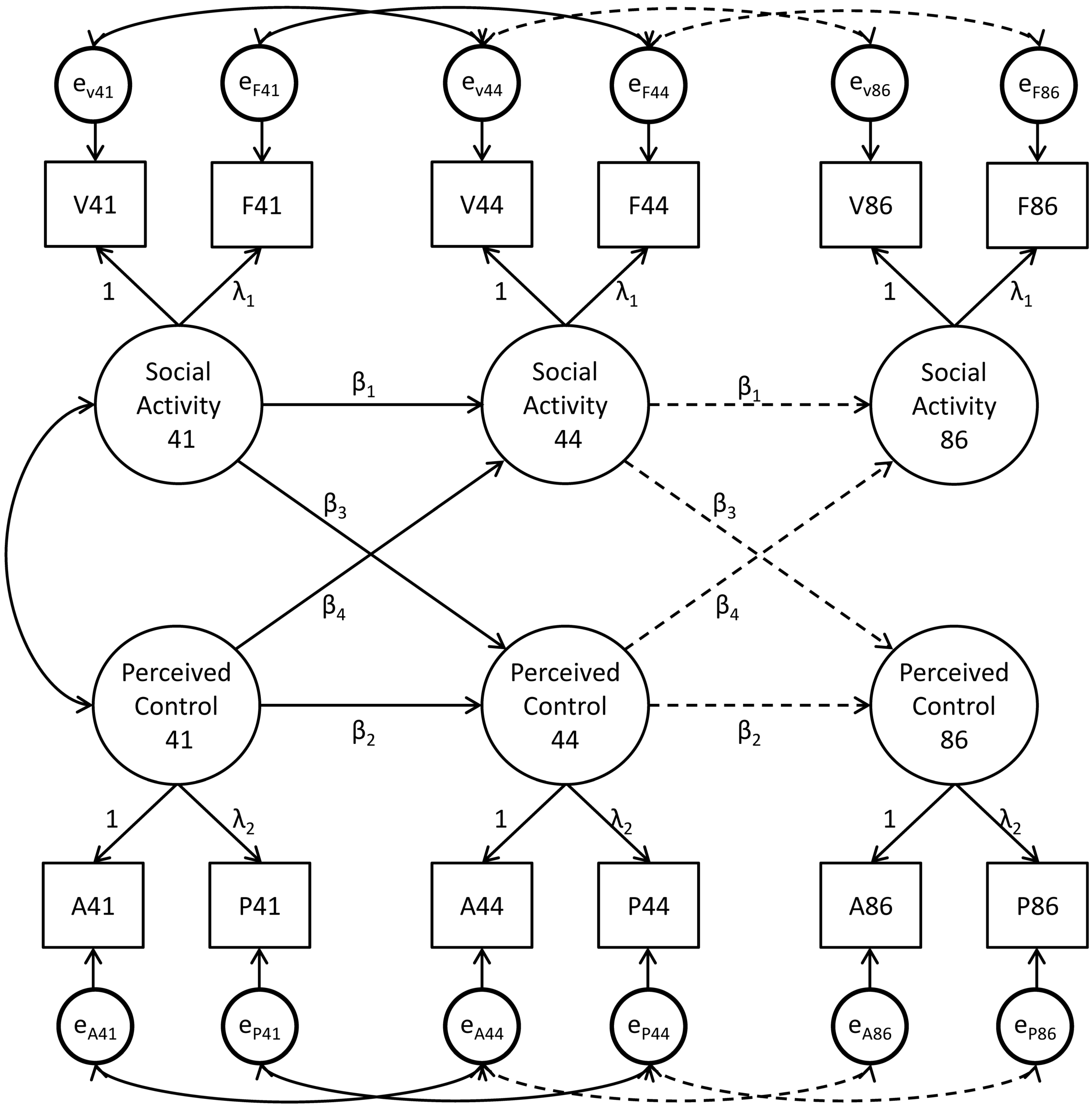

Figure 2.1. Cross-lagged auto-regressive model examining the relationship between perceived control and social activity in middle-aged and older adults.

2.4 Results

The hypothesized model (with no constraints on autoregressive or cross-lagged paths, except equality over age; see Figure 2.1) fit the data well ($\chi^2(1121) = 3585.48$, $p < .001$; CFI = 0.95; RMSEA = 0.01). Perceived control ($b = 0.80$, $p < .001$) and social activity ($b = 0.66$, $p < .001$) showed considerable stability over age. Results indicate a reciprocal association between perceived control and social activity. Higher perceived control predicted more social activity ($b = 0.08$, $p <$

.001). Exclusion of this effect resulted in significantly poorer model fit ($\Delta\chi^2(1) = 76.33$, $p < .001$). In addition, higher social activity predicted greater perceived control ($b = 0.03$, $p < .001$). Exclusion of this effect also resulted in poorer fit ($\Delta\chi^2(1) = 30.08$, $p < .001$). The model with the effects constrained to be equal was a poorer fit than the model with the effects allowed to differ in magnitude ($\Delta\chi^2(1) = 11.39$, $p < .001$). The effect of perceived control on social activity appeared to be stronger than the effect of social activity on perceived control.

Associations between perceived control and social activity did not vary with age. Allowing the effect of perceived control on social activity to change linearly with age did not improve model fit compared to the model with the effects constrained to be equal across age ($\Delta\chi^2(1) = 0.024$ $p = .88$). Similarly, allowing the effect of social activity on perceived control to change linearly with age did not improve model fit compared to the model with the effects constrained to be equal across age ($\Delta\chi^2(1) = 2.16$, $p = .14$). Constraints specifying equality over age were therefore retained in the final model.

Figure 2.2 shows the final model controlling for self-rated health. The measurement model (factor loadings and residual errors) is excluded for simplicity. The model showed acceptable fit ($\chi^2(1788) = 4872.98$, $p < .001$; CFI = 0.94; RMSEA = 0.01). Self-rated health showed moderate stability over age ($b = 0.56$, $p < .001$). Although reduced in magnitude, the cross-lagged effects between perceived control and social activity were still significant. Higher perceived control predicted more social activity 3 years later ($b = 0.05$, $p < .001$). Exclusion of this effect resulted in significantly poorer model fit ($\Delta\chi^2(1) = 138.14$, $p < .001$). Higher social activity predicted greater perceived control 3 years later ($b = 0.02$, $p < .01$). Exclusion of this effect also resulted in poorer fit ($\Delta\chi^2(1) = 135.60$, $p < .001$). In addition, better self-rated health was associated with greater perceived control ($b = 0.05$, $p < .001$) and social activity ($b = 0.08$, $p < .001$) 3 years later, while greater perceived control ($b = 0.17$, $p < .001$) and social activity ($b = 0.10$, $p < .001$) were associated with better self-rated health 3 years later.

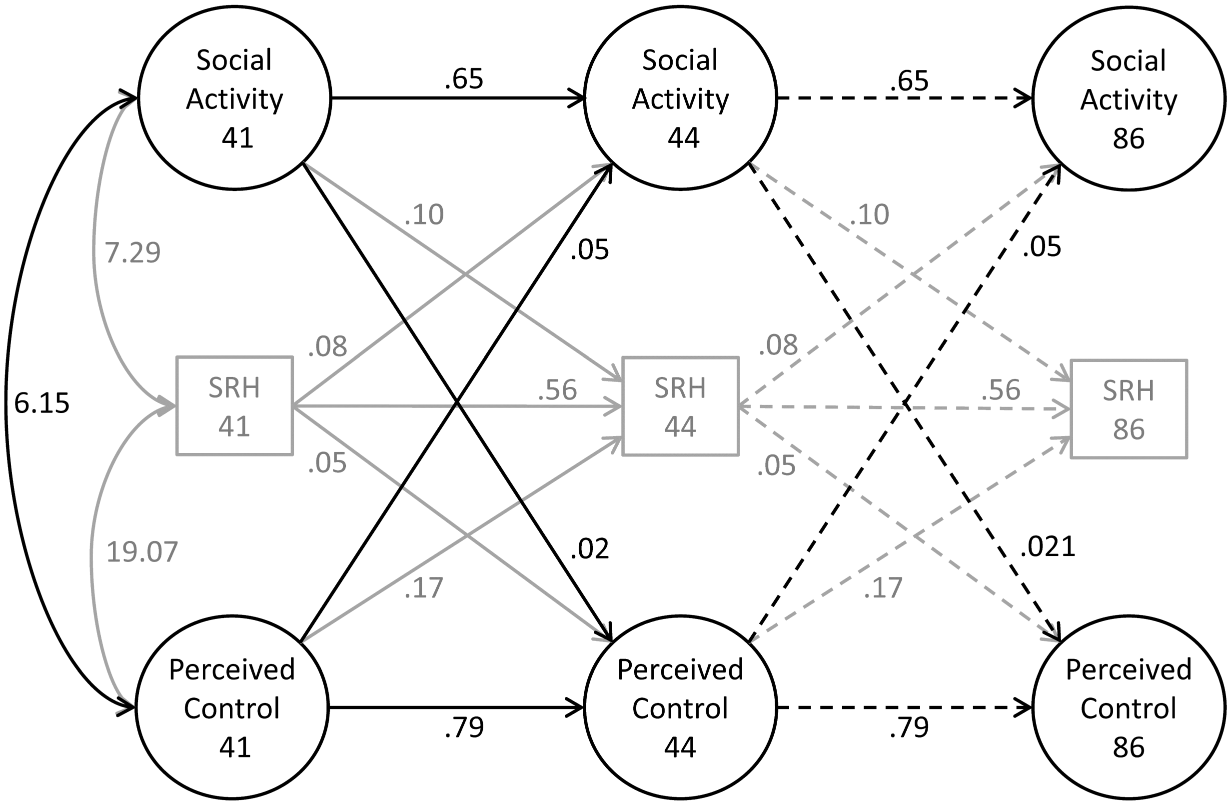

Figure 2.2. Unstandardized coefficients for the cross-lagged auto-regressive model examining the relationship between perceived control, social activity and self-ratted health in middle-aged and older adults. All autoregressive and cross-lagged effects were statistically reliable ($p < .01$).

2.5 Discussion

This study aimed to assess whether perceived control influences social activity, independent of the effects of social activity on perceived control. We examined reciprocal 3-year lagged relationships between perceived control and social activity in midlife and older adults. Both directions of effects (i.e., perceived control influencing social activity and vice versa) were significant, but the effect of perceived control on social activity was stronger than the effect of social activity on perceived control. The effects remained significant after controlling for time-varying self-rated health.

An early discussion and review of the literature suggests that perceived control is associated with a range of positive outcomes in physical and psychological domains (Rodin, 1986). Recent research has also shown that perceived control is positively associated with psychological well-being (Gerstorf et al., 2014; Luszcz, 1996), cognitive ability (Windsor & Anstey, 2008), physical health (Schöllgen et al., 2011), and longevity (Infurna, Gerstorf, Ram, et al., 2011). Although we cannot make direct causal inferences from the data, the finding that perceived control predicted social activity 3 years later adds to this literature, supporting the notion that perceived control may play a role in promoting social activity engagement in older adults. We found no age differences in the relationship between perceived control and social activity, suggesting that the effects predicted to be stronger in older adults were of equal magnitude earlier in the lifespan. Midlife adults may also experience barriers to social activity participation, such as family or employment obligations, that may be overcome with persistence and strategy use. In addition, the effects of perceived control on perceptions of activity difficulty may be similar across age. If perceived control affects social activity across adulthood, the cumulative effects over time could be sizeable, with limited activity becoming particularly evident by old age for those with lower control beliefs.

This study could have significant clinical implications. Targeted intervention has the potential to increase perceived control (see e.g., Lachman et al., 2011; Rodin, 1986 for discussion). If perceived control influences social activity, interventions aimed at increasing perceived control may promote social activity and enable individuals to maintain social engagement as they age. Intervention focusing on four main sources of control beliefs; performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal, might be particularly effective (Bandura, 1977). For example, perceived control might be improved through education, encouragement, or providing opportunity for mastery experiences by facilitating the accomplishment of smaller goals. Considerable research examines interventions aimed at increasing exercise through enhancing self-efficacy (see e.g., Lee, Arthur, & Avis, 2008; Williams & French, 2011 for discussion and review). Similar interventions may be effective in the domain of social activity. A recent intervention that included activities targeting perceived control, such as focusing on past success (performance accomplishments) and watching a film with an older person as a role model (vicarious experience), increased time spent volunteering in older adults (Warner, Wolf, et al., 2014). Though perceived control was not measured, this study suggests that perceived control could be a mediator of behaviour change.

Moreover, promoting social activity through enhancing perceived control may lead to additional benefits for aging individuals. Although we did not make specific predictions regarding self-rated health, our results show that higher perceived control and social activity were independently associated with more positive change in self-rated health, which in turn was associated with further positive development in perceived control and social activity. Furthermore, prior high levels of social activity were also related to positive development in perceived control. Considering this interacting dynamic, an intervention targeted at improving perceived control may initiate a positive feedback loop resulting in a cascading beneficial effect across a broad range of outcomes associated with the concept of successful aging, such as physical and cognitive health, as well as social engagement. This is in line with a recent study that found that, among adults aged 24 to 75 at baseline, greater initial control predicted weaker 9-year declines in health and stronger increases in social support, while better initial health and more support predicted stronger 9-year increases in control (Gerstorf et al., 2011). Changes in perceived control were associated with concurrent changes in health and social support. This research and ours supports Lachman's (2006) conceptual model of control beliefs that posits independent multidirectional relationships with a range of outcomes.

2.5.1 Limitations and Future Directions

To our knowledge, this is the first study to examine the reciprocal relationship between perceived control and social activity. A major strength of the study is that the data were from a large, population-based sample; however, we note some limitations and important directions for future research. Firstly, there were few observations of adults aged over 85 years and no observations for those over 87 years were included. Therefore, findings may not generalize to the oldest-old. In particular, perceived control may be less predictive of social activity if considerable physical limitations exist and therefore fewer activities are under the individual's objective control.

In addition, the method of analysis has some limitations. We combined data from the three cohorts and constructed an age scale for use as the time metric in our analyses. This cohort-sequential design enabled us to examine the relationship between perceived control and social activity over a wide age range using multiple shorter data collections. Although this approach has been shown to closely approximate true longitudinal change across large time spans (S. C. Duncan et al., 1996), combining cross-sectional and longitudinal data can result in some bias due to cohort effects (Farrington, 1991). Furthermore, autoregressive effects describe stability in individual differences (i.e., individuals' relative standing) but do not capture within-person stability. For example, a large autoregressive coefficient could mean that individuals did not exhibit change, or that everyone changed at the same rate, or that rate of change was systematically related to initial levels of the variable (Selig & Little, 2012). Similarly, cross-lagged effects indicate whether those with a higher value in one variable show more positive residual change in the other variable at the following assessment, but do not describe the pattern of change. Using dual-change score models (DCSMs) may have remedied these issues (Ferrer & McArdle, 2003). Unfortunately, applying DCSMs to the data set at hand resulted in insolvable convergence problems. Nonetheless, our analysis provides valuable insights into reciprocal effects and temporal ordering that would not have been possible using methods such as growth curve modelling.

Finally, we suggested that perceived control might promote social activity because individuals with higher perceived control view difficult activities more positively and direct more effort and compensation strategies to overcome barriers to activity. We did not, however, explicitly examine these mechanisms. In addition, when we controlled for self-rated health in the final analysis, interrelations of health with perceived control and social activity reduced the magnitude of the association between perceived control and social activity. Causal mechanisms underlying these associations are yet to be established. Perceived control may be associated with positive health behaviours (Rodin, 1986), which may improve health and increase the individual's ability to partake in social activity. Furthermore, different aspects of social integration may act as mediators in the well-established relationship between perceived control and health in older ages (c.f., Gerstorf et al., 2011). Future research should more closely examine the mechanisms governing the dynamic reciprocal associations between perceived control, social integration, and health, focusing on mediation effects.

2.5.2 Conclusions

In sum, results from this study indicate a reciprocal relationship between perceived control and social activity in middle-aged and older adults. The finding that perceived control predicts social activity could have implications for the development of interventions aimed at enabling older adults to maintain their social activity as they age. Dynamic reciprocal associations with self-rated health suggest the potential for improvements in perceived control to have broader positive effects, as well as a possible underlying mechanism for the association between perceived control and social activity. Future research should aim to examine the processes by which perceived control may influence social activity, including a possible mediating role of health.

CHAPTER

3

PERCEIVED CONTROL MODERATES THE EFFECTS OF FUNCTIONAL LIMITATION ON OLDER ADULTS' SOCIAL ACTIVITY: FINDINGS FROM THE AUSTRALIAN LONGITUDINAL STUDY OF AGEING

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Author Contributions
RGC proposed and organized the manuscript, analysed the data, wrote the manuscript, and edited the manuscript based on the co-authors' and reviewers' comments. TDW and MAL contributed to proposing the manuscript, provided feedback on the manuscript draft, and contributed to editing the manuscript. MAL also contributed to the design and administration of the primary study on which this manuscript is based.

3.1 Abstract

Objectives: Research has shown that functional limitation is related to reduced social activity in older adults; however, individuals with high perceived control have greater confidence in their ability to achieve outcomes, and are more likely to show persistence and employ strategies to overcome challenges. The aim of this study was to examine whether perceived control protects against the negative effects of functional limitation on older adults' social activity.

Method: Participants were 835 older adults aged 69 to 103 years at baseline from the Australian Longitudinal Study of Ageing. Multilevel modelling was used to examine baseline and within-person change in functional limitation and perceived control as predictors of 18-year trajectories of social activity.

Results: An interaction between baseline functional limitation and perceived control indicated that having greater functional limitation was associated with less social activity and greater decline over time for those with lower perceived control, but not for those with higher control. Within-person change in functional limitation was not reliably associated with social activity.

Discussion: This study highlights the importance of perceived control as a protective psychological resource and may have implications for developing interventions aimed at enabling older adults to maintain their social activity as they experience functional decline.

3.2 Introduction

Engagement in social activity is often considered to be a hallmark of successful aging (e.g., Rowe & Kahn, 1997) and appears to be key contributor to aging well. For example, higher social activity is associated with greater emotional well-being (e.g., Menec, 2003) and reduced incidence of disability (e.g., James, Boyle et al., 2011), dementia (e.g., H.-X. Wang et al., 2002), and mortality (e.g., James, Boyle et al., 2011). In addition, higher social activity has been found to be related to lower rates of cognitive (P. A. Thomas, 2011) and motor decline (Buchman et al., 2009). Social activities are some of the most common activities that older adults participate in after activities of daily living and instrumental activities. For example, in a sample of healthy community-dwelling older adults, 72% reported socializing on the previous weekday, 51% reported talking on the phone, and 11% reported participating in a club or organized activity (Parisi, 2010). In addition, McKenna and colleagues (2007) found that older Australian adults engage in an average of 2.7 hours of social leisure activity per day. Despite these trends, social activity tends to decline with age, particularly in oldest-old age (e.g., Bukov et al., 2002; P. A. Thomas, 2011).

3.2.1 Physical Functioning and Social Activity

One possible cause of decline in social activity in older adults is a decline in physical functioning that can occur with age. Although chronic illness and physical impairments may particularly reduce older adults’ ability to participate in physical and other activities that require considerable motor skill, severe deficits in physical functioning may also affect participation in activities that require less physical resources, such as social activities. Reduced physical independence may particularly affect social activities that require transport to a location outside the home due to, for example, driving cessation, which is associated with decreased levels of out-of-home activity (Marottoli et al., 2000).

Research has shown that greater functional disability, low mobility (Rosso, Taylor, Tabb, & Michael, 2013), and poorer health (Bukov et al., 2002) are associated with less social activity in older adults. In addition, Bukov and colleagues (2002) found that those with poorer health (measured using a composite of functional ability, mental health, and living in a residential care facility) were more likely to decrease their social activity over time. Janke and colleagues (2006) found that over time, as the severity of functional limitation increased, participation in social activity decreased. Interestingly, illness was not related to social activity. This may suggest that illness only presents a barrier to social activity when physical functioning is affected.

Although functional limitation may not be a part of normal aging, loss of physical functioning cannot always be prevented. It is therefore important to identify resources that protect against the effect of functional limitation on social activity. Lifespan perspectives of development describe how individuals successfully develop and adapt across the lifespan. The theory of selective optimization with compensation suggests that successful adaptation involves selecting and prioritizing goals, optimizing means or resources using strategies such as increasing time or effort, and compensating using alternative means to achieve goals when previous means become limited (P. B. Baltes & Baltes, 1990). These self-regulation strategies may enable older adults to maximize their social activity in the face of functional limitations. Perceived control represents a specific psychological resource with the potential to play an important role in adaptation; promoting effective self-regulation and maintenance of social activity.

3.2.2 The Influence of Perceived Control on Social Activity

Research related to perceptions of control has a long history in sociology and psychology, with belief in one's ability to control the environment represented by a range of constructs over the last few decades (see Skinner, 1995). We suggest that perceived control, defined as the perceived ability to intentionally produce desired outcomes (Reid & Ziegler, 1981), is likely to influence older adults' social activity. Self-efficacy is one component of perceived control that represents the belief that one can successfully perform the behaviour needed to produce the desired outcome (Bandura, 1977). Social cognitive theory states that self-efficacy is a major determinant of behaviour because individuals are more likely to perform behaviours that they believe they are capable of (Bandura, 1977). People choose challenging activities if they believe they can cope with them, but tend to avoid situations that they interpret as threatening (Bandura, 1977, 1997). Older adults with higher self-efficacy may choose to participate in a greater range and more difficult social activities, whereas those with lower self-efficacy may view challenging or unfamiliar activities as threats to be avoided. Similarly, the theory of planned behaviour asserts that perceived behavioural control is a strong predictor of intentions, which in turn predict behaviour (Ajzen, 1991).

Perceptions of control may be particularly relevant for older adults who experience barriers to social activity participation, as perceptions of control may promote effective adaptation and buffer the negative effects of risk factors, including age-related losses, on social activity. Perceptions of control affect how individuals utilize existing resources (Skinner, 1995), influencing how much effort they expend (Ajzen, 1991), how long they persist, and how they devise strategies to overcome challenges (Bandura, 1977, 1997). This may empower older adults to overcome barriers to activity. In particular, although declines in physical functioning may increase the difficulty of some activities, older adults with higher perceived control may engage in more effective optimization and compensation by increasing their effort or finding alternative ways to enable social activity participation.

Previous cross-sectional research has linked perceived control and general self-efficacy with social activity in both lifespan (Jopp & Hertzog, 2007) and older adult samples (M. M. Baltes et al., 1990). Domain-specific social self-efficacy has also been found to be related to social activity in older adults (Perkins et al., 2008). In a longitudinal study, using data from the German Socio-Economic Panel Study, Infurna and colleagues examined social activity on two occasions 11 years apart in participants aged 16 to 97 at baseline (Infurna, Gerstorf, Ram, et al., 2011). Participants with greater baseline social activity and those who experienced more favourable changes in social activity showed higher perceived control at 11 years; however, the study did not examine the effects of initial levels of perceived control on changes in social activity over time. These studies highlight important links between perceived control and social activity in older adults; however, they provide little insight into processes linking control and social activity, or whether having high control enables older adults to maintain more activity when experiencing aging-related functional decline. The aim of this study was therefore to examine whether perceived control protects against the effects of functional limitations on older adults' social activity.

3.2.3 The Present Study

Using multilevel modelling techniques with data from the Australian Longitudinal Study of Ageing, we examined whether perceived control moderated the effects of functional limitation on 18-year trajectories of social activity in older adults. Although some researchers include forms of productive social activity such as volunteering (e.g., Bukov et al., 2002), we restricted our definition of social activity to collective activity, which is "the common acting of group members, whereby the intention is directed toward the group itself and not toward reaching an outside goal" (Bukov et al., 2002, p. 511). In general, collective social activities are performed for the enjoyment of those who participate.

Given that social activity tends to decline in the oldest-old, we expected a slight average decline in social activity over time. In light of previous research (e.g., Bukov et al., 2002), we predicted that older adults with higher baseline functional limitation would participate in less social activity and show greater declines in social activity over time, as compared to those with lower functional limitation. We also predicted that baseline perceived control would protect against the effects of functional limitation on social activity. We therefore expected an interaction between functional limitation and perceived control, such that the negative association between functional limitation and social activity would be less evident among older adults with higher perceived control. In addition, consistent with previous research (Janke et al., 2006), we predicted that older adults would report less social activity on occasions when functional limitation was higher relative to baseline, and more social activity on occasions when functional limitation was lower relative to baseline (negative within-person association). We also expected interactions with perceived control, such that the within-person association of functional limitation with activity would be weaker among older adults with higher perceived control.

3.3 Methods

3.3.1 Participants and Design

Participants were from the Australian Longitudinal Study of Ageing (ALSA). Sampling and design of the ALSA is described in detail elsewhere (Luszcz et al., 2014). The study comprises 13 waves of data collection spanning 22 years to date. Five major waves; wave 1 (1992−1993), 3 (1994−1995), 6 (2000−2001), 7 (2003−2004), 9 (2007−2008), and 11 (2010−2011), provided the relevant data through home-based interviews and self-complete questionnaires, and were thus included in this study (additional waves were brief telephone interviews).

An age-stratified (70−74, 75−79, 80−84, and 85+ years) primary sample was drawn from the South Australian Electoral Roll comprising individuals over 70. Their spouses (over 65), and co-residents (over 70) were also invited to participate. The full ALSA sample included 2087 participants aged 65 to 103 years at baseline. The sample for this study was drawn from primary respondents (*n* = 1477), with spouses and co-residents excluded due to expected non-independence of social activity. Participants were included if they reported functional limitation and perceived control at baseline, and social activity at one or more assessments. Participants were excluded if they lived at a residential care facility at baseline, but were retained if they moved to a residential care facility after the baseline assessment. Participants therefore comprised 835 adults aged 69 to 103 at baseline.

To examine longitudinal selectivity, we used an effect size measure to indicate the degree to which individuals who participated in multiple follow-up waves differed from the full 835-participant sample at baseline (see Lindenberger et al., 2002). Effect size is given in *SD* units, where *SD* refers to that of the 835-participant sample. Individuals who participated in three or more waves (*n* = 367) tended to be younger (-0.34*SD*), and reported less functional limitation (-0.23*SD*), greater perceived control (+0.17*SD*), and more social activity at baseline (+0.15*SD*) than the full baseline sample. The magnitude of positive selectivity was larger for those who participated in more waves, except for perceived control (e.g., for those who participated in all 6 waves (*n* = 56), age -0.96*SD*, functional limitation -0.69*SD*, social activity +0.28*SD*). Selectivity effects for sex (+.21*SD*), partner status (+0.26*SD*), and education (+.22*SD*) were only evident for those who participated in 4 or more, 5 or more, and 6 or more waves, respectively.

3.3.2 Measures

3.3.2.1 Social activity. Our starting point for a social activity measure was four items from the Adelaide Activities Profile (M. S. Clark & Bond, 1995) that have previously been used to measure social engagement (Hoppmann et al., 2008). Participants were asked how often in a typical 3-month period they 1) Made telephone calls to friends or family, using response options (1) *None*, through (2) *Up to 3 calls a week*, (3) *4 to 10 calls a week*, and (4) *10+ calls a week*; 2) Participated in social activities at a centre such as a club or community centre (e.g., bingo, senior citizens, self-education courses), using response options (1) *Less than once a month*, through (2) *About once a month*, (3) *About once a week*, and (4) *More than once a week*; 3) Participated in an outdoor social activity (e.g., BBQs, picnics, spectator sports), using response options (1) *Never*, through (2) A*bout once a month*, (3) *About once a fortnight*, and (4) *Once a week or more*; and 4) Invited people to their home, using response options (1) *Less than once a fortnight*, through (2) *About once a fortnight*, (3) *About once a week*, and (4) *More than once a week*.

Final selection of items was based on confirmatory factor analysis examining the extent to which a 4-item social activity factor exhibited longitudinal measurement invariance over five waves (wave 11 was excluded due to small sample size). It is important to establish that measurement properties such as factor loadings are similar across occasions to ensure that measurement properties do not confound longitudinal relationships, and that observed changes reflect true change rather than the changing structure of the construct (e.g., Horn & McArdle, 1992). Preliminary analysis indicated that item 4 did not load consistently on the factor over time and it was thus dropped from the model. For the remaining three items, a strong factorial invariance model (see L. K. Muthén & Muthén, 1998−2012 for details) fit the data well (χ^2 (78) = 199.81, $p < .001$; CFI = .94; RMSEA = .03). Standardized regression weights ranged from .29 to .64. Responses for the three items were summed. Total scores ranged from 3 to 12, with higher scores indicating more frequent social activity.

3.3.2.2 Perceived control. Perceived control was measured at all waves using a 12-item version of the expectancy scale of the Desired Control Measure (Reid & Ziegler, 1981), which assesses control beliefs in areas of involvement with others, engagement in activities, and health. Participants rated the degree to which they agreed with statements such as "I have quite a bit of influence on the degree to which I can be involved in activities" from (1) *strongly agree* to (5) *strongly disagree*. Scores ranged from 12 to 60 and were reversed so that higher scores indicate higher perceived control. Reliability was acceptable at each wave (α ranged from .69 to .77).

3.3.2.3 Functional limitation. Functional limitation was assessed at all waves with two items asking whether the participant is able to walk up and down stairs to the first floor of a building without help and walk half a mile without help (Rosow & Breslau, 1966), and five items asking whether the participant has difficulty pulling or pushing a large object, stooping, crouching or kneeling, carrying weights over 10 pounds, extending arms above shoulder level, and handling small objects (Nagi, 1976). If participants required help or had any difficulty with an item, they received a score of 1 for that item. Items were summed to produce a score ranging from 0 to 7, with higher scores indicating greater functional limitation. The scale showed acceptable reliability at each wave (α ranged from .76 to .82).

3.3.2.4 Covariates. Covariates were baseline age, sex (0 = *male*; 1 = *female*), partner status (0 = *not partnered*; 1 = *partnered, i.e., married or de facto*), and education (age left school: 0 = *less than 15 years*; 1 = *15 years or older*). It is well known that physical functioning can decline with age. Perceived control also tends to decline with age (Lachman et al., 2011). Studies have shown that women report lower perceived control (Lachman et al., 2011) and engage in more social activity compared to men (e.g., Janke et al., 2006). Being married is associated with less informal social activity (Janke et al., 2006; see, however, P. A. Thomas, 2011). In addition, a lower level of education is related to greater functional limitation, less social activity (e.g., Buchman et al., 2009), and lower perceived control (Infurna, Gerstorf, Ram, et al., 2011) in older adults.

3.3.3 Analysis

Multilevel growth curve modelling was used to estimate trajectories of social activity over 18 years. Multilevel models adjust for non-independence of data, allowing for nesting of repeated measures within individuals and examination of intraindividual and interindividual variability (Singer & Willett, 2003). We first specified an unconditional growth model to estimate average trajectories of activity. Examination of the sample means suggested a shallow increase in social activity between waves 1 and 7 and a decline between waves 9 and 11. Linear and quadratic time scores were therefore included. Linear time was fixed at baseline (0), 2, 8, 11, 15, and 18 years to reflect non-equidistant measurements. Accordingly, quadratic time scores were 0, 4, 64, 121, 225, and 324. The full information maximum likelihood estimator was used to correct for missing data (K.-H. Yuan & Bentler, 2000). Comparison of nested models with and without random slopes revealed that allowing for individual deviations from the linear and quadratic slopes resulted in better fit than models allowing no random slopes ($\Delta\chi^2$ (5) = 25.03, p < .05) or a random linear slope only ($\Delta\chi^2$ (3) = 14.3, $p < .05$). For the following models, no other random effects improved model fit.

Next, we examined associations of the baseline predictors with social activity. Model 1 examined the effects of baseline functional limitation on level (intercept) and change (linear and quadratic slopes) in social activity, adjusting for covariates. Model 2 also included the effects of baseline perceived control and the interaction term (baseline functional limitation x baseline perceived control) on level (intercept) and change (linear and quadratic slopes) in social activity. Functional limitation, control, and age were centred on the mean at baseline. Model intercepts therefore represent estimates at the mean of these variables, and at 0 for sex (male), partner status (not partnered), and age left school (< 15 years).

Finally, we examined the associations of within-person change in functional limitation and perceived control with social activity. Scores for both within-person predictor variables (functional limitation and control) were calculated at every wave as the raw score at that wave minus the participant's baseline score. This provides an indication at each time point as to whether the individual increased (positive scores) or decreased (negative scores) in functional limitation or perceived control since baseline. This enabled examination of whether these changes were associated with similar within-person changes in social activity. Specifically, the coefficient for the within-person predictors indicates whether social activity tended to be higher or lower on occasions when functional limitation or perceived control were higher or lower relative to baseline (see Singer & Willett, 2003). We did not examine associations of within-person change with linear and quadratic time, as we did not expect the within-person associations to differ systematically across the study interval. Model 3 examined the effects of within-person functional limitation on social activity, adjusting for baseline limitation and covariates. Models 4 and 5 added within-person perceived control and two new interaction terms: within-person control x within-person limitation (Model 4) and baseline control x within-person limitation (Model 5), while controlling for baseline control and the previous baseline interaction term. Random slopes for quadratic time did not improve model fit for Models 3 to 5 and were thus excluded.

Model fit was indicated by the log likelihood (-2LL), Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC), with lower values demonstrating better fit (Singer & Willett, 2003). To estimate the proportion of variance explained, *pseudo* R^2 was calculated as a proportional reduction in variance from the unconditional growth model (Singer & Willett, 2003). For example, the proportion of variance explained for the between-person intercept was calculated as:

$$pseudo\ R^2_u = \frac{\sigma^2_u(\text{unconditional growth model}) - \sigma^2_u(\text{conditional model})}{\sigma^2_u(\text{unconditional growth model})}$$

Analyses used Stata/SE 13.1.

3.4 Results

Table 3.1 shows descriptive statistics and bivariate correlations at baseline.

Table 3.1

Descriptive Statistics and Bivariate Correlations at Baseline

	1.	2.	3.	4.	5.	6.	7.
1. Age		.03	-.28***	-.003	.20***	-.13***	-.15***
2. Female (%)			-.33***	.08*	.25***	.10**	.21***
3. Partnered (%)				-.03	-.12***	-.04	-.15***
4. Left school ≥ 15yrs (%)					-.06	.03	.06
5. Functional limitation						-.20***	-.11**
6. Perceived control							.31***
7. Social activity							-
M or %	78.07	32.78	61.08	47.61	2.29	45.41	5.98
SD	5.83				1.99	5.21	1.95

Note: $n = 835$, except social activity $n = 827$

$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Participants who were older showed greater functional limitation, lower perceived control, and participated in less social activity at baseline. Being female was associated with greater limitation, higher control, and more activity, whereas being partnered was associated with lower limitation and less activity. Functional limitation was negatively associated with both perceived control and social activity, whereas perceived control was positively related to social activity.

Results for the unconditional growth model are shown in Table 3.2. The intercept, linear slope, and quadratic slope were significant, with the pattern of results indicating an initial increase in social activity (positive linear slope) followed by a decline over time (negative quadratic slope).

Table 3.2

Unstandardized Coefficients (and Standard Errors) from the Multilevel Growth Curve Model Examining Unconditional Trajectories of Social Activity

	Intercept	Linear slope	Quadratic slope
Fixed effects	5.92 (0.07)*	0.07 (0.02)*	-0.005 (0.002)*
Random effects (var.)	2.27 (0.19)*	0.06 (0.02)*	0.0002 (0.0001)*
Covariances			
Intercept – Linear	-0.20 (0.05)*		
Intercept – Quadratic	0.01 (0.003)*		
Linear – Quadratic	-0.003 (0.001)*		
Residual (var.)	1.60 (0.08)*		
-2LL	7737.20		
AIC	7757.20		
BIC	7813.08		

Note: var. = variance, AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria. Random effects significance indicated by 95% confidence intervals.

*$p < .05$

Table 3.3 shows results for multilevel models examining the associations of baseline functional limitation and perceived control with level and change in social activity. Model 1 shows that functional limitation was negatively related to participants' initial level of social activity (intercept), but was not associated with rates of change in social activity over time (linear and quadratic slopes). In addition, older age and being partnered were negatively related to level of social activity (intercept). Being female was associated with a higher level (intercept) and shallower decline (quadratic slope) in social activity. Model 1 explained 17.7% of variance in the level of social activity (intercept), 24.6% in the linear change slope, and 24.7% in the quadratic change slope. Model 2 indicates significant effects of the interaction between perceived control and functional limitation on the social activity intercept, linear slope, and quadratic slope, indicating that the association between functional limitation and both level and rates of change in social activity depended on level of perceived control. Model 2 explained 8.8% more variance in the level of social activity (intercept) (26.5%) and 3.5% more variance in the quadratic slope (28.3%), as compared to Model 1. No additional variance in the linear slope was explained.

Table 3.3

Unstandardized Coefficients (and Standard Errors) from Multilevel Models 1−2 Examining Baseline Predictors of Social Activity

	Model 1			Model 2		
	Intercept	Linear slope	Quadratic slope	Intercept	Linear slope	Quadratic slope
Fixed effects	5.92(0.14)*	0.05(0.06)	-0.01(0.004)*	5.96(0.13)*	0.03(0.06)	-0.01(0.004)*
Main effects						
Limitation	-0.11(0.03)*	-0.01(0.01)	0.0003(0.001)	-0.05(0.03)	-0.01(0.01)	0.001(0.001)
Control				0.09(0.01)*	-0.004(0.005)	0.0005(0.0004)
Interaction effects						
Control x Limitation				0.01(0.005)*	-0.01(0.003)*	0.001(0.0002)*
Covariates						
Age	-0.05(0.01)*	-0.001(0.005)	-0.004(0.004)	-0.04(0.01)*	-0.001(0.005)	-0.0005(0.0004)
Sex[a]	0.83(0.14)*	-0.010(0.05)	0.01(0.004)*	0.70(0.14)*	-0.09(0.05)	0.01(0.003)*
Partnered[b]	-0.61(0.14)*	0.05(0.05)	-0.001(0.004)	-0.56(0.14)*	0.06(0.05)	-0.001(0.004)
Left school[c]	0.13(0.12)	0.02(0.05)	0.001(0.003)	0.14(0.12)	0.02(0.05)	0.001(0.003)
Random effects (var.)	1.87(0.17)*	0.04(0.02)*	0.0001(0.0001)*	1.67(0.16)*	0.04(0.02)*	0.0001(0.0001)*
Residual (var.)	1.61(0.09)*			1.61(0.09)*		

(continued)

	Model 1			Model 2		
	Intercept	Linear slope	Quadratic slope	Intercept	Linear slope	Quadratic slope
Covariances						
Intercept – Linear	-0.15(0.05)*			-0.16(0.05)*		
Intercept – Quadratic	0.01(0.003)*			0.01(0.003)*		
Linear – Quadratic	-0.002(0.001)*			-0.002(0.001)*		
-2LL	7583.79			7504.40		
AIC	7633.79			7566.40		
BIC	7773.41			7739.53		

Note: var. = variance, AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria. Random effects significance indicated by 95% confidence intervals.

[a]Male = 0, Female =1; [b]0 = not partnered, 1 = partnered. [c]0 = < 15 years, 1 = ≥ 15 years.

*$p < .05$

To facilitate interpretation of the perceived control-functional limitation interaction, we graphically examined estimated trajectories of social activity for combinations of low and high functional limitation and perceived control, where low and high refer to 1 standard deviation below and above the means, respectively. Figure 3.1 shows that, after controlling for the covariates, the association between functional limitation and social activity varied depending on the level of perceived control. Low limitation trajectories showed a relatively low level of decline in social activity over time. When limitation was high, perceived control was protective; those with high limitation and low control had the lowest level and greatest decline in social activity, whereas those with high control showed little change over time, irrespective of degree of functional limitation. Simple slope analysis indicated that perceived control was positively associated with level and rates of change in social activity for those with high limitation (intercept estimate = 0.12, $p < .05$, linear slope estimate = -0.02, *ns*; quadratic slope estimate = 0.002, $p < .05$), but only level of social activity for those with low limitation (intercept estimate = 0.06, $p < .05$; linear slope estimate = 0.006, *ns*; quadratic slope estimate = -0.001, *ns*).

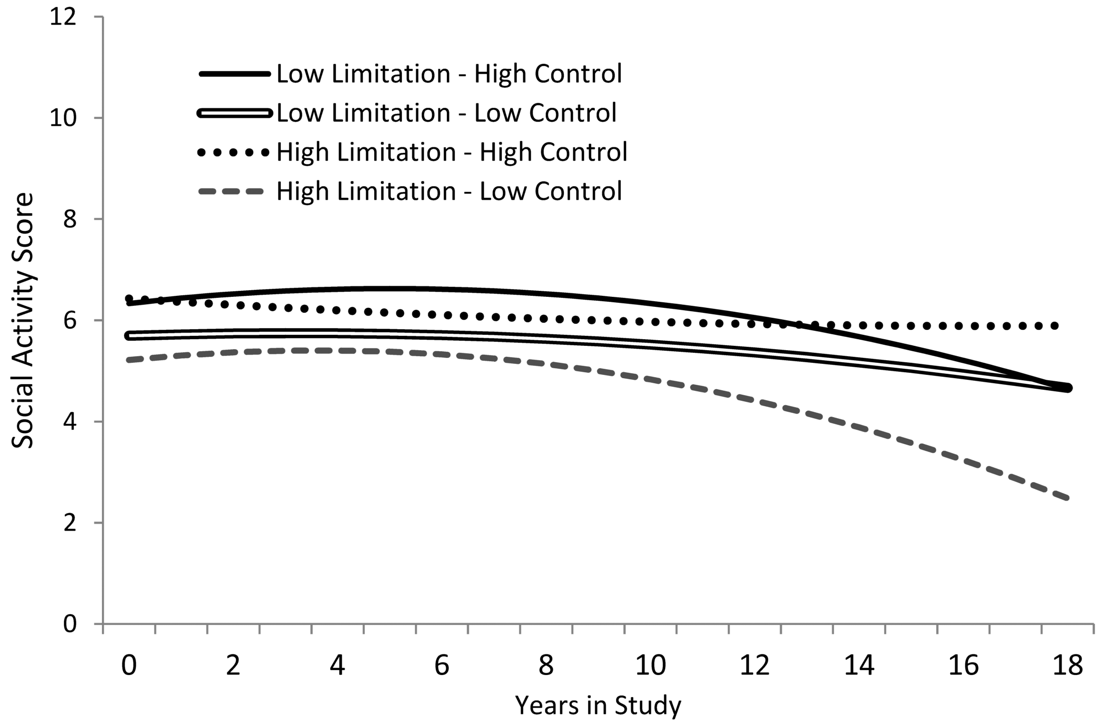

Figure 3.1. Estimated trajectories of social activity for older adults with combinations of low (-1*SD*) and high (+1*SD*) baseline perceived control and functional limitation, at the mean of covariates (Model 2).

Table 3.4 shows results for Models 3 to 5 examining the association between within-person change in functional limitation and social activity. Within-person limitation was negatively associated with social activity in Model 3, indicating that participants reported less activity on occasions when they reported higher limitation relative to baseline. This effect was not significant in subsequent models when perceived control was included. There were no effects of the within-person interactions on social activity, indicating that neither baseline nor within-person change in perceived control moderated the association between within-person functional limitation and social activity.

Table 3.4

Unstandardized Coefficients (and Standard Errors) from Multilevel Models 3−5 Examining Within-Person Predictors of Social Activity

	Model 3			Model 4			Model 5		
	Intercept	Linear slope	Quadratic slope	Intercept	Linear slope	Quadratic slope	Intercept	Linear slope	Quadratic slope
Fixed effects	5.95(0.13)*	0.05(0.06)	-0.01(0.005)*	5.98(0.13)*	0.10(0.07)	-0.01(0.01)[†]	5.98(0.13)*	0.09(0.07)	-0.01(0.01)[†]
Main effects									
Baseline									
Limitation	-0.06(0.03)[†]	-0.02(0.01)	0.001(0.001)	-0.06(0.03)	-0.02(0.02)	0.001(0.001)	-0.06(0.03)	-0.02(0.02)	0.002(0.001)
Control				0.09(0.01)*	-0.004(0.01)	0.001(0.001)	0.09(0.01)*	-0.003(0.01)	0.001(0.001)
Within-person									
Limitation	-0.09(0.03)*			-0.06(0.04)			-0.06(0.04)		
Control				0.003(0.01)			0.01(0.01)		
Interactions									
BC x BL				0.01(0.01)*	-0.01(0.003)*	0.001(0.0003)*	0.01(0.01)*	-0.01(0.003)*	0.001(0.0003)*
WC x WL				-0.01(0.01)					
BC x WL							-0.01(0.01)		

(continued)

	Model 3			Model 4			Model 5		
	Intercept	Linear slope	Quadratic slope	Intercept	Linear slope	Quadratic slope	Intercept	Linear slope	Quadratic slope
Covariates									
Age	-0.04(0.01)*	0.001(0.005)	-0.005(0.004)	-0.04(0.01)*	0.01(0.01)	-0.001(0.0004)*	-0.04(0.01)*	0.01(0.01)	-0.001(0.0005)*
Sex[a]	0.70(0.14)*	-0.09(0.05)	0.01(0.003)*	0.67(0.14)*	-0.13(0.06)*	0.01(0.004)*	0.68(0.14)*	-0.13(0.06)*	0.01(0.004)*
Partnered[b]	-0.55(0.13)*	0.06(0.05)	-0.001(0.004)	-0.56(0.13)*	0.09(0.06)	-0.003(0.004)	-0.56(0.13)*	0.09(0.06)	-0.003(0.004)
Left school[c]	0.12 (0.12)	0.03(0.04)	-0.001(0.003)	0.11 (0.12)	-0.0002(0.05)	0.002(0.004)	0.11(0.12)	0.004(0.05)	0.001(0.004)
Random effects (var.)	1.48(0.14)*	0.004(0.002)*		1.39(0.15)*	0.002(0.002)*		1.39(0.15)*	0.002(0.002)*	
Residual (var.)	1.71(0.08)*			1.76(0.10)*			1.75(0.10)*		
Intercept – Linear cov.	-0.04(0.02)*			-0.03(0.02)			-0.03(0.02)		
-2LL	7430.95			6293.15			6293.10		
AIC	7482.95			6355.15			6355.10		
BIC	7627.85			6522.55			6522.49		

Note: BC = baseline control, BL = baseline limitation, WC = within-person control, WL = within-person limitation, var. = variance, cov. = covariance, AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria. Random effects significance indicated by 95% confidence intervals.

[a]Male = 0, Female =1; [b]0 = not partnered, 1 = partnered. [c]0 = < 15 years, 1 = ≥ 15 years.

*$p < .05$, †$p < .06$

3.5 Discussion

The results support the hypothesis that perceived control is protective of the effects of functional limitation on trajectories of social activity in older adults. Although social activity showed little average change over 18 years, analysis revealed individual differences in trajectories of social activity based on functional limitation and perceived control at baseline. Greater baseline limitation was associated with less social activity, but there were no associations with rates of change. Associations with rates of change may not have been evident because baseline perceived control moderated the association between functional limitation and social activity, particularly for those with high limitation. Having high functional limitation resulted in less social activity and greater decline in social activity over time for those with low perceived control at baseline, but not for those with high control at baseline.

As predicted, Model 3 indicates that on occasions when functional limitation was higher than baseline, participants engaged in less social activity. This association was not, however, significant when perceived control and the baseline interactions were included. This indicates that the effect may not be robust and does not contribute to social activity beyond the effects of the baseline predictors. In addition, neither baseline nor within-person change in perceived control moderated the relationship between change in functional limitation and social activity. Reliable within-person effects may not have been evident because the measure of functional limitation was not sensitive enough to capture increases in limitation for those who had relatively high limitation at baseline. Within-person change in functional limitation was negatively associated with level of limitation at baseline (r ranged -.22 to -.35 across waves), suggesting that those with higher baseline limitation showed less increase over time. However, the measure only indicated whether the participant had any difficulty or required help with a range of activities of daily living, and did not measure the degree of difficulty or how much help was needed. This may have resulted in ceiling effects for participants with high baseline limitation. Future research should assess whether reliable associations are found using a more sensitive measure of functional limitation.

There is an extensive body of research linking sense of control with positive outcomes. An early discussion and review of the literature suggests that greater perceived control is associated with better physical and psychological health (Rodin, 1986). Recent research has shown that perceived control is positively associated with life satisfaction (Lachman & Weaver, 1998a), morale, self-esteem (Luszcz, 1996), cognitive ability (Luszcz, Anstey, & Ghisletta, 2015; Windsor & Anstey, 2008), physical functioning (James, Boyle et al., 2011), and longevity (Infurna, Gerstorf, Ram, et al., 2011) in older adults.

In addition to having direct associations with positive outcomes, perceived control may act as a protective resource for older adults by moderating the effects of risk factors on outcomes. For example, perceived control has been found to protect against the negative effects of stress on emotional well-being in older adults (Roberts et al., 1994), and the negative effects of low socioeconomic status on health, life satisfaction, and depressive symptoms in adults aged 25 to 75 years (Lachman &Weaver, 1998). Perceived control may promote positive outcomes through a range of affective, behavioural, motivational, and physiological processes (see Lachman et al., 2011; Rodin, 1986 for discussion). For example, individuals with higher control are more likely to engage in health-promoting behaviours (Rodin, 1986). In addition, having higher perceived control reduces negative cognitive and emotional appraisals and physiological responses to stress (Rodin, 1986). Our finding that perceived control appears to be broadly protective of the effects of functional limitation on older adults' social activity supports the importance of perceived control as a protective psychological resource and suggests that perceived control may also facilitate self-regulation and behavioural adaptation to functional loss. We do, however, note the possibility of reverse causation in the relationships between functional limitation, perceived control, and social activity. For example, engaging in social activity can have positive effects on health and functioning, such as reduced incidence of disability (James, Boyle et al., 2011), and fulfilling social roles can increase feelings of mastery and control (Thoits, 2011). Future research would benefit from further examining this possible reciprocal causation.

Knowledge of protective resources is particularly important in the context of intervention for age-related losses, such as functional decline, that cannot always be prevented. Perceived control may be amenable to change through influencing the individual's environment, knowledge, or beliefs (see Lee et al., 2008; Rodin, 1986 for discussion) and could therefore present an opportunity for promoting activity when it is not appropriate to aim intervention solely at improving physical functioning. We note that some older adults may not be unsatisfied with a decline in social activity. Socioemotional selectivity theory suggests that it may be emotionally adaptive for older adults to reduce ties with peripheral network members and to focus on close, meaningful relationships (Carstensen, Isaacowitz, & Charles, 1999). This may result in reduced social activity but not necessarily in reduced network satisfaction or perceived support. Nonetheless, given the positive association of social activity with cognitive and physical functioning, continued engagement in social activity is likely to be valuable.

3.5.1 Limitations and Outlook

To our knowledge, this is the first study to examine whether perceived control moderates the effects of functional limitation on older adults' social activity. Although we cannot draw causal inferences from the data, our finding that the negative effects of functional limitation were attenuated for older adults with higher perceived control suggests that perceived control may play an important role in enabling older adults to maintain social activity when faced with functional loss. A major strength of this study is that the data were from a population-based sample, spanning six occasions and approximately 18 years. However, we note some limitations and important directions for future research.

Firstly, we note that the surviving sample differed from that at baseline due to attrition. Individuals who participated in more waves tended to be younger, have fewer functional limitations and greater perceived control, and participated in more social activity at baseline. We used a full information maximum likelihood estimator with robust standard errors to correct for bias arising from missing data, however such bias may nonetheless have implications on the generalizability of our findings, making them conditional on selection effects (Hofer & Sliwinski, 2006).

In addition, we suggested that older adults with higher perceived control would be less affected by functional limitation because they would view difficult activities as less threatening and would expend more effort to overcome their limitation. This study did not, however, allow us to examine these processes. Understanding the mechanisms by which perceived control influences social activity could have significant implications for developing interventions to promote social activity in older adults. Future research should therefore examine whether perceived control influences the effects of functional limitation on ratings of perceived difficulty or barriers to social activity, and whether perceived control influences strategies used to overcome barriers to activity, such as exerting more effort or persisting through physical discomfort. In addition, individuals higher in perceived control may be more effective at soliciting support from others (Gerstorf et al., 2011), which could result in encouragement to engage in social activity, as well as practical support such as transport and mobility assistance. It may also be useful to include a measure of intentions to engage in social activity in order to examine the effects of functional limitation and perceived control in the context of the theory of planned behaviour (Ajzen, 1991).

Lastly, we examined collective social activity only. Our findings may not generalize to productive social activities, such as volunteering which is also associated with positive outcomes for older adults (Morrow-Howell, Hinterlong, Rozario, & Tang, 2003). Future research could examine the interactive effects of functional limitation and perceived control on productive social activity. In addition, research examining other types of activity such as physical activity may prove fruitful. Cross-sectional (e.g., Perkins et al., 2008) and cross-lagged (e.g., Warner, Ziegelmann, Schüz, Wurm, & Schwarzer, 2011) associations between self-efficacy and physical activity in older adults have been found. Based on the rationale and findings of this study, we might expect that older adults' physical activity is less affected by functional limitation if they have higher perceived control. However, the relationship may not hold for activities that require considerable physical resources and are not objectively under the individual's volitional control.

3.5.2 Conclusion

In sum, findings from this study suggest that perceived control is protective of the effects of functional limitation on older adults' social activity. This contribution to the literature could have potential implications for the development of interventions aimed at enabling older adults to maintain their social activity as they experience functional decline. Future research should aim to examine the processes by which perceived control protects against the effects of functional limitation on older adults' social activity, and whether perceived control might be protective of the effects of functional limitation on other types of activity.

CHAPTER

4

THERE'S MORE THAN MEETS THE EYE: COMPLEX ASSOCIATIONS OF DAILY PAIN, PHYSICAL SYMPTOMS, AND SELF-EFFICACY WITH ACTIVITY IN MIDDLE AND OLDER ADULTHOOD

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Author Contributions

RGC proposed and organized the manuscript, analysed the data, wrote the manuscript, and edited the manuscript based on the co-authors' and reviewers' comments. TDW contributed to proposing the manuscript and, along with JAM and AAMB, provided advice on data analysis, provided feedback on the manuscript draft, contributed to editing the manuscript, and contributed to the design of the primary study on which this manuscript is based.

4.1 Abstract

Background: Activity participation is associated with a range of positive outcomes in adulthood. Research has shown that pain and physical symptoms are associated with less activity in older adults, whereas higher self-efficacy is associated with more activity. Such research tends to examine between-person cross-sectional or long-term change, limiting the opportunity to explore dynamic within-person processes that unfold over shorter time periods.

Objectives: This study aimed to (i) replicate previous between-person associations of self-efficacy with activity engagement, and (ii) examine whether daily variation in pain, physical symptoms, and self-efficacy corresponded with daily within-individual variation in different types of activity. We predicted that participants would engage in less activity on days when they experienced more pain or physical symptoms than their average (a negative within-person association) and that participants would engage in more activity on days when self-efficacy was higher than average (a positive within-person association).

Methods: This study used an online diary study to assess self-reported daily pain, physical symptoms, self-efficacy, and activity engagement among 185 adults aged 51 to 84 years for up to 7 days. Multilevel modelling was used to examine whether between-person (average) and daily within-person variability in pain, physical symptoms, and self-efficacy were associated with social, physical, and mental activity.

Results: In line with previous research, between-person self-efficacy was positively associated with social and physical activity. Supporting the hypotheses, within-person self-efficacy was also positively associated with social and physical activity. Results for pain and physical symptoms were less consistent. Between-person pain was positively associated with social activity. Age interactions indicated that within-person pain was negatively associated with social activity and positively associated with physical activity among older adults. Within-person symptoms were positively related to social and mental activity.

Conclusion: Stable individual differences as well as short-term within-person variation in physical and psychological functioning are associated with day-to-day variation in activity. Between-person associations did not always reflect within-person associations (e.g., pain). These complex associations may be influenced by a range of factors including the type of activity and how it is defined (e.g., specific activities and their difficulty), the type of physical symptoms experienced, and age.

4.2 Introduction

Participation in leisure activity, such as social, physical, and mental activities that are not required for basic personal care, is often considered to be a hallmark of successful ageing and is associated with a range of positive outcomes including greater emotional well-being, better physical and cognitive functioning (e.g., Menec, 2003), reduced incidence of dementia (H.-X. Wang et al., 2002), and longevity (Glass et al., 1999). Understanding risk and protective factors is important in order to facilitate older adults' maintenance of activity engagement into later life in the context of increasing resource restrictions (P. B. Baltes & Smith, 2003). The literature suggests that the experience of pain and unpleasant physical symptoms may be a risk factor for declining activity in older adults, whereas a higher level of self-efficacy is associated with more activity (e.g., D. O. Clark, 1999; Perkins et al., 2008; E. Thomas, Peat, Harris, Wilkie, & Croft, 2004). However, this research tends to focus on between-person differences in these variables, examining how individuals' average levels of pain, physical symptoms, and self-efficacy are associated with their average level of activity engagement. To date, there has been little research focused on short-term within-person change, examining how short-term variations in pain, physical symptoms, and self-efficacy are associated with variation in activity engagement over the same time frame. Understanding this within-person variability is important for identifying sources of variation that may be relevant for developing interventions to promote activity. In particular, within-person approaches that utilize intensive, short-term longitudinal designs enable examination of more momentary and immediate effects that are integral for understanding daily experience (Sliwinski, 2008). This study therefore aims to examine daily within-person associations of pain, physical symptoms, and self-efficacy with social, physical, and mental activity.

4.2.1 Associations of Pain, Physical Symptoms, and Self-Efficacy with Activity

Research focusing on between-person differences has shown that older adults with poor health and physical functioning tend to engage in less social and physical activity than those with better health and functioning (e.g., Kaplan, Newsom, McFarland, & Lu, 2001; Rosso et al., 2013). Compared to those with higher functional ability, older adults with functional impairment also tend to reduce their social activity at a greater rate as they age (Janke et al., 2006). In addition, 38% of adults aged over 50 years reported pain that interferes with daily activity (E. Thomas et al., 2004), while 50% of socioeconomically disadvantaged middle-aged and older adults reported that pain prevents them from walking and exercising more often (D. O. Clark, 1999). Physical symptoms including swelling and fatigue, as well as fear of chest pain and shortness of breath, are also reported to be barriers to exercise (D. O. Clark, 1999).

In contrast, self-efficacy, which represents beliefs that one can successfully perform desired behaviours (Bandura, 1977, 1997), has the potential to promote activity in older adults. Social cognitive theory suggests that individuals choose behaviours that they believe they are capable of and avoid those that are perceived as beyond their capability (Bandura, 1977, 1997). Self-efficacy also influences how long individuals persist during challenging tasks (Bandura, 1977, 1997). Individuals with higher self-efficacy may therefore choose to participate in a greater range of activities, including more difficult or unfamiliar activities, and may show greater persistence and employ strategies to overcome barriers to activity. Supporting this conjecture, cross-sectional research has shown that general and domain-specific self-efficacy are positively related to older adults' physical and social activity (Jopp & Hertzog, 2007; Langan & Marotta, 2000; Perkins et al., 2008). In addition, longitudinal studies have shown that higher baseline exercise self-efficacy is associated with greater exercise frequency at 6 (Warner, Schüz, et al., 2011) and 12 month follow-ups (Warner, Ziegelmann, et al., 2011).

Despite support for between-person associations of pain, physical symptoms, and self-efficacy with activity, between-person associations do not always reflect within-person processes (see e.g., Hoffman & Stawski, 2009). For example, individuals' general level of self-efficacy may influence how much activity they tend to do compared to other people (between-person association), but more immediate temporal factors, such as short-term variation in self-efficacy, may explain why an individual performs more activity on some days compared to other days (within-person association). If only between-person associations are found, this may suggest that relatively stable individual differences but not within-person variation are related to activity. Utilizing repeated measures on a daily or momentary basis allows examination of individual variability in response to short-term variation in predictor variables (Sliwinski, 2008). This approach can explore more momentary temporal associations (Sliwinski, 2008) and whether variables covary across short intervals of time (e.g., Neupert & Allaire, 2012). As self-efficacy is a dynamic self-regulatory process that shows short-term fluctuation (Neupert & Allaire, 2012), processes linking self-efficacy and activity may occur on a daily level, with individuals engaging in more activity on days when they feel more capable of meeting activity-related goals. Two studies have shown that, when participants reported greater confidence in their ability to engage in physical activity in the next few hours, they were more likely to report greater physical activity during the following assessment period (Dunton et al., 2009; Hekler et al., 2012). In addition, as well as exhibiting between-person associations of pain and symptoms with activity, individuals may reduce their activity on days when they feel greater pain or experience more unpleasant physical symptoms. Studies of middle-aged and older adults have shown that momentary fatigue (assessed multiple times per day) predicted less physical activity in the previous (Murphy, Kratz, Williams, & Geisser, 2012) and subsequent assessment periods (Dunton et al., 2009), but pain was not associated with physical activity (Murphy et al., 2012). We know of no studies examining associations of within-person pain, symptoms, or self-efficacy with other types of activity.

4.2.2 The Present Study

The aim of the present study was to examine short-term within-person associations of pain, physical symptoms, and self-efficacy with social, physical, and mental activity using microlongitudinal data from a sample of middle-aged and older adults. We predicted that participants would engage in less activity on days when they experienced more pain or physical symptoms than their average (negative within-person associations). We also predicted that participants would engage in more activity on days when self-efficacy was higher than average (a positive within-person association).

Increasing age tends to be met with a decline in physical, cognitive, and psychological resources (P. B. Baltes & Smith, 2003). These resource restrictions can affect older adults' ability to cope with stressors such as pain and unpleasant physical symptoms (Charles, 2010), resulting in a greater impact on activity for older adults as compared to middle-aged adults. Indeed, E. Thomas and colleagues (2004) found that older adults were more likely to report that their pain affected their participation in work and housework. In addition, associations between self-efficacy and activity may be stronger in old age because perceived control promotes adaptation to losses such as functional decline that increase with age (Lachman et al., 2011). We therefore predicted that the negative effects of daily pain and physical symptoms on activity and the positive effects of daily self-efficacy on activity would be stronger for older adults.

4.3 Methods

4.3.1 Participants and Procedure

Participants were a convenience sample of 185 adults aged 51 to 84 years, who accepted an email invitation sent to all members of a non-profit advocacy organization (National Seniors Australia) to participate in an online diary study. Participants completed a baseline questionnaire containing demographic, psychological, social, and cognitive measures, and up to seven daily questionnaires assessing activity, pain, physical symptoms, positive and stressful events, self-efficacy, and vocabulary. Measures used in the present study are described below. Participants were asked to complete seven daily questionnaires after dinner at approximately the same time each day within 2 weeks of the baseline assessment. Participants were included in the present study if they completed the baseline assessment and at least one daily questionnaire. Participants completed an average of 4.8 daily questionnaires (21% of participants completed seven questionnaires, 29% completed six, 14% completed five, 12% completed four, and 24% completed three or fewer).

4.3.2 Daily Measures

4.3.2.1 Activity. Three scales measuring social, physical, and mental activity were developed for use in the current study. Participants were asked to indicate how much time they spent doing 28 activities in the past 24 hours on a scale ranging from (0) *no time at all*, through (1) *some time but less than 15 min*, (2) *between 15 and 30 min*, (3) *between 30 min and 1 hr*, (4) *1 to 2 hr*, (5) *2 to 4 hr*, (6) *4 to 8 hr*, (7) *8 to 12 hr*, and (8) *more than 12 hr*. The activity list was adapted from the National Study of Daily Experiences, which was intended capture general daily activity (Tighe, Dautovich, & Allen, 2015), and included additional activities that are generally associated with cognition (Bielak, 2010, 2017). As leisure activity was the focus of the study, only conceptually relevant items were used. We therefore excluded activities such as caring for others and passive activities such as sleeping and watching TV. Light physical activity was excluded a priori because it requires fewer physical resources and therefore may not be associated with pain, symptoms, and self-efficacy in the same way as medium and vigorous activity. For example, individuals may choose to engage in light activity in lieu of more difficult activity on days when self-efficacy is lower or on days when pain or symptoms are higher. The final activity scales were constructed as follows, using nine items from the 28-item list.

Social activity was computed as the sum of scores for three items, producing a scale with a potential range of 0−24. Items were 1) interacting with people who are not close family and friends; 2) leading, coaching, or mentoring others; and 3) in conversations or meetings that focused on solving problems (e.g., group decisions, research, or social problem).

Physical activity was computed as the sum of scores for two items, producing a scale with a potential range of 0−16. Items were 1) vigorous-intensity activity or exercise (i.e., breathing heavily, sweating heavily, pushing your body/heart-rate to a high intensity); and 2) medium-intensity activity or exercise (i.e., moderate increase in breathing, light sweating, but you could have pushed yourself further).

Mental activity was computed as the sum of scores for four items, producing a scale with a potential range of 0−32. Items were 1) active reading (e.g., books, newspapers, magazines, not just flipping through a magazine); 2) writing (e.g., emails, stories, letters); 3) listening to information (e.g., attending a lecture, listening to talk radio); and 4) finding information using the internet or reference books/materials.

Reliability of within-person change uses variance components estimates to indicate how much of the item response variation is due to systematic within-person change over time, rather than measurement error (Cranford et al., 2006). Reliability of within-person change was high for all activities (R_c *Social* = .99; R_c *Physical* = .89; R_c *Mental* = .98), indicating that the activity scales reliably measured individual differences in change across days.

4.3.2.2 Pain. Daily pain was assessed with the question "What number between 0 (*no pain*) and 100 (*pain as bad as it can be*) best describes your level of bodily pain today?" (Almeida, Wethington, & Kessler, 2002).

4.3.2.1 Physical symptoms. The number of daily physical symptoms was calculated as the sum of symptoms from a 19-item list, indicated using the item "Which symptoms did you have in the last 24 hours? (Mark all that apply)". The symptoms were from a shortened version of Larsen and Kasimatis' (Larsen & Kasimatis, 1991) physical symptom checklist (e.g., Almeida et al., 2002) and comprised headache, backache, joint pain, dizziness, nausea, allergy symptoms, poor appetite, congestion, sore throat, muscle soreness, menstrual pain, cold/flu, chest pain or tightness, constipation or diarrhoea, trouble breathing, heart pounding, hot/cold flashes, trembling or shaking, and other symptom.

4.3.2.2 Self-efficacy. Self-efficacy was measured using four items from the Generalized Self-Efficacy Scale (Schwarzer & Jerusalem, 1995), adapted to reflect a 24-hour time frame. Participants indicated how much they felt the following over the last 24 hours: 1) That you could accomplish any goals that you set for yourself, 2) Confident you could deal efficiently with any unexpected events, 3) That you could solve most problems that came your way if you tried hard enough, and 4) Confident in your ability to cope with any difficulties you might face. Participants responded on a scale from (1) *not at all* to (4) *very much*. Items were summed to produce a score ranging from 4 to 16, with higher scores indicating higher self-efficacy. Reliability of within-person change was high (R_c = .98; see Cranford et al., 2006).

4.3.3 Baseline Covariates

Analyses controlled for a range of covariates that have previously been shown to be associated with constructs included in our models. Analyses controlled for age because physical functioning, control beliefs, and activity tend to decline with age (Janke et al., 2006; Lachman et al., 2011). Similarly, we controlled for gender (0 = *female*, 1 = *male*), partner status (0 = *not partnered*, 1 = *partnered*), retirement status (0 = *not retired*, 1 = *retired*), and total years of education, as potential confounders that show various associations with health, control beliefs, and activity (e.g., Janke et al., 2006; Jopp & Hertzog, 2007; Lachman et al., 2011; Warner, Schüz, et al., 2011). Analyses also controlled for self-rated health, assessed with the item "In general would you say your health is (1) *poor*, (2) *fair*, (3) *good*, (4) *very good* or (5) *excellent*?" Global self-rated health represents a relatively enduring construct that is related to but distinct from health status and is a unique predictor of outcomes (Bailis, Segall, & Chipperfield, 2003). Self-rated health is associated with activity and control beliefs (e.g., Warner, Schüz, et al., 2011) and may be reflected by individual differences in sensitivity or willingness to report pain, physical symptoms, or illness (Bailis et al., 2003).

4.3.4 Analysis

Data were analysed using a series of multilevel ordered logit models (Snijders & Bosker, 2012). Multilevel models adjust for non-independence of data, allowing for nesting of repeated measures within individuals and examination of intraindividual and interindividual variability. Time-varying predictors are composed of two sources of variation; within-person variability (how individuals fluctuate across time, e.g., short-term variability in self-efficacy) and between-person variability (more stable individual differences, e.g., the extent to which individuals generally have higher or lower self-efficacy than others; Hoffman & Stawski, 2009). Preliminary analyses specified a series of unconditional means models (not shown) to obtain estimates of variance and calculate the proportion of variance that was between-person (i.e., intraclass correlation $\rho = \sigma^2_u / (\sigma^2_u + \pi^2/3)$, with the underlying latent variable assumed to have a standard logistic distribution with variance equal to $\pi^2/3$ (Snijders & Bosker, 2012). Between-person variance comprised 42% for social activity, 49% for physical activity, 56% for mental activity, 73% for pain, 54% for symptoms, and 81% for self-efficacy.

Each predictor was separated into two variables in order to estimate the effects of within- and between-person variance separately (see Hoffman & Stawski, 2009). Scores for within-person pain, symptoms, and self-efficacy were calculated by subtracting the individual's mean from each daily score. This removes individual differences and examines variation in activity as individuals experience pain, symptoms, or self-efficacy more or less than on their average day. Scores for between-person pain, physical symptoms, and self-efficacy were calculated as the individual's mean to examine the influence of the individual's average levels of pain, symptoms, and self-efficacy on activity. Covariates were measured at baseline and continuous scores were centred on the sample mean.

A series of conditional random-intercept models were constructed sequentially. For each activity, Model 1 included the baseline covariates. Models 2, 3, and 4 included pain, symptoms, and self-efficacy, respectively. Model 5 included all main effects simultaneously in order to control for associations between the predictors and examine the unique effects of each predictor. Model 6 included interactions between age and within- and between-person pain, symptoms, and self-efficacy to examine whether age moderated the predicted associations (see e.g., Diehl & Hay, 2010). Where Model 6 indicated an age interaction, we used simple slopes analysis to examine the nature of the interaction, calculating the effects at 55 years and 70 years as examples that illustrate the effects for middle-aged and older adults, respectively. Slopes do not vary across individuals, as inclusion of random effects did not improve model fit. Including terms for day and day^2 improved model fit for social and mental activity and were included in the relevant models in order to remove effects that could influence the association of the within-person time-varying covariates with activity (see Neupert & Allaire, 2012).

For each covariate, the ordered logit model estimates one coefficient over all levels of the dependent variable. Odds ratios therefore represent the ratio of the odds of being in a higher rather than a lower category, given a one-unit increase in the covariate, without reference to specific categories (Snijders & Bosker, 2012). This assumes proportional odds, or that the effects of the predictors on cumulative response probabilities are constant across all categories of the dependent variable. We tested whether this assumption should be rejected using an approximate likelihood ratio test. We specified a fixed effects model for each activity including key predictors (age, within- and between-person pain, symptoms, and self-efficacy). The test statistic was non-significant for all activities, satisfying the proportional odds assumption (social activity χ^2 (133) = 151.51 p = .13; physical activity χ^2 (70) = 88.76, p = .06; mental activity χ^2 (140) = 150.58, p = .26). Model fit was indicated by the log likelihood (-2LL), Akaike Information Criterion (AIC), and Bayesian

Information Criterion (BIC), with lower values demonstrating better fit. All analyses used maximum likelihood estimation with adaptive Gauss–Hermite quadrature in Stata 13.1.

4.4 Results

Table 4.1 shows descriptive statistics and bivariate correlations at day 1. Participants who were older, male, partnered, and retired reported less social activity. Being partnered was associated with less mental activity. Higher self-efficacy was associated with more physical activity.

4.4.1 Social Activity

Results from multilevel models predicting social activity are shown in Table 4.2. Odds ratios can be interpreted as change in the odds of reporting higher activity for each 1-point increase in the predictor (examples below). Participants with greater between-person pain and self-efficacy engaged in more social activity. Specifically, for a 1-point increase in between-person (average) pain, the odds of reporting more social activity increased by 2% (Model 6 OR = 1.02 [1.02, 1.04]). Similarly, for a 1-point increase in between-person self-efficacy, the odds of reporting more social activity increased by 10% (Model 6 OR = 1.10 [1.02, 1.20]). There was no main effect of within-person pain on social activity, but Model 6 revealed a significant interaction with age. Simple slopes analysis indicated that social activity was lower on days of higher pain for older adults (aged 70 years; OR = 0.97 [0.95, 0.99], $p = .01$) but not for middle-aged adults (55 years; OR = 1.01 [0.99, 1.04], $p = .22$). This indicates that, for a 1-point increase in within-person pain, the odds of reporting more social activity decreased by 3% for older adults only. Greater within-person physical symptoms predicted more social activity only in Models 5 and 6 when pain and self-efficacy were included. Within-person self-efficacy was positively related to social activity in all models (Models 4, 5, and 6).

Table 4.1

Correlations between all Variables at Day 1

Variables	*n*	Range	*M* (*SD*)	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Age	185	51−84	61.7 (5.9)	.39***	.12	.41***	.01	-.04	-.27***	-.05	-.10	.12	-.12	-.20*
2. Male (%)	185		44.9	-	.43***	.24**	.09	-.12	-.23**	.04	-.10	.03	-.07	-.14
3. Partnered (%)	185		62.7		-	.02	-.07	.08	-.20*	.01	-.16*	.02	-.09	-.10
4. Retired (%)	185		46.0			-	.12	-.06	-.22**	-.06	-.04	-.01	.03	-.04
5. Education	185	6−29	15.4 (4.0)				-	-.05	-.01	.14	.03	.02	-.09	-.07
6. Self-rated health	185	1−5	3.6 (0.9)					-	-.04	.03	.06	.29*	-.32***	-.23**
7. Social activity	164	0−23	4.6 (3.3)						-	.02	.27***	.12	-.01	-.05
8. Physical activity	165	0−10	2.2 (2.5)							-	.11	.25**	-.01	-.08
9. Mental activity	165	0−22	9.6 (4.0)								-	.03	-.10	-.07
10. Self-efficacy	162	4−16	11.9 (3.1)									-	-.14	-.22**
11. Pain	165	0−100	14.5 (18.6)										-	.33**
12. Physical symptoms	165	0−19	1.8 (1.5)											-

Note: Spearman's rho, except correlations between age, pain, and symptoms use Pearson's correlation coefficient. Higher scores indicate higher education, better self-rated health, more social, physical, and mental activity, higher self-efficacy, greater pain, and more physical symptoms.

*$p < .05$, **$p < .01$, ***$p < .001$

Table 4.2

Odds Ratios [and 95% Confidence Intervals] from Multilevel Ordered Logit Models Predicting Social Activity[a]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Day	0.58 [0.43, 0.77]***	0.58 [0.43, 0.78]***	0.60 [0.44, 0.80]**	0.58 [0.43, 0.77]***	0.61 [0.46, 0.83]**	0.60 [0.44, 0.81]**
Day^2	1.06 [1.02, 1.11]**	1.06 [1.02, 1.10]**	1.06 [1.02, 1.10]**	1.06 [1.02, 1.10]**	1.03 [1.02, 1.10]**	1.06, 1.10]**
Age	0.96 [0.91, 1.01]	0.97 [0.92, 1.01]	0.96 [0.91, 1.00]	0.95 [0.91, 1.00]*	0.96 [0.92, 1.01]	0.97 [0.92, 1.02]
Male	0.77 [0.42, 1.41]	0.84 [0.47, 1.52]	0.77 [0.43, 1.44]	0.76 [0.42, 1.37]	0.80 [0.45, 1.43]	0.79 [0.44, 1.41]
Partnered	0.81 [0.46, 1.42]	0.80 [0.46, 1.38]	0.79 [0.45, 1.38]	0.80 [0.46, 1.38]	0.77 [0.45, 1.32]	0.78 [0.45, 1.33]
Retired	0.51 [0.30, 0.86]*	0.48 [0.29, 0.81]**	0.51 [0.30, 0.87]*	0.51 [0.30, 0.86]*	0.48 [0.29, 0.79]**	0.45 [0.26, 0.75]**
Education	1.06 [0.99, 1.12]	1.06 [0.99, 1.11]	1.06 [0.99, 1.12]	1.06 [1.00, 1.13]	1.05 [0.99, 1.11]	1.05 [0.99, 1.12]
Self-rated health	1.01 [0.77, 1.34]	1.15 [0.86, 1.53]	1.01 [0.76, 1.33]	0.92 [0.69, 1.21]	1.04 [0.78, 1.39]	1.08 [0.81, 1.46]
Pain(BP)		1.02[1.01, 1.04]**			1.02 [1.01, 1.05]**	1.02 [1.02, 1.04]*
Symptoms(BP)			0.98 [0.78, 1.22]		0.84 [0.65, 1.05]	0.85 [0.65, 1.12]
Self-efficacy(BP)				1.12 [1.03, 1.22]**	1.10 [1.01, 1.20]*	1.10 [1.02, 1.20]*
Pain(WP)		1.00[0.98, 1.01]			0.99 [0.98, 1.01]	0.99 [0.98, 1.01]
Symptoms(WP)			1.10 [0.96, 1.25]		1.24 [1.06, 1.45]**	1.23 [1.05, 1.44]**
Self-efficacy(WP)				1.11 [1.01, 1.22]*	1.12 [1.02, 1.24]*	1.13 [1.02, 1.24]*
Pain(BP)*Age						1.00 [0.99, 1.00]

(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Symptoms(BP)*Age						1.01 [0.96, 1.06]
Self-efficacy(BP)*Age						1.00 [0.98, 1.02]
Pain(WP)*Age						0.997 [0.99, 1.00]*
Symptoms(WP)*Age						1.00 [0.97, 1.00]
Self-efficacy(WP)*Age						0.99 [0.97, 1.03]
Intercept variance	1.98 [1.38, 2.86]*	1.82[1.26, 2.64]*	1.82[1.26, 2.64]*	1.83[1.26, 2.66]*	1.73[1.18, 2.50]*	1.74 [1.20, 2.53]*
-2LL	4128.31	4096.12	4102.42	4064.26	4042.42	4031.23
AIC	4186.31	4158.12	4164.42	4126.26	4112.42	4113.23
BIC	4325.48	4306.72	4313.02	4274.64	4279.91	4309.44

Note: OR = odds ratio, CIs = confidence intervals, WP = within-person, BP = between-person, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria. Random effects significance indicated by 95% CIs. Social activity potential range = 0−24, actual range = 0−23.

*$p < .05$, **$p < .01$, ***$p < .001$

[a]Models were built up in the following order:

Model 1 Baseline covariates

Model 2 Baseline covariates + within- and between-person pain

Model 3 Baseline covariates + within- and between-person symptoms

Model 4 Baseline covariates + within- and between-person self-efficacy

Model 5 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy

Model 6 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy + age interactions

4.4.2 Physical Activity

Table 4.3 presents results from multilevel models predicting physical activity. Education and self-rated health were positively related to physical activity in some models. Between-person self-efficacy was positively related to physical activity. There was no main effect of within-person pain on physical activity; however, Model 6 revealed a significant interaction with age. Simple slopes analysis indicated that physical activity was higher on days of greater pain for older adults (aged 70 years; OR = 1.04 [1.01, 1.07], $p = .01$) but not for middle-aged adults (55 years; OR = 0.99 [0.97, 1.01], $p = .48$). Within-person self-efficacy was positively related to physical activity. Model 6 indicated a significant interaction between age and within-person self-efficacy. Simple slopes analysis indicated that physical activity was higher on days of higher self-efficacy for older adults (aged 70 years; OR = 1.52 [1.22, 1.80], $p < .001$) but not for middle-aged adults (55 years; OR = 0.89 [0.73, 1.06], $p = .19$).

In order to evaluate our decision to exclude light activity from the physical activity measure (outlined in 4.3.2 Daily Measures), we conducted sensitivity analyses examining associations of the predictors with light activity and with a 3-item composite measure that included light, medium, and vigorous activity (see Appendix A for results). Models predicting light activity showed non-significant omnibus effects and no effects of self-efficacy on activity. Similarly, the effects of self-efficacy on the 3-item composite measure were reduced in magnitude, such that main effect of within-person self-efficacy on physical activity was not significant.

Table 4.3

Odds Ratios [and 95% Confidence Intervals] from Multilevel Ordered Logit Models Predicting Physical Activity[a]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Age	0.96 [0.91, 1.02]	0.96 [0.91, 1.02]	0.96 [0.91, 1.02]	0.95 [0.90, 1.01]	0.95 [0.90, 1.01]	0.94 [0.88, 1.00]*
Male	1.84 [0.90, 3.75]	1.94 [0.94, 3.97]	1.88 [0.91, 3.87]	1.80 [0.90, 3.62]	1.87 [0.92, 3.78]	1.79 [0.88, 3.64]
Partnered	1.05 [0.54, 2.07]	1.04 [0.53, 2.05]	1.03 [0.52, 2.04]	1.02 [0.53, 1.98]	1.00 [0.51, 1.96]	1.01 [0.52, 1.99]
Retired	1.02 [0.54, 1.92]	1.01 [0.53, 2.05]	1.03 [0.54, 1.95]	1.00 [0.54, 1.87]	1.00 [0.54, 1.88]	1.02 [0.54, 1.92]
Education	1.07 [1.00, 1.15]	1.07 [1.00, 1.15]	1.07 [1.00, 1.15]	1.08 [1.00, 1.15]*	1.08 [1.00, 1.16]*	1.08 [1.00, 1.16]*
Self-rated health	1.51 [1.08, 2.11]*	1.58 [1.11, 2.25]*	1.50 [1.07, 2.11]*	1.37 [0.97, 1.92]	1.41 [0.98, 2.02]	1.43 [0.99, 2.06]
Pain(BP)		1.01[1.00, 1.03]			1.01 [0.98, 1.03]	1.00 [0.98, 1.02]
Symptoms(BP)			0.95 [0.73, 1.25]		0.99 [0.73, 1.34]	0.98 [0.70, 1.39]
Self-efficacy(BP)				1.15 [1.03, 1.27]*	1.14 [1.03, 1.25]*	1.15 [1.03, 1.28]*
Pain(WP)		1.01[1.00, 1.03]			1.01 [0.99, 1.03]	1.01 [1.00, 1.03]
Symptoms(WP)			1.10 [0.94, 1.28]		1.07 [0.89, 1.27]	1.05 [0.87, 1.28]
Self-efficacy(WP)				1.11 [1.00, 1.24]*	1.12 [1.01, 1.25]*	1.13 [1.02, 1.26]*
Pain(BP)*Age						1.00 [0.99, 1.00]
Symptoms(BP)*Age						1.00 [0.94, 1.06]
Self-efficacy(BP)*Age						1.01 [1.00, 1.03]

(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Pain(WP)*Age						1.003 [1.00, 1.01]*
Symptoms(WP)*Age						1.00 [0.97, 1.06]
Self-efficacy(WP)*Age						1.04 [1.01, 1.06]**
Intercept variance	2.88 [2.03, 4.08]*	2.90[2.05, 4.10]*	2.90[2.05, 4.10]*	2.70[1.90, 3.84]*	2.74[1.93, 3.80]*	2.76 [1.94, 3.92]*
-2LL	2958.24	2932.52	2933.65	2917.60	2910.37	2885.56
AIC	2994.24	2.972.52	2.973.65	2957.60	2958.37	2951.56
BIC	3080.64	3068.39	3.069.52	3053.33	3073.22	3095.13

Note: OR = odds ratio, CIs = confidence intervals, WP = within-person, BP = between-person, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria. Random effects significance indicated by 95% CIs. Physical activity potential range = 0−16, actual range = 0−12.

**p* < .05, ***p* < .01, ****p* < .001

[a]Models were built up in the following order:

Model 1 Baseline covariates

Model 2 Baseline covariates + within- and between-person pain

Model 3 Baseline covariates + within- and between-person symptoms

Model 4 Baseline covariates + within- and between-person self-efficacy

Model 5 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy

Model 6 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy + age interactions

4.4.3 Mental Activity

Results from multilevel models predicting mental activity are shown in Table 4.4. Within-person symptoms were positively associated with mental activity, indicating that participants tended to engage in more mental activity on days when they experienced more symptoms (Models 3, 5, and 6). There were no other significant effects.

4.4.4 Supplementary Analyses

In order to further explore the nature of the within-person relationships, supplementary lagged analyses (see Appendix B for results) considered the temporal ordering of effects by examining associations of the within-person predictors (pain, symptoms, and self-efficacy at T - 1) on activity the following day (e.g., Neupert & Allaire, 2012). For each type of activity, Model 6 was re-specified to predict next-day activity, while also including same-day activity (activity at T - 1) and next-day predictors (pain, symptoms and self-efficacy at T) to control for autoregressive effects. There were no significant effects of pain, symptoms, or self-efficacy on next-day activity. We also partitioned activity variance into within- and between-person components (Hoffman & Stawski, 2009) and used a series of similar models to examine the reverse order of effects, i.e., whether within-person activity was associated with pain, physical symptoms, or self-efficacy the following day. There were no significant effects of activity on next-day pain, symptoms, or self-efficacy.

Table 4.4

Odds Ratios [and 95% Confidence Intervals] from Multilevel Ordered Logit Models Predicting Mental Activity[a]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Day	0.46 [0.35, 0.62]***	0.45 [0.33, 0.60]***	0.48 [0.36, 0.65]***	0.46 [0.34, 0.61]***	0.48 [0.36, 0.66]***	0.48 [0.36, 0.66]***
Day^2	1.08 [1.04, 1.12]***	1.08 [1.04, 1.13]***	1.08 [1.04, 1.12]***	1.08 [1.04, 1.12]***	1.08 [1.03, 1.12]***	1.08 [1.04, 1.12]**
Age	0.97 [0.91, 1.03]	0.97 [0.92, 1.04]	0.97 [0.91, 1.03]	0.96 [0.90, 1.03]	0.97 [0.91, 1.03]	0.96 [0.90, 1.03]
Male	1.27 [0.57, 2.81]	1.28 [0.58, 2.86]	1.28 [0.57, 2.89]	1.25 [0.56, 2.76]	1.26 [0.56, 2.82]	1.19 [0.53, 2.64]
Partnered	0.34 [0.16, 0.72]**	0.34 [0.16, 0.72]**	0.34 [0.16, 0.73]**	0.32 [0.15, 0.69]**	0.34 [0.16, 0.72]**	0.33 [0.15, 0.70]**
Retired	1.30 [0.64, 2.63]	1.24 [0.61, 2.53]	1.29 [0.63, 2.64]	1.31 [0.65, 2.65]	1.27 [0.62, 2.59]	1.30 [0.64, 2.66]
Education	1.03 [0.95, 1.12]	1.03 [0.95, 1.12]	1.03 [0.95, 1.12]	1.03 [0.95, 1.12]	1.03 [0.95, 1.12]	1.02 [0.94, 1.11]
Self-rated health	1.18 [0.81, 1.71]	1.26 [0.85, 1.86]	1.20 [0.82, 1.75]	1.09 [0.75, 1.61]	1.17 [0.77, 1.75]	1.14 [0.76, 1.73]
Pain(BP)		1.01[0.99, 1.03]			1.01 [0.99, 1.03]	1.01 [0.99, 1.04]
Symptoms(BP)			1.05 [0.79, 1.41]		1.00 [0.72, 1.39]	0.87 [0.60, 1.25]
Self-efficacy(BP)				1.09 [0.97, 1.23]	1.10 [0.97, 1.23]	1.09 [0.97, 1.23]
Pain(WP)		0.99[0.98, 1.01]			0.99 [0.97, 1.00]	0.99 [0.97, 1.00]
Symptoms(WP)			1.22 [1.08, 1.39]**		1.30 [1.11, 1.52]**	1.29 [1.10, 1.51]**
Self-efficacy(WP)				0.97 [0.88, 1.06]	0.98 [0.90, 1.08]	0.98 [0.89, 1.07]
Pain(BP)*Age						1.00 [0.99, 1.00]

(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Symptoms(BP)*Age						0.95 [0.90, 1.01]
Self-efficacy(BP)*Age						1.01 [0.99, 1.03]
Pain(WP)*Age						1.00 [1.00, 1.00]
Symptoms(WP)*Age						1.00 [0.97, 1.03]
Self-efficacy(WP)*Age						1.00 [0.98, 1.02]
Intercept variance	4.11 [3.09, 5.46]*	4.14[3.11, 5.50]*	4.25[3.20, 5.65]*	4.08[3.06, 5.44]*	4.15[3.12, 5.52]*	4.04 [3.03, 5.38]*
-2LL	4597.10	4556.46	4548.67	4524.98	4508.38	4500.17
AIC	4657.10	4620.46	4612.67	4588.98	4580.38	4584.17
BIC	4801.13	4773.85	4766.06	4742.16	4752.66	4785.17

Note: OR = odds ratio, CIs = confidence intervals, WP = within-person, BP = between-person, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria. Random effects significance indicated by 95% CIs. Mental activity potential range = 0−32, actual range = 0−22.

**p* < .05, ***p* < .01, ****p* < .001

[a]Models were built up in the following order:

Model 1 Baseline covariates

Model 2 Baseline covariates + within- and between-person pain

Model 3 Baseline covariates + within- and between-person symptoms

Model 4 Baseline covariates + within- and between-person self-efficacy

Model 5 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy

Model 6 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy + age interactions

4.5 Discussion

This study examined associations of within-person pain, symptoms, and self-efficacy with social, physical, and mental activity in middle-aged and older adults. Findings for self-efficacy were relatively consistent, indicating positive associations with social and physical activity. The effect of self-efficacy on physical activity was stronger for older adults. Results for pain and physical symptoms were less reliable. In contrast to our hypotheses, within-person symptoms were positively related to social and mental activity. In addition, within-person pain was positively associated with physical activity for older adults, but not middle aged adults. Supporting, our hypotheses, greater within-person pain was associated with being less socially active for older adults. These findings are discussed below.

4.5.1 Within-Person Self-Efficacy and Activity

Although we cannot make causal inferences from our data, the finding that participants engaged in more physical activity on days when self-efficacy was higher supports our hypothesis and corresponds with previous research that suggests that self-efficacy may promote daily physical activity (Dunton et al., 2009; Hekler et al., 2012). We extended these findings by including an interaction with age and found that self-efficacy was related to physical activity for older adults, but not for middle-aged adults. This supports our suggestion that having high self-efficacy may help protect against barriers to activity that become more common with increasing age. To our knowledge, this is the first study to demonstrate that middle-aged and older adults also participate in more social activity on days when self-efficacy is higher. It is important to understand factors that promote a range of activities, as activities requiring less physical exertion, such as social activity, confer benefits to older adults comparable to those related to physical activity (Glass et al., 1999).

The finding that physical and social activities are higher on days when self-efficacy is higher represents an important contribution to the literature. Processes linking self-efficacy and activity are assumed to occur within the individual but tend to be examined using between-person methods.

Within-person perspectives are needed in order to understand how experiences of self-efficacy and activity participation are associated during the day. The daily diary design used in this study, coupled with multilevel modelling, allowed analysis of how daily variability in self-efficacy predicted daily activity, highlighting the importance of examining intra-individual variability in control beliefs, rather than conceptualizing self-efficacy as a stable, trait-like attribute.

Previous studies have shown daily self-efficacy to be a protective psychological resource. For example, older adults' cognitive performance has been found to be better on days of higher self-efficacy (Neupert & Allaire, 2012). In addition, the effects of stress on older adults' negative affect have been found to be lower on days of higher perceived control (Diehl & Hay, 2010). The finding that higher daily self-efficacy is associated with more social and physical activity adds to the literature demonstrating that daily self-efficacy is linked to positive outcomes. It is important to note, however, that spending time with others and fulfilling social roles increases feelings of mastery and control (Thoits, 2011). In addition, mastery experiences, which could include successfully participating in physical activity, increase feelings of self-efficacy (Bandura, 1977). Experiencing positive interactions with others and engaging in physical activity could therefore have a reciprocal influence on daily self-efficacy.

The present study differs from previous research by using a general measure of self-efficacy that addresses beliefs about achieving goals and problem-solving, rather than beliefs related to one's ability to perform specific activities. Associations of between-person general self-efficacy and activity have been shown (Jopp & Hertzog, 2007; Langan & Marotta, 2000), however, most previous cross-sectional (e.g., Perkins et al., 2008; Warner, Ziegelmann, et al., 2011), and microlongitudinal (Dunton et al., 2009; Hekler et al., 2012) research has used activity-specific measures of self-efficacy. The finding that higher within-person general self-efficacy predicts greater activity is particularly notable because self-efficacy is most predictive of outcomes when measurement items are specifically related to the behaviour or goal (Bandura, 1997). This could have implications for developing interventions to promote activity; if self-efficacy increases activity, interventions targeting general self-efficacy may be effective for promoting engagement in multiple types of activity.

Although between- and within-person self-efficacy predicted social and physical activity, there was no association of self-efficacy with mental activity. This may be because the activities that we defined as mental, such as reading and writing, were not perceived as challenging in our well-educated sample. Individuals with higher self-efficacy choose more difficult behaviours and show more persistence to overcome obstacles or difficulties (Bandura, 1977, 1997). Self-efficacy may not be particularly relevant where the behaviour is perceived as easy with few obstacles to performance. Future research should assess differential effects of self-efficacy on activities according to the level of perceived difficulty.

4.5.2 Within-Person Pain and Activity

Findings for pain were less consistent than those for self-efficacy. In line with our hypotheses, social activity was lower on days when participants experienced more pain. This was the case for older adults, but not for middle-aged adults, supporting the assertion that declining resources may reduce older adults' ability to cope with pain (Charles, 2010). Older adults report that the experience of chronic pain leads to a reduction in social activity over time (Mackichan, Adamson, & Gooberman-Hill, 2013), but this is the first study we are aware of that links short-term within-person pain and social activity in older adults. Unexpectedly, we found that between-person pain was positively associated with social activity. Individuals with greater average pain may tend to spend more time interacting with health professionals, which could be reflected by item 1) *interacting with people who are not close family and friends*; however, supplementary analysis (not shown) indicated that between-person pain was most strongly associated with item 2) *leading, coaching, or mentoring others* and item 3) *in conversations or meetings that focused on solving problems*. It is possible that individuals with chronic pain regularly engaged in these more mentally demanding social activities through, for example, volunteering or other civic engagement, in lieu of physically demanding activities, and that any reduction in social activity over time was not able to be captured in the time frame of this study.

In contrast to our hypothesis, older adults engaged in more physical activity on days when pain was higher. It is unlikely that older adults chose to engage in more physical activity because they experienced more pain that day. Rather, participating in more physical activity likely led to increased pain. This is consistent with previous research showing that, although it can have a beneficial long term effect on pain, physical activity can cause transient increases in pain among older adults with chronic conditions, for example arthritis (Focht, Ewing, Gauvin, & Rejeski, 2002). Supplementary analyses did not show physical activity to be related to pain the following day, consistent with previous studies showing the negative effects of physical activity on pain to be relatively brief (e.g., Focht et al., 2002). The predicted negative association of between-person pain with physical activity was not found. It is possible that individuals experiencing regular or chronic pain develop effective strategies to adapt to and cope with their regular level of pain. However, when pain is experienced as worse than normal, they may still be affected.

The finding that neither between- nor within-person pain were associated with mental activity is not entirely surprising when considering that the activities classified as mental activity, such as reading and writing, are reasonably passive and unlikely to require considerable physical resources or be expected to exacerbate existing pain. Therefore, decisions regarding mental activity participation may be unaffected by the experience of pain.

4.5.3 Within-Person Physical Symptoms and Activity

There was no support for the prediction that participants would engage in less activity on days of higher physical symptoms. Contrary to the hypothesis, within-person symptoms were positively related to social activity. Individuals may seek social support on days when they experience more symptoms. Specifically, item 1) *interacting with people who are not close family and friends* could indicate visiting a health professional; however, supplementary analyses (not shown) suggested that the positive association was driven mainly by item 3) *conversations or meetings that focused on solving problems*. This association with problem solving may reflect symptoms arising from stress in the context of work or civic engagement. In addition, activities that require transport outside the home may increase exposure to potential triggers of symptoms, such as allergens that can cause congestion and allergy symptoms.

Interestingly, the effect of within-person symptoms was only evident when all predictors were considered simultaneously (Models 5 and 6). This may be due to a suppression effect of self-efficacy. Within-person self-efficacy was positively associated with social activity (see Table 4.2) and negatively associated with within-person symptoms (r = -.12, p < .001). Omission of a suppressor leads to underestimation of the relationship between the predictor and dependent variable, but including the suppressor can enhance the relationship (Cohen, Cohen, West, & Aiken, 2013). The positive within-person effects of physical symptoms may therefore have occurred only in the full model as the variance of self-efficacy was accounted for.

Within-person symptoms were not related to physical activity. Although our findings suggested that physical activity may cause a temporary increase in pain, a similar association may not have been found for physical symptoms because many of the symptoms are related to conditions that would not be caused by activity, for example, sore throat and congestion. Contrary to the hypothesis, within-person symptoms were positively related to mental activity. When chronic illness leads to a reduction in activities such as social and physical activity, activities like listening to music, reading, and writing are commonly chosen as replacement activities (Duke, Leventhal, Brownlee, & Leventhal, 2002). A similar process may occur at the daily level, with individuals increasing engagement in less physically demanding activity on days when more symptoms are present.

No effects of between-person symptoms on activity were found. Similar to our above suggestion for pain, we may not have found any negative associations of between-person symptoms with activity because individuals may learn to cope with regular symptoms. Cross-sectional comparisons may underestimate the effects of symptoms on activity when fluctuations in symptoms, rather than average level, are the more important predictor.

4.5.4 Limitations and Future Directions

This study highlights the utility of using microlongitudinal methods to examine between- and within-person effects of predictors on daily activity; however, we note some limitations and directions for future research. Firstly, although summing scores from ordinal scales is common in activity research (e.g., Janke et al., 2006; Paganini-Hill et al., 2011), the response options did not allow us to calculate time spent in each activity. Nonetheless, our approach allowed us to examine variation in activity, capturing increases and decreases across days. In addition, self-report measures of activity may be prone to under- or over-estimation. Analyses removing two outliers that appeared to reflect over-reporting (not shown) did not change the results, but reporting bias may still be present. In particular, self-report measures of physical activity (e.g., diaries and questionnaires) tend to be less accurate than direct or objective methods (e.g., accelerometry and heart rate monitoring), with studies showing that under- and over-reporting often occur (Prince et al., 2008). Nonetheless, the results of the sensitivity analysis suggest that participants were able to differentiate between participation in different types of physical activity, supporting the utility of self-report measures of activity when more intensive objective measures are not available.

We also note that the social activity measure indicates broader social engagement, but does not include activity with family and friends. Whereas activities such as mentoring may be relatively more likely to occur outside the home, activity with family and friends may be more likely to occur inside the home or indirectly (e.g., over the telephone). Activity with family and friends may therefore require fewer physical resources and be more weakly associated with pain and physical symptoms as compared to the items used in this study. In addition, our index of social activity included two activities that likely have a high degree of mental complexity (i.e., mentoring; and group problem solving; Bielak, 2017). Self-efficacy may have a greater influence on social activities that are perceived to be more physically or mentally complex but play less of a role in activities with fewer barriers to participation, such as interacting with close others. Future research may benefit from examining different types of social activity.

Although we proposed causal relationships governing associations of pain, symptoms, and self-efficacy with activity, we were unable to ascertain the true direction of effects. Supplementary analyses examining pain, symptoms, and self-efficacy as predictors of next-day activity, as well as activity as a predictor of next-day pain, symptoms, and self-efficacy, did not indicate the temporal ordering of associations. Lagged associations may not have been evident because participants were asked to complete the daily assessments on any 7 days within 2 weeks; therefore not all assessments were completed on consecutive days. Using only consecutive assessments approximately halved the number of observations, reducing statistical power. Bias may also have occurred if characteristics of the participants' experiences during the day caused them to skip that day's assessment. In addition, within-person processes linking self-efficacy, pain, and symptoms with activity may occur within the day but not across days. Lagged within-day associations between self-efficacy and physical activity have previously been found (Dunton et al., 2009). Future research should examine predictors of daily activity using multiple assessments per day on consecutive days, allowing simultaneous examination of within-day and across-day associations.

Finally, the characteristics of our sample pose some limitations. The sample was relatively small; therefore low statistical power may have resulted in non-significant effects and may have reduced the available power to test age interactions (although several reliable age interactions were found). In addition, the sample included predominantly middle-aged and young-old adults. We predicted that associations of pain, symptoms, and self-efficacy with activity would be stronger for older adults but our sample did not include adults aged over 85 years. Between-person associations of self-efficacy with activity have been found in research that included the oldest-old (e.g., Perkins et al., 2008), but research examining within-person processes among the oldest-old is scarce. Research using measurement burst designs comprising multiple microlongitudinal data collections over time (Sliwinski, 2008) would provide further insight into developmental effects by simultaneously examining short-term variability, long-term within-person change, and how within-person relationships change over time. We also note that participants were generally healthy, with 89% rating their health as good, very good, or excellent. Of particular relevance, most participants reported only low levels of pain and physical symptoms. Associations between pain, symptoms, and activity may differ for those with poor health and more debilitating pain or symptoms. Future research should aim to replicate these findings in a larger, more diverse sample.

We note that the effect sizes observed in our study generally appear small. This could be because the relatively young and healthy sample experienced fewer barriers to activity participation than are likely to be evident in the general population. However, small effects are typical when examining daily variation in behaviour as many other contextual variables play a role (e.g., weather). Nonetheless, our novel findings suggest the value of further research in this area. A more diverse sample including oldest-old adults and individuals with lower self-efficacy and more severe pain and symptoms may allow observation of stronger associations. Indeed, future research examining individuals most as risk for decline in activity is an important next step in considering interventions to promote activity.

4.5.5 Conclusion

This study examined predictors of daily activity in middle-aged and older adults. We predicted that daily pain and physical symptoms would be risk factors for daily activity, whereas daily self-efficacy would be positively associated with daily activity. Findings for pain and physical symptoms were not consistent. Within-person symptoms showed some positive associations with activity, whereas pain showed positive and negative associations. These divergent findings suggest that different causal process might govern associations of pain and symptoms with activity and highlight the need for further examination in order to better understand these relationships. In contrast, results for self-efficacy were relatively consistent, showing short-term covariation with physical and social activity. Cross-sectional and longitudinal research assumes self-efficacy is a relatively stable construct and tends to employ a between-person framework. Although we cannot infer causation, the daily diary design allowed us to demonstrate that daily fluctuations in self-efficacy may also influence activity participation. This supports the notion of self-efficacy as a dynamic self-regulatory process (Neupert & Allaire, 2012) and suggests that, although general level of self-efficacy is important in predicting activity, within-person approaches examining dynamic processes are also needed.

This study is an important step in understanding dynamic factors that may influence daily activity and suggests some avenues for additional research. Future research could use multiple assessments per day on consecutive days in order to simultaneously examine within- and across-day associations of pain, symptoms, and self-efficacy with activity. In addition, future research may benefit from including different types of social activity, as well as more diverse samples including oldest-old adults and those with more severe pain and physical symptoms.

CHAPTER

5

PERCEIVED EASE OF ACTIVITY (BUT NOT STRATEGY USE) MEDIATES THE RELATIONSHIP BETWEEN SELF-EFFICACY AND ACTIVITY ENGAGEMENT IN MIDLIFE AND OLDER ADULTS

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Author Contributions

RGC planned the project and was responsible for the day-to-day administration of the project, including participant recruitment, data collection, and data management. RGC also analysed the data, wrote the manuscript, and edited the manuscript based on the co-author's comments. TDW contributed to planning the project, supervised the project, provided advice on data analysis, provided feedback on the manuscript draft, and contributed to editing the manuscript.

5.1 Abstract

Activity participation is associated with a range of positive outcomes in older adults, but tends to decline with age. Considerable research links self-efficacy with activity, suggesting that beliefs about one's capability may play an important role in mitigating age-related activity decline. However, the processes underlying these associations are not well understood. This study used structural equation modelling with cross-sectional data from 412 adults aged 50 to 93 years to examine whether perceived ease of activity and use of adaptive strategies mediated the association between self-efficacy and activity. Perceived ease of activity mediated the positive associations between self-efficacy and social and physical (but not mental) activity. Use of adaptive strategies was not a significant mediator. This study suggests that self-efficacy may influence older adults' perception of activities and, in turn, the activities they choose to participate in, and has potential implications for developing interventions to promote activity in later life.

5.2 Introduction

Activity participation is associated with a range of positive outcomes in older adults, including greater emotional well-being, better physical and cognitive functioning (e.g., Menec, 2003), reduced incidence of dementia (H.-X. Wang et al., 2002), and longevity (Glass et al., 1999). Research suggests, however, that overall activity participation declines with age (e.g., Agahi et al., 2006). In addition, research has shown age-related declines in specific activities including physical (e.g., Resnick, 2004) and social activities (e.g., Bukov et al., 2002). Understanding risk and protective factors is therefore important in order to facilitate activity participation in later life. Considerable research links control beliefs with older adults' activity engagement, suggesting that control beliefs may play an important role in helping older adults minimize age-related activity decline.

Perceived control refers broadly to beliefs about one's general ability to realize desired outcomes, whereas self-efficacy encompasses beliefs that one can successfully perform the particular behaviours required to obtain desired outcomes (Bandura, 1977; Lachman et al., 2011). Longitudinal research has shown higher exercise self-efficacy to be associated with greater exercise frequency 6 (Warner, Schüz, et al., 2011) and 12 months later (Warner, Ziegelmann, et al., 2011). In addition, research has shown 18-month (Resnick, 2004) and 4-year change (S. M. White et al., 2012) in exercise self-efficacy to be related to change in physical activity over the same period. Though fewer longitudinal studies examine control beliefs and social activity in older adults, research has demonstrated reciprocal 3-year relationships between perceived control and social activity (see Chapter 2; Curtis, Huxhold, & Windsor, 2016). Using shorter and more intensive time-scales, microlongitudinal studies have shown that, when participants reported greater confidence in their ability to engage in physical activity in the next few hours, they were more likely to report greater activity during the following assessment period (Dunton et al., 2009). In addition, older adults have been found to participate in more social and physical activity on days when they report higher general self-efficacy (see Chapter 4; Curtis, Windsor, Mogle, & Bielak, 2017).

These relationships suggest the possibility that interventions aimed at improving self-efficacy may help to facilitate activity in later life; however, the mechanisms behind these relationships are not well established. Research that examines the potential processes that underlie the association between control beliefs and activity is an important preliminary step in identifying the characteristics of interventions that might be most effective in promoting activity. We propose that (i) perceived ease of activity and (ii) use of selection, optimization, and compensation (SOC) strategies may each partially account for the relationship between self-efficacy and activity engagement in older adults.

5.2.1 Perceived Ease of Activity: Rationale and Preliminary Evidence

Social cognitive theory states that self-efficacy is a significant determinant of behaviour because individuals are more likely to choose environments and tasks that they believe they can cope with, and are more likely to engage in challenging behaviours if they believe they are capable of them and avoid situations that they interpret as threatening (Bandura, 1977, 1997). Perceptions of task difficulty are based on the congruence between perceived task demands and personal abilities and resources (Klumb, 2001). Due to their perception of greater personal abilities, individuals with higher self-efficacy may anticipate that desired activities, particularly complex or demanding activities, will be easier for them to do and therefore be more likely to initiate these activities. Conversely, individuals with low self-efficacy are likely to perceive tasks to be more difficult (Bandura, 1997).

Research evidence supports associations of perceived ease of activity with self-efficacy and activity engagement. Studies have shown that older adults with higher self-efficacy tend to report their daily activities as easier than those with lower self-efficacy (Klumb, 2001), and that reported difficulty of daily activities is associated with greater decline in activity in older adults (Pushkar et al., & Maag, 1997; Rousseau et al., 2005). Although one study showed that the relationship between self-efficacy and apathy (a reduction in voluntary goal-directed behaviours as reported by a close relative) was mediated by subjective task demand (Esposito et al., 2014), we are aware of no studies that simultaneously examine associations among self-efficacy, perceived ease of activity, and activity engagement in older adults.

5.2.2 SOC: Rationale and Preliminary Evidence

In addition to influencing perceived ease of activity, self-efficacy may promote the use of SOC strategies that assist in adapting to age-related changes that can adversely affect activity, such as reduced mobility (Agahi et al., 2006), sensory impairment (Marsiske et al., 1997), and driving cessation (Marottoli et al., 2000). Successful coping and adaptation is suggested to involve selecting and prioritizing goals and activities, optimizing means or resources using strategies such as increasing time or effort, and compensating using alternative methods or resources to achieve goals when previous means become limited (P. B. Baltes & Baltes, 1990). Control beliefs are thought to promote effective self-regulation through the use of adaptive strategies (Lachman, 2006), affecting how individuals utilize existing resources (Skinner, 1995), and influencing how much effort they expend, how long they persist, and how they solve problems and devise strategies to overcome challenges (Bandura, 1997). Therefore, when experiencing age-related changes that could affect activity engagement, individuals with higher self-efficacy may engage in more effective SOC by prioritizing activity-related goals, increasing their effort, or finding alternative ways to participate in their activities.

Supporting these assertions, SOC has been shown to correlate with environmental mastery (the perceived ability to manage one's life and environment) in adolescents and adults (Freund & Baltes, 2002) and general perceived control in midlife and older adults (Hahn & Lachman, 2015).

Qualitative research indicates that older adults use adaptive strategies that reflect SOC processes in order to enable reengagement or continuation in their leisure activities when experiencing chronic health conditions (Hutchinson & Nimrod, 2012) or rehabilitation following an acute health event (Hutchinson & Warner, 2014). In addition, quantitative studies have shown SOC to be associated with leisure-time physical activity in midlife and older adults (Son et al., 2009) and adults with arthritis (Son & Janke, 2015). An association of SOC with leisure repertoire (the number of activities reported) has also been shown (Janke et al., 2015). Although this study examined self-efficacy for managing arthritis symptoms, it did not examine whether arthritis self-efficacy was related to SOC.

Few studies have examined the association of SOC with both self-efficacy and activity engagement in older adults. In a sample of younger and older adults engaged in orthopaedic rehabilitation, exercise self-efficacy was correlated with SOC and physical activity goal attainment 12 months after discharge (Ziegelmann & Lippke, 2007a). In addition, SOC predicted physical activity goal attainment. The study did not assess whether SOC mediated the association between exercise self-efficacy and physical activity. Further analysis showed that maintenance self-efficacy (confidence in engaging in physical activity on a long-term basis) was correlated with SOC and exercise frequency (Ziegelmann & Lippke, 2007b). SOC also predicted exercise and partially mediated the association between perceived loss of resources and exercise; however, the study did not assess whether SOC mediated the association between maintenance self-efficacy and exercise. In a separate study, among adults aged 50 years and older, use of self-regulation strategies to promote exercise partially mediated the association between exercise self-efficacy and physical activity (Umstattd et al., 2008). Although the strategies were not SOC-specific, this study supports the notion that self-efficacy may affect activity engagement by promoting older adults' use of adaptive strategies. We are aware of no mediation studies concerned with late life activity engagement that examine SOC-specific strategies or non-physical activity.

5.2.3 The Present Study

The present study used structural equation modelling with data from a cross-sectional survey to examine associations between self-efficacy and engagement in social, physical, and mental activity, and whether these associations were mediated by perceived ease of activity and use of SOC strategies. We employed a general measure of self-efficacy that addresses beliefs about one's ability to achieve goals and solve problems (Schwarzer & Jerusalem, 1995). Although self-efficacy is expected to be less predictive of outcomes when the measurement items are not specific to the behaviour (Bandura, 1997), findings related to general self-efficacy have the potential to inform the development of interventions that are relevant for promoting engagement in multiple types of activity. Whereas previous studies examine perceived difficulty of regular or current activity, the present study asks participants how difficult they would find the activity if they were asked to do it, in order to account for the possible effects of perceived difficulty of activity on non-participation. In line with the theoretical view that the strategies comprising SOC work together to facilitate positive outcomes (Freund & Baltes, 2002), and in keeping with previous research (e.g., Janke et al., 2015; Ziegelmann & Lippke, 2007a), we used a composite SOC factor as a general index of adaptive potential rather than examining selection, optimisation, and compensation separately.

Although this study was primarily interested in older adults, midlife adults were included in order to examine whether the predicted associations differed across the second half of life. In particular, increasing age tends to be met with a decline in physical, cognitive, and psychological resources (P. B. Baltes & Smith, 2003). SOC may therefore be more important in assisting those in later life to adapt to these changes and overcome barriers to activity, relative to middle-aged adults typically experiencing fewer of these ageing-related changes.

5.3 Methods

5.3.1 Participants and Design

Participants were a convenience sample of 412 Australian adults aged 50 to 93 years who responded to an invitation to participate in a survey on leisure activity. Invitations were distributed through newsletters and emails to members of seniors advocacy, educational, and social organizations, and to individuals who previously provided consent to be contacted about research participation opportunities (see Appendices C−G for participant documentation). Participants completed an online self-report questionnaire containing a range of demographic, health, and psychological measures, as well as measures of activity participation, perceived ease of activity, and SOC strategies related to leisure activity participation (see Appendix H). Relevant measures are outlined below. Table 5.1 shows descriptive statistics and correlations for the predictors of activity participation. This research was approved by the Flinders University Social and Behavioural Research Ethics Committee.

5.3.2 Measures

5.3.2.1 Self-efficacy. Self-efficacy was measured using the Generalized Self-Efficacy Scale (Schwarzer & Jerusalem, 1995). Participants indicated their agreement with ten statements such as "I can always manage to solve difficult problems if I try hard enough" and "It is easy for me to stick to my aims and accomplish my goals" on a scale with options (1) *not at all true* to, (2) *hardly true*, (3) *moderately true*, and (4) *exactly true*. Items were summed to produce a score with a potential range of 10 to 40, with higher scores indicating greater self-efficacy. The scale showed high internal consistency ($\alpha = .91$).

Table 5.1

Descriptive Statistics and Correlations for Predictors of Activity Participation

Variables	*n*	Range	*M*(*SD*)	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Age (years)	411	50–93	70.17 (8.46)	-.10 *	-.06	.33***	.01	.15 **	-.37***	.06	-.03	-.06	.03	-.16**
2. Gender (female %)	411		75.18	–	-.15 *	.04	.11 *	.02	-.03	.05	-.10	.08	-.02	.10
3. Education	408	6–46	16.23 (4.48)		–	.03	.01	-.05	-.02	.11 *	-.10	-.04	.03	-.02
4. Functional Limitation	402	10–30	13.89 (4.35)			–	-.24 ***	-.04	-.71***	-.04	-.04	.10*	-.11*	-.16**
5. Self-efficacy	394	19–40	33.32 (4.40)				–	.27 ***	.21***	.18 ***	.03	.12*	.35***	.18***
Perceived ease of activity														
6. Social activity	385	2–7	6.00 (1.41)					–	.12*	.28 ***	-.08	-.002	.17**	.12*
7. Physical activity	385	1–7	5.48 (1.86)						–	.11 *	.05	-.05	.21***	.27***
8. Mental activity	385	2–7	6.60 (0.89)							–	-.01	-.01	.21***	-.002
SOC														
9. Elective selection	392	0–12	3.94 (3.12)								–	.45***	.29***	.17**
10. Loss-based selection	385	0–12	3.83 (2.85)									–	.27**	.04
11. Optimization	387	0–12	6.53 (3.19)										–	.46***
12. Compensation	384	0–12	2.91 (2.84)											–

Note: Pearson's correlation coefficient, except correlations with gender use Spearman's rho. Higher scores indicate higher education, greater functional limitation, higher self-efficacy, greater perceived ease of activity, and greater use of SOC strategies.

*$p < .05$, **$p < .01$, ***$p < .001$

5.3.2.1 SOC strategies for leisure activity. SOC strategies were measured using an adapted version of P. B. Baltes and colleagues' (1999) 12-item SOC questionnaire, which examines broad processes of adaptation and strategy-use related to goal striving in unspecified domains. For this study, the items were modified to specifically examine how individuals used SOC strategies in their leisure activities (see Son & Janke, 2015 for a similar example). The 12-item questionnaire comprised four 3-item subscales representing the SOC strategies elective selection, loss-based selection, optimisation, and compensation. For each item, two persons were presented. One person exemplified use of the target SOC behaviour (e.g., "I concentrate all my energy on a few leisure activities" as an indicator of elective selection), while the other indicated an alternative non-SOC behaviour (e.g., "I divide my energy among many leisure activities"). Participants indicated which of the two persons was most similar to them. Participants also indicated how much they thought they would behave like the person they indicated as being most similar to them, using a scale with options (1) *a little*, (2), *moderately*, (3) *a lot*, and (4) *exactly* (e.g., Bajor & Baltes, 2003). For each item, participants received a score of 0 if they selected the non-SOC behaviour or their rating of 1 to 4 if they selected the SOC behaviour

To reduce measurement error, analyses used a latent SOC factor comprising the four 3-item subscales. Coefficient alphas were generally low (elective selection α = .54; loss-based selection α = .48; optimisation α = .73; compensation α = .55); however, items within the subscales are designed to measure different aspects of the particular strategy, with low reliability also evident in previous studies using similar scales (e.g., Bajor & Baltes, 2003). A confirmatory factor analysis with each subscale loading onto a latent SOC factor initially showed a poor fit to the data (χ^2 (3) = 84.2, $p < .001$; CFI = .67; RMSEA = .25) with standardized regression weights ranging from .33 to .84. Allowing item residuals for loss-based selection and elective selection (which have considerable conceptual and item overlap) to covary resulted in good model fit (χ^2 (2) = 7.50, p =

.02; CFI = .98; RMSEA = .08), though inclusion of this parameter did not change the results and was therefore not included in the main models.

5.3.2.1 Perceived ease of activity. Participants rated how difficult they would find a range of activities if they were asked to do them on a scale ranging from (0) *very easy*, to (7) *very difficult*. Activities were 1) physical activities, such as walking or playing sports; 2) social activities, such as meeting friends and attending a social club or senior's centre; and 3) mental activities, such as doing crosswords or reading a book or newspaper. Scores were reversed so that higher scores indicate greater perceived ease of activity.

5.3.2.1 Activity. Participants completed a modified version of the Activity Characteristics Questionnaire (ACQ; Bielak, 2017) that was adapted to reflect a weekly (rather than daily) timeframe. Participants were asked to indicate how much time they spend in a typical week participating in 27 activities on a scale ranging from (1) *no time at all*, through (2) *some time but less than 15 min*, (3) *between 15 and 30 min*, (4) *between 31 min and 1 hr*, (5) *1 to 2 hr*, (6) *2 to 4 hr*, (7) *4 to 8 hr*, (8) *8 to 12 hr*, and (9) *more than 12 hr*.

Three latent variables indicating social, physical, and mental activity were constructed for use in the current study. As leisure activity was the focus, only conceptually relevant items were used. We therefore excluded activities that did not fit this definition, such as shopping and organizing. Light physical activity was excluded a priori because it requires fewer physical resources and therefore may not be positively associated with self-efficacy in the same way as medium and vigorous activity (i.e., individuals with lower self-efficacy may engage in more light activity in lieu of more difficult activity). We also excluded mental games testing knowledge or vocabulary, and mental games testing memory, reasoning or spatial abilities, as these activities did not load on the latent mental activity factor and caused poor model fit. The final activity variables were constructed using 15 items from the ACQ as outlined below. Confirmatory factor analysis indicated that the proposed activity categories provided a moderate fit to the data (χ^2 (87) = 386.76,

$p < .001$; CFI = .91; RMSEA = .10). Standardized regression weights ranged from .40 to .84. Intercorrelations for the latent activity factors were: social–physical $r = .29$; social–mental $r = .76$; and mental–physical $r = .17$.

Social activity comprised 1) interacting with your closest confidantes (i.e., those few who you are closest to; e.g., spouse, children) either talking face-to-face, on the phone, or video calls such as via Skype; 2) interacting with people who are not your closest confidantes (i.e., any person not included in the previous question); 3) meeting new people (i.e., where face-to-face introductions took place); and 4) attending community events (e.g., going to a concert or play, visiting a museum or gallery, sporting events, religious events); 5) actively participating in conversations or meetings that focussed on solving a problem; and 6) leading, coaching, supervising, teaching, or mentoring others.

Physical activity comprised 1) medium-intensity activity or exercise (i.e., moderate increase in breathing, light sweating, but you could have pushed yourself further); 2) vigorous-intensity activity or exercise (i.e., breathing heavily, sweating heavily, pushing your body/heart-rate to a high intensity); and 3) physical activity alongside or while interacting with other people.

Mental activity comprised 1) actively reading, either online (e.g., emails) or in paper-form (e.g., newspapers, letters, mail); 2) writing (of any kind, e.g., emails, stories, letters); 3) actively listening to information (e.g., attending a lecture, listening to talk radio at home or in the car, TV news); 4) finding or researching information using the internet, or reference books/materials; 5) solving a problem on your own (e.g., work, car, finances, research, travel); and 6) working on complex decisions (i.e., requires lots of thought, have to consider multiple factors, and there will be different consequences depending on what you choose).

5.3.2.2 Covariates. Covariates were age (years), gender (1 = *male*, 2 = *female*), education (years), and functional limitation. Functional limitation was measured using the physical functioning subscale of the RAND 36-Item Health Survey (SF-36; Hays, Sherbourne, & Mazel, 1993). Participants indicated whether their health limited them (1) *not at all*, (2) *a little*, or (3) *a lot* in ten daily activities (vigorous activities, such as running, lifting heavy objects, participating in strenuous sports; moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf; lifting or carrying groceries; climbing several flights of stairs; climbing one flight of stairs; bending, kneeling, or stooping; walking more than 1 km; walking several blocks; walking one block; and bathing or dressing). Items were summed to produce a score ranging from 10 to 30, with higher scores indicating greater functional limitation. The scale showed high internal consistency (α = .92).

5.3.3 Analysis

Structural equation modelling was used to examine whether the effect of self-efficacy on activity was mediated by SOC and perceived ease of activity. Figure 5.1 outlines the model that forms the basis of the analysis. The measurement model (i.e., loadings of the SOC subscales on the latent SOC factor and the individual activities on the latent activity factor) is excluded for simplicity. Significant indirect effects indicate mediation. The indirect effect of self-efficacy on activity via SOC is calculated as the product of the unstandardized paths linking self-efficacy to SOC and SOC to activity (a_1*b_1). The indirect effect of self-efficacy on activity via perceived ease of activity is the product of the unstandardized paths linking self-efficacy to perceived ease and perceived ease to activity (a_2*b_2). The total indirect effect is calculated as the sum of the specific indirect effects [$(a_1*b_1) + (a_2*b_2)$]. The direct effect of self-efficacy on activity (i.e., the remaining effect that is not via the mediators) is indicated by c'. The total effect (c) of self-efficacy on activity is the sum of the direct effect and all of the specific indirect effects (see e.g., B. Muthén, 2011; Preacher & Hayes, 2008).

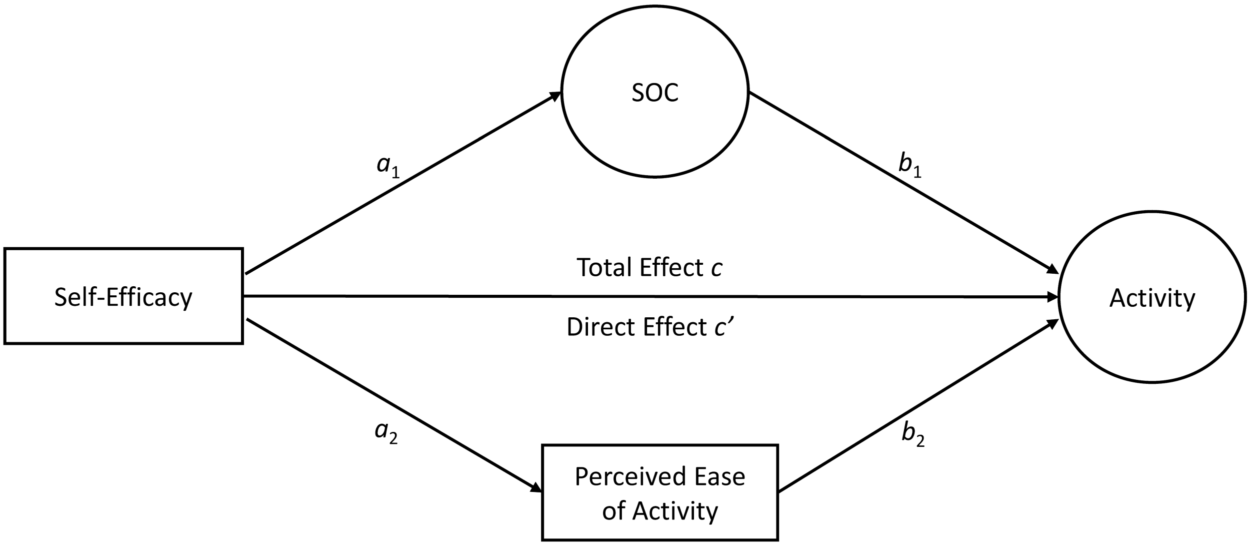

Figure 5.1. Structural equation model estimating SOC and perceived ease of activity as mediators of the relationship between self-efficacy and activity.

Social, physical, and mental activity were analysed in separate models as distinct outcome variables. For perceived ease of activity, models included only the item relevant to the specific outcome variable. For each activity, an unadjusted model contained no covariates, and an adjusted model controlled for age, gender, education, and functional limitation by including paths to both mediators and activity. All models specified that the mediators covary. Activity items were treated as ordinal categorical due to the nature of the response scale, and all continuous variables were converted to standardized z-scores. Analyses used Bayesian estimation to obtain parameter estimates and 95% credibility intervals (or posterior probability intervals, which indicate that, given the observed data, there is a 95% chance that true value of the parameter is within this interval) for the individual paths, indirect effects, and total effects. Coefficients were considered significant if the credibility interval did not include zero (B. Muthén & Asparouhov, 2012). Bayes is a full-information estimator that can accommodate missing data and categorical variables. In addition, Bayes does not assume normality of the sampling distribution of parameter estimates and is therefore useful for mediation models where indirect effects are rarely normally distributed (see e.g., B. Muthén & Asparouhov, 2012; Y. Yuan & MacKinnon, 2009). Analyses were conducted in Mplus 7.11 using non-informative priors and two independent Markov chain Monte Carlo (MCMC) chains to compute credibility intervals of the posterior distribution with equal tail percentages.

5.4 Results

5.4.1 Social Activity

Figure 5.2 shows path coefficients for the model estimating SOC and perceived ease of social activity as mediators of the relationship between self-efficacy and social activity. In both the unadjusted and adjusted models, self-efficacy was positively associated with SOC and perceived ease of social activity. In turn, perceived ease of activity was positively associated with social activity, conditional on the effects of self-efficacy. SOC did not, however, predict social activity. The direct effect of self-efficacy on social activity was also non-significant.

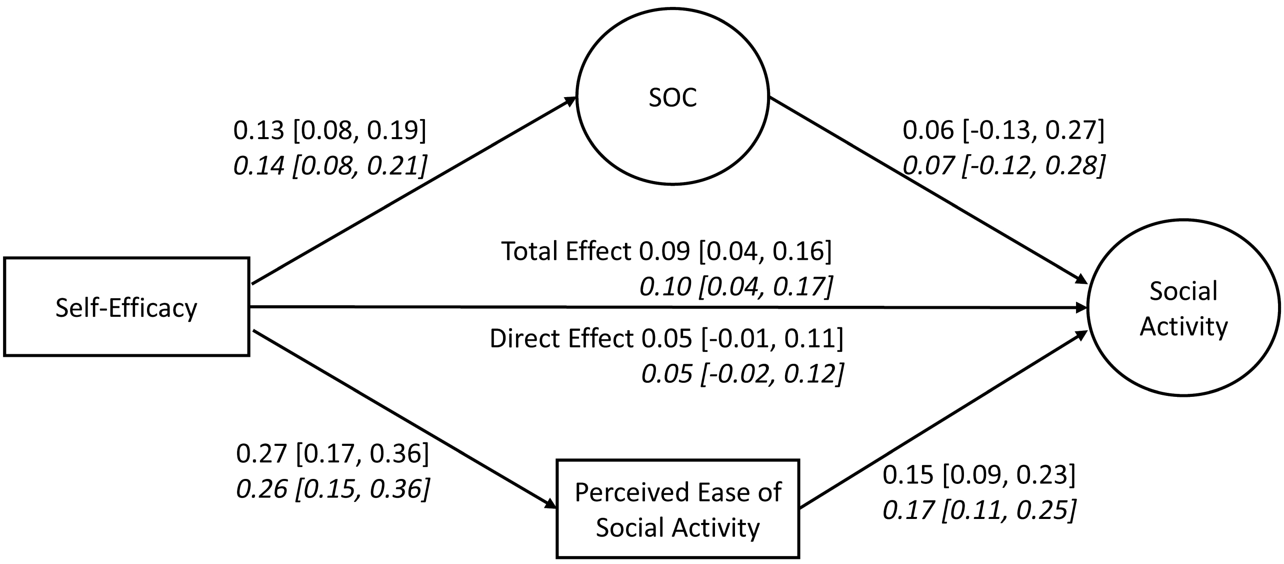

Figure 5.2. Unstandardized path coefficients [and Bayesian 95% credibility intervals] for the relationship between self-efficacy and social activity via SOC and perceived ease of activity. Italics indicate results controlling for age, gender, education, and functional limitation.

In both unadjusted and adjusted models, the total indirect effect of self-efficacy on social activity via the mediators was significant (unadjusted 0.05 [0.02, 0.09]; adjusted 0.05 [0.02, 0.09]). In addition, the specific indirect effect of self-efficacy on social activity via perceived ease of activity was significant (unadjusted 0.04 [0.02, 0.07]; adjusted 0.04 [0.02, 0.07]). Contrary to the hypothesis, however, the indirect effect of self-efficacy on social activity via SOC was not significant (unadjusted 0.01 [-0.02, 0.03]; adjusted 0.01 [-0.02, 0.04]). The unadjusted and adjusted models explained 15% (R^2 = .15 [0.08, 0.22]) and 19% (R^2 = .19 [0.12, 0.28]) of the variance in social activity, respectively.

5.4.2 Physical Activity

Figure 5.3 shows path coefficients for the model estimating SOC and perceived ease of physical activity as mediators of the relationship between self-efficacy and physical activity. The pattern of results for the unadjusted model was similar to that for social activity. Self-efficacy was positively associated with SOC and perceived ease of physical activity. In turn, perceived ease of physical activity was positively associated with physical activity, conditional on the effects of self-efficacy. However, the path from self-efficacy to perceived ease of activity was not significant in the adjusted model. Paths from SOC to physical activity and the direct effect of self-efficacy on physical activity were not significant in either model.

In both models, the total indirect effect of self-efficacy on physical activity via the mediators was significant (unadjusted 0.20 [0.11, 0.31]; adjusted 0.08 [0.01, 0.16]). In addition, the specific indirect effect of self-efficacy on physical activity via perceived ease of activity was significant in the unadjusted model (0.16 [0.08, 0.25]), but not the adjusted model (0.04 [-0.01, 0.09]). The indirect effect of self-efficacy on physical activity via SOC was not significant (unadjusted 0.04 [-0.02, 0.11]; adjusted 0.04 [-0.01, 0.11]). The unadjusted and adjusted models explained 43% (R^2 = .43 [0.33, 0.52]) and 45% (R^2 = .45 [0.35, 0.54]) of the variance in physical activity, respectively.

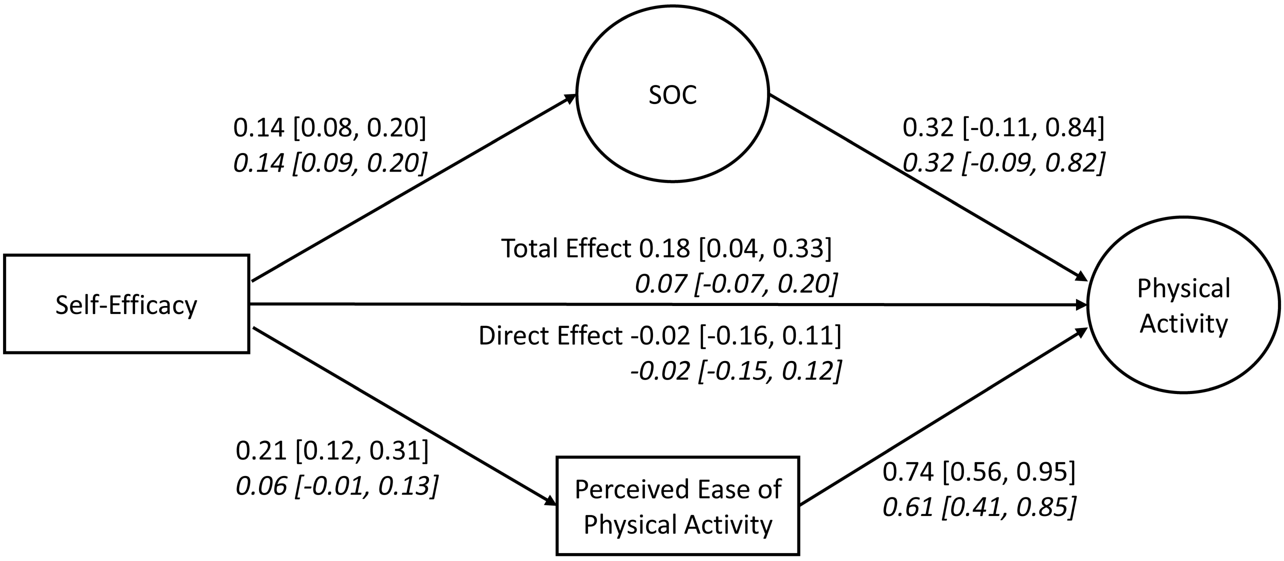

Figure 5.3. Unstandardized path coefficients [and Bayesian 95% credibility intervals] for the relationship between self-efficacy and physical activity via SOC and perceived ease of activity. Italics indicate results controlling for age, gender, education and functional limitation.

5.4.3 Mental Activity

Figure 5.4 shows path coefficients for the model estimating SOC and perceived ease of mental activity as mediators of the relationship between self-efficacy and mental activity. In the unadjusted and adjusted models, self-efficacy was positively associated with SOC and perceived ease of mental activity. In addition, the direct effect of self-efficacy on mental activity was significant. However, paths from SOC and perceived ease of activity to mental activity were not significant.

In both models, neither the indirect effect of self-efficacy on mental activity via SOC (unadjusted 0.004 [-0.03, 0.04]; adjusted 0.003 [-0.03, 0.04]), nor the indirect effect of self-efficacy on physical activity via perceived ease of activity (unadjusted 0.01 [0.000, 0.03]; adjusted 0.01 [-0.001, 0.03]) were significant (although the effect for perceived ease of activity was positive, we considered this to be non-significant as the credibility interval covered 0). In addition, the total indirect effect of self-efficacy on mental activity via the mediators was not significant (unadjusted

0.02 [-0.02, 0.05]; adjusted 0.01 [-0.02, 0.05]). The unadjusted and adjusted models explained 5% (R^2 = .05 [0.01, 0.10]) and 12% (R^2 = .12 [0.06, 0.20]) of the variance in mental activity, respectively.

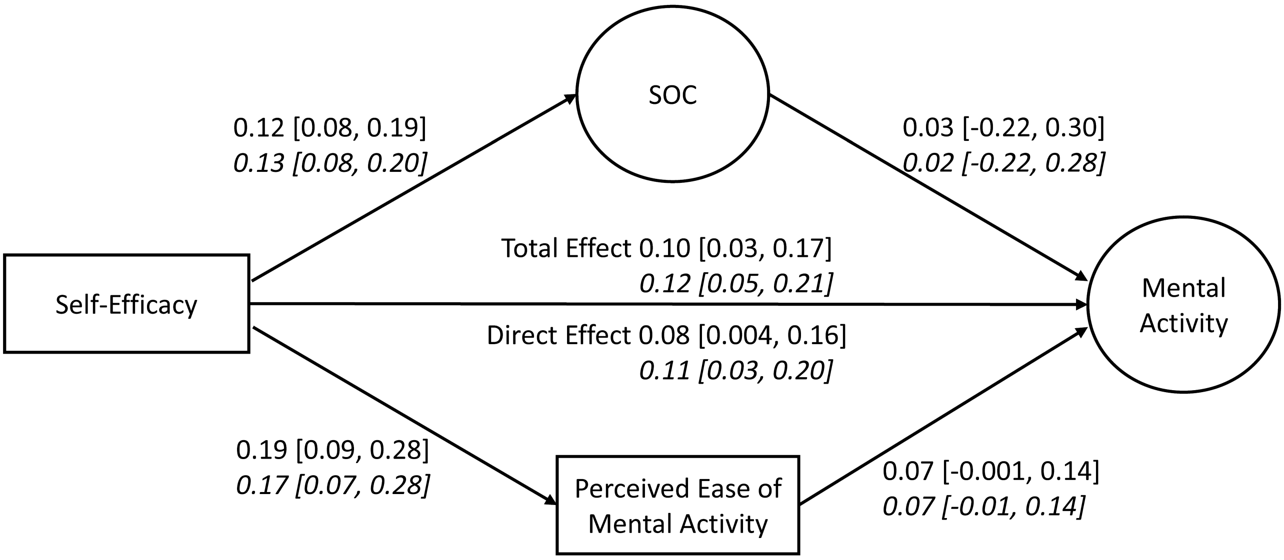

Figure 5.4. Unstandardized path coefficients [and Bayesian 95% credibility intervals] for the relationship between self-efficacy and mental activity via SOC and perceived ease of activity ease of activity. Italics indicate results controlling for age, gender, education and functional limitation.

In order to examine our decision to exclude mental games from the mental activity factor, we repeated the analysis including the two excluded items (Figure 5.5). The results closely mirrored the initial findings, but the credibility interval for the path from perceived ease of activity to mental activity did not include zero, which also resulted in a statistically significant indirect effect of self-efficacy on physical activity via perceived ease of activity (unadjusted 0.01 [0.001, 0.03]; adjusted 0.01 [0.001, 0.03]). Although these results partially support mediation, they appear marginal and may be unreliable given that the lower bounds of the credibility intervals were close to zero. The indirect effect of self-efficacy on mental activity via SOC (unadjusted 0.002 [-0.03, 0.03]; adjusted 0.003 [-0.03, 0.03]) and the total indirect effect (unadjusted 0.02 [-0.01, 0.05]; adjusted 0.02 [-0.02, 0.05]) remained non-significant in the supplementary analyses. The amount of variance explained was similar to the initial mental activity models (unadjusted R^2 = .05 [0.02, 0.11]; adjusted R^2 = .12 [0.06, 0.20]).

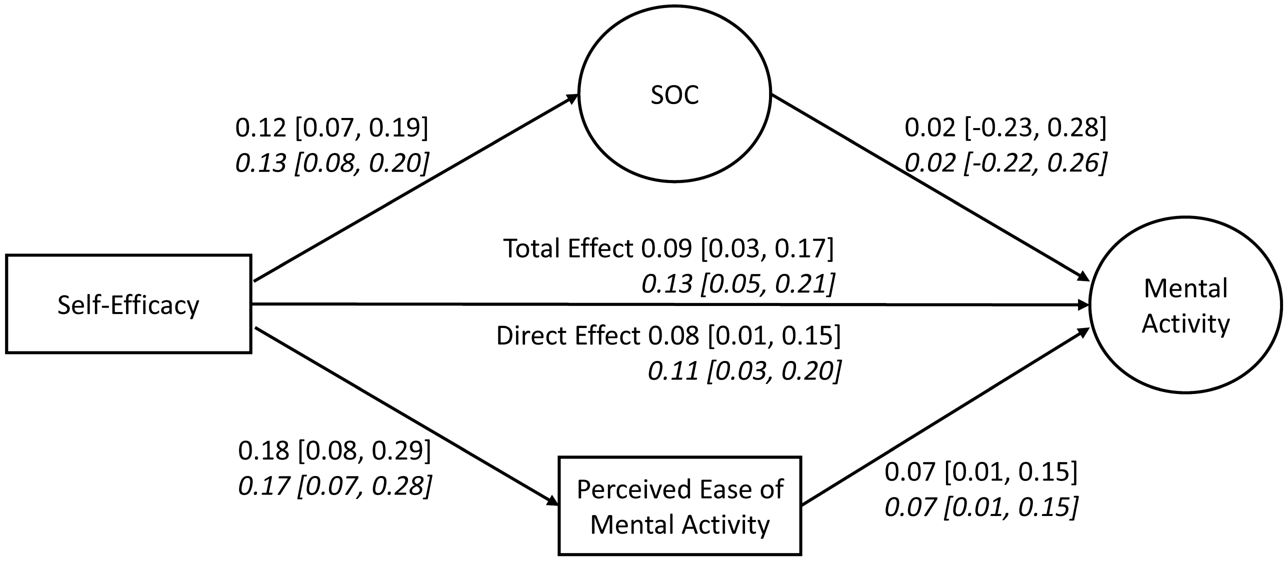

Figure 5.5. Unstandardized path coefficients [and Bayesian 95% credibility intervals] for the relationship between self-efficacy and mental activity including mental games via SOC and perceived ease of activity. Italics indicate results controlling for age, gender, education and functional limitation.

5.4.4 Analyses of Age Differences

Additional analyses were conducted to examine the possibility that mediation effects of SOC might have been obscured due to the inclusion of a substantial proportion of relatively high functioning ‘young-old’ adults in our sample. Increasing age tends to be met with a decline in physical, cognitive, and psychological resources (P. B. Baltes & Smith, 2003). The use of SOC strategies may therefore be more important in assisting those in later life to adapt and overcome barriers to activity such as sensory loss, driving cessation, or loss of social networks. We used multi-group modelling to compare the mediation effects between participants aged 70 years and older (n = 209) and those aged 69 years and younger (n = 177). Models controlled for gender, education, and functional limitation. The measurement model (i.e., factor loadings and thresholds) was constrained to be equal between the two groups, with the path estimates allowed to vary.

Difference parameters (with 95% credibility intervals) were computed as the effect for older adults minus the effect for younger adults.

Table 5.2 shows the results of the multi-group analyses. Only the indirect effect of self-efficacy on physical activity via perceived ease of physical activity showed a significant group difference, indicating that the mediation effect of perceived ease of physical activity was stronger for the older adults. Follow-up analyses examined which path contributed to this age difference. Difference parameters indicated that both the path from self-efficacy to perceived easy of activity and the path from perceived ease of activity to physical activity were stronger for older adults (older a_2 - younger a_2 0.18 [0.03, 0.33]; older b_2 - younger b_2 0.56 [0.21, 0.94]).

5.5 Discussion

This study aimed to examine possible processes underlying the association between self-efficacy and activity in midlife and older adults. Specifically, it examined whether perceived ease of activity and use of SOC strategies accounted for self-efficacy–activity associations. Results showed that perceived ease of activity mediated the relationship between self-efficacy and social and physical activity. For social activity, the associations remained significant after controlling for age, gender, education, and functional limitation. For physical activity, however, the mediation effect was not significant after controlling for the covariates. This may be because age and functional limitation were strongly negatively correlated with perceived ease of physical activity (see Table 1). Interestingly, in the analysis of age differences controlling for the covariates, the path from self-efficacy to perceived ease of activity was significant in the older group. Therefore, the mediation effect of perceived ease of activity was significantly stronger for those aged 70 years and older, as compared to those aged 69 years and younger. This finding is congruent with the notion that protective resources may be increasingly important for adaptation and well-being in later life when resource restrictions become more common (P. B. Baltes & Smith, 2003).

Table 5.2

Unstandardized Path Coefficients [and Bayesian 95% Credibility Intervals] for the Multi-Group Models Examining Age Differences in the Relationship between Self-Efficacy and Activity via SOC and Perceived Ease of Activity

	Social activity		Physical activity		Mental activity	
Parameter	Older	Younger	Older	Younger	Older	Younger
a_1 SE →SOC	0.16 [0.09, 0.25]*	0.15 [0.07, 0.24]*	0.15 [0.08, 0.23]*	0.14 [0.07, 0.23]*	0.15 [0.08, 0.24]*	0.14 [0.07, 0.24]*
a_2 SE→ PEoA	0.26 [0.12, 0.39]*	0.26 [0.11, 0.42]*	0.13 [0.04, 0.23]*	-0.05 [-0.16, 0.07]	0.14 [0.004, 0.28]*	0.23 [0.07, 0.39]*
b_1 SOC→Activity	0.04 [-0.21, 0.32]	0.10 [-0.18, 0.40]	0.15 [-0.43, 0.74]	0.61 [0.05, 1.31]*	0.18 [-0.15, 0.55]	-0.15 [-0.55, 0.23]
b_2 PEoA→Activity	0.16 [0.07, 0.26]*	0.19 [0.11, 0.30]*	0.86 [0.58, 1.17]*	0.29 [0.04, 0.57]*	0.10 [-0.001, 0.22]	0.01 [-0.11, 0.13]
c' Direct SE→Activity	0.10 [0.01, 0.20]*	0.01 [-0.10, 0.11]	0.08 [-0.11, 0.28]	-0.14 [-0.35, 0.05]	0.05 [-0.07, 0.18]	0.21 [0.09, 0.35]*
a_1*b_1 Indirect SOC	0.01 [-0.04, 0.05]	0.01 [-0.03, 0.06]	0.02 [-0.06, 0.12]	0.08 [0.01, 0.20]*	0.03 [-0.02, 0.09]	-0.02 [-0.09, 0.03]
a_2*b_2 Indirect PEoA	0.04 [0.01, 0.08]*	0.05 [0.02, 0.10]*	0.11 [0.03, 0.22]*	-0.01 [-0.06, 0.02]	0.01 [-0.002, 0.04]	0.002 [-0.03, 0.03]
(a_1*b_1)+(a_2*b_2) Total Indirect	0.05 [-0.002, 0.10]	0.06 [0.01, 0.13]*	0.14 [0.02. 0.27]*	0.07 [-0.03, 0.19]	0.04 [-0.01, 0.11]	-0.02 [-0.09, 0.04]
c Total effect	0.15 [0.06, 0.24]*	0.07 [-0.02, 0.17]	0.22 [0.03, 0.42]*	-0.07 [-0.26, 0.12]	0.10 [-0.01, 0.21]	0.19 [0.07, 0.32]*
Difference parameters (Older-Younger)						
a_1*b_1 Indirect SOC	-0.01 [-0.07, 0.05]		-0.06 [-0.20, 0.06]		0.05 [-0.02, 0.14]	
a_2*b_2 Indirect PEoA	-0.01 [-0.06, 0.04]		0.13 [0.04, 0.24]*		0.01 [-0.02, 0.05]	
(a_1*b_1)+(a_2*b_2) Total Indirect	-0.02 [-0.10, 0.06]		0.06 [-0.10, 0.23]		0.06 [-0.02, 0.15]	
c Total effect	0.08 [-0.05, 0.21]		0.29 [0.02, 0.57]*		-0.09 [-0.26, 0.07]	
R^2	.19 [0.09, 0.30]*	.22 [0.12, 0.34]*	.56 [0.44, 0.65]*	.30 [0.16, 0.43]*	.12 [0.05, 0.22]*	.17 [0.07, 0.28]*

Note: SE = self-efficacy, PEoA = perceived ease of activity. Analyses controlled for gender, education, and functional limitation.
*denotes significance (credibility intervals do not include 0)

Control beliefs are suggested to promote positive outcomes through a range of affective, behavioural, motivational, and physiological pathways (see e.g., Lachman et al., 2011 for discussion). This study contributes to the literature by demonstrating one specific process through which self-efficacy may influence activity. The finding that perceived ease of activity mediated self-efficacy–activity associations supports the notion that self-efficacy influences older adults' perceptions of activities and, in turn, the activities they choose to participate in. This finding could help to inform the development of interventions aimed at promoting activity engagement. It has been suggested that understanding the mechanisms underlying associations of perceived control with ageing-related outcomes is important for developing personalized interventions that target individuals' needs (e.g., Robinson & Lachman, 2017). The identification of perceived difficulty as one potential barrier to activity for older adults with low self-efficacy suggests the possibility that activity interventions targeting self-efficacy may be most effective when they include methods aimed at improving evaluations of activity ease or difficulty. In addition, although control beliefs are potentially modifiable (Lachman et al., 2011), they may be resistant to change in some individuals. For these individuals, activity interventions could potentially focus on methods of directly improving perceived ease of activity (e.g., by modifying perceived task demands), rather than self-efficacy per se.

In contrast to the findings for social and physical activity, the effect of self-efficacy on mental activity was not mediated by perceived ease of activity. The majority of participants (76.6%) reported that they would find mental activities very easy to do if they were asked to do them. Perceived ease of activity may not be a relevant predictor of activity where little variation exists and few people anticipate the activity to be difficult. It is also possible that the examples used in the wording of the item assessing perceived difficulty of mental activity (doing crosswords or reading a book or newspaper) did not adequately capture the more complex nature of some of the mental activity scale items (e.g., researching information, solving a problem, and working on complex decisions). We also note that our mental activity measure included only a select few examples of mental activity that may not fully represent participants’ mental activity experiences. Inclusion of different examples of mental activity may have produced divergent results.

Contrary to the hypothesis, SOC did not mediate the relationship between self-efficacy and activity. Self-efficacy was positively associated with SOC but SOC did not predict social, physical, or mental activity in the full sample or in either age group. Research suggests that SOC is particularly important for individuals with a lower level of resources. One study showed that, although those with fewer resources (a composite including demographic, cognitive, health, and social resources) tended to use SOC strategies less often, SOC buffered the effects of low resources on subjective well-being (Jopp & Smith, 2006). In a similar vein, SOC may predict activity only when adaptive strategies are required to overcome limitations or barriers to activity. Whereas the present study used a relatively healthy sample, associations of SOC with activity may be more evident in vulnerable groups. Indeed, SOC has been shown to be associated with activity in adults with arthritis (e.g., Janke et al., 2015; Son & Janke, 2015). In addition, research has shown that perceived control moderates the effects of functional limitation on older adults' social activity (Curtis et al., 2017). It may be that SOC strategies are more important as moderators of the association between resource restrictions and reduced activity, rather than as a mediator of the effect of control beliefs on activity.

5.5.1 Limitations and Future Directions

To our knowledge, this is the first study to show that perceived ease of activity (but not SOC) partially mediates the influence of self-efficacy on older adults' activity; however, limitations of the study highlight the need for further research. Firstly, we cannot draw causal inferences from the cross-sectional data. Social cognitive theory suggests that mastery experiences (which could include successfully engaging in difficult or goal-directed activity) are a significant predictor of self-efficacy (Bandura, 1977). Furthermore, it is conceivable that more frequent engagement in activities could lead to the perception that they are easier. Longitudinal mediation studies are therefore needed to gain a better understanding of how dynamic associations among activity-related cognition and activity engagement unfold over time.

There is currently no consensus on the best method of measuring activity engagement. The ACQ describes types of activities according to their characteristics and therefore has the potential to be inclusive of a wider range of activities than activity-specific questionnaires (Bielak, 2017). It is important to note, however, that self-report measures of activity may be prone to under- or over-estimation. It may have been especially difficult for participants to estimate their engagement in abstract activities (e.g., working on complex decisions) using a weekly timeframe. Future research would benefit from using complementary assessment methods that reduce reporting bias, such as objective physical activity measures or daily diary approaches that require recall over a shorter period.

In addition, there may have been some incongruence between the SOC measure and the activity indices. We modified the items from P. B. Baltes and colleagues' (1999) 12-item SOC questionnaire to specifically examine how individuals used SOC strategies in their leisure activities. Similar domain-specific scales have previously been used, such as SOC for physical activity (Ziegelmann & Lippke, 2007a) and SOC for leisure activity in the context of coping with arthritis symptoms (e.g., Janke et al., 2015; Son & Janke, 2015). However, the ACQ was developed to measure activities expected to influence cognitive ability (Bielak, 2017) and included activities could have been performed in the context of self-care, civic, or other productive engagement. If participants did not view the activities to be leisure-oriented, their SOC ratings may have been less relevant.

Lastly, the study used a non-representative sample that included few participants aged over 85 years (n = 14) or who reported significant functional limitation. In addition, high average levels of education likely reflect an interest in lifelong learning by members of educational organisations. Self-efficacy may be less predictive of activity for older adults with limited resources where fewer activities are under the individual's objective control. Conversely, self-efficacy might be an important predictor of activity that enables individuals to overcome barriers to activity when resources are low. In addition, although we might expect SOC to be more relevant for activity when individual resources are low and there are greater barriers to activity, a minimum level of personal resources is likely required to enact these strategies. Future research examining oldest-old adults and those with fewer resources is an important next step in considering interventions to promote activity for those most at risk of declining engagement.

5.5.2 Conclusions

In sum, this study highlights perceived ease of activity as one possible process by which self-efficacy influences activity engagement in older adults. This finding could contribute to the consideration of characteristics of self-efficacy interventions that may be most effective in promoting activity in later life. Longitudinal studies are needed in order to demonstrate the predicted temporal ordering of variable associations. In addition, research using alternative methods of measuring activity engagement and SOC, as well as more diverse samples, may prove fruitful.

CHAPTER

6

DISCUSSION

6.1 Summary of Results and Original Contributions

This thesis examined associations of control beliefs with activity engagement in midlife and older adults in four independent studies that showed relatively consistent results. These studies make an original contribution to knowledge by addressing specific gaps identified in the previous literature (see 1.4 Literature Review). Perceived control significantly predicted social activity 3 years later (Chapter 2) and buffered the negative effects of functional limitation on longitudinal trajectories of social activity (Chapter 3). As compared to previously demonstrated cross-sectional associations, the finding that perceived control was associated with change in social activity over time provides stronger support for the notion that perceived control may influence social activity. In addition, participants reported engaging in more social and physical activity on days when self-efficacy was higher (Chapter 4). The use of a complementary daily diary approach enabled us to demonstrate associations of short-term within-person variability in control beliefs and activity that may have been obscured in previous cross-sectional and longitudinal studies. Finally, perceived ease of activity was found to mediate the associations of self-efficacy with social and physical activity (Chapter 5). Examining potential mechanisms underlying perceived control-activity associations is an important preliminary step in considering the characteristics of interventions that might be most effective in promoting activity (see 6.2.2 Considerations for Developing Perceived Control Interventions to Promote Activity Engagement). Although we cannot claim causal conclusions from the observational data used in the thesis (see 6.3.1 Strengths and Limitations of the Research Design), the results support the notion that control beliefs play an important role in older adults' activity engagement.

As well as indicating reliable associations of control belief with activity engagement, the thesis demonstrates more nuanced patterns of association, suggesting that control beliefs may be differentially related to activity according to characteristics of both the activity and the individual. Control beliefs were consistently related to social and physical activity, but were not related to mental activity. This may reflect a broad pattern whereby control beliefs more strongly predict activities that require greater social (e.g., social networks, emotional support) or physical resources (e.g., physical or sensory functioning, health, mobility) and therefore present greater potential barriers to activity participation. Individuals with greater control beliefs tend to choose more difficult behaviours, show greater persistence, and develop more effective strategies to solve problems or overcome difficulties (Ajzen, 1991; Bandura, 1977; Lachman, 2006). Control beliefs may therefore be most relevant for facilitating difficult activities, such as strenuous exercise or out-of-home social activity, whilst being unrelated to activities that have relatively fewer barriers to participation, including simple mental activities such as reading or listening to talk radio. In a similar vein, the effect of daily variability in self-efficacy on physical activity and the mediation effect of perceived ease of activity on the relationship between self-efficacy and physical activity were stronger for older adults. Control beliefs may be more relevant for overcoming barriers to activity for older adults who are likely to experience greater difficulty in activity due to a decline in physical, cognitive, or psychological resources (P. B. Baltes & Smith, 2003).

This thesis notably differs from previous research by demonstrating associations of control beliefs with activity engagement using measures of general control beliefs, rather than measures of activity-specific control beliefs as favoured in previous research. We are not aware of previous research examining microlongitudinal associations of general control beliefs with older adults' activity engagement, and longitudinal studies employing measures of general control beliefs have focused exclusively on associations with physical activity (Drewelies et al., 2016; Infurna & Gerstorf, 2013). We consider our findings to be particularly noteworthy, since control beliefs are most predictive of outcomes when measurement items are specific to the behaviour or goal (e.g., Bandura, 1997). We might therefore expect that the associations of control beliefs with social and physical activity would have been greater had we used activity-specific measures of control. This also raises the possibility that associations between self-efficacy and mental activity may have been evident had we used measures of self-efficacy for mental activity. Comparison of the magnitude of the effects of domain-specific versus general control beliefs on older adults' activity is an important avenue for future research with potential implications for activity intervention (see 6.2.2 Considerations for Developing Perceived Control Interventions to Promote Activity Engagement).

6.1.1 The Multidirectional Nature of the Associations between Perceived Control and Ageing-Related Outcomes

Perceived control tends to show a curvilinear pattern across the lifespan; increasing across the first half of life, peaking in midlife, and declining in older age (Robinson & Lachman, 2017). It has been suggested that declines in control beliefs in later life may be due to negative stereotypes about ageing that are reinforced by experiencing loss of resources (e.g., Bandura, 1997; Levy, 2003). Negative ageing stereotypes, for example, that ageing is characterized by irreversible physiological decline, tend to be introduced in childhood and reinforced through repeated exposure over the lifespan (Levy, 2003). In older age, individuals become members of the stereotyped group. Age-based stereotypes therefore become self-relevant and may be internalized as self-stereotypes through the process of stereotype embodiment, whereby individuals come to believe that the negative stereotypes are an accurate representation of their own ageing process (Levy, 2009). These internalized stereotypes, or self-perceptions of ageing, act as a framework by which older adults interpret their daily experiences (Levy, 2009). Older adults with negative self-perceptions of ageing may interpret experiences such as memory lapses, fatigue, or reduced physical strength as due to uncontrollable age-related decline, rather than potentially controllable factors such as reduced effort or unfavourable circumstances. Such attributions may lower older adults' sense of control (Lachman et al., 2011). This process is compounded as older adults experience fewer opportunities to control the environment due to a reduction in resources (e.g., physical or cognitive functioning) that creates barriers to goal-directed behaviour or reduced contingency between behaviour and desired outcomes (see e.g., Robinson & Lachman, 2017).

Research provides support for the notion that negative self-perceptions of ageing and reduced personal resources influence older adults' control beliefs. For example, experimental research using age-based stereotypes to manipulate self-perceptions of ageing have shown negative perceptions to be related to lower memory and mathematical self-efficacy (Levy, 1996; Levy, Hausdorff, Hencke, & Wei, 2000). Observational research has shown that self-perceptions of ageing as entailing physical loss are negatively correlated with perceived control, and self-perceptions of ageing as entailing ongoing personal development are positively correlated with perceived control (Wurm, et al., 2007; Wurm, Tomasik, & Tesch-Römer, 2010). Furthermore, having, for example, greater functional limitation, more depressive symptoms, and less emotional support have been shown to be associated with steeper declines in perceived control over time (Infurna & Okun, 2015).

Lachman's conceptual model of ageing, control beliefs, and motivation describes the multidirectional relationship between ageing-related changes and perceived control (Lachman, 2006; Lachman et al., 1997). The model suggests that, while ageing-related loss can lead to a lowered sense of control (as described above), this reduction in perceived control can have subsequent negative flow-on effects on future outcomes through, for example, lowered motivation, negative affect, and changes in behaviour (see also 1.3.2 Rationale for the Relationship between Perceived Control and Activity). Indeed, having lower perceived control has been shown to predict future negative outcomes such as poorer memory performance (e.g., Luszcz et al., Ghisletta, 2015), lower life satisfaction (e.g., Gerstorf et al., 2014), and poorer physical health (e.g., Gerstorf et al., 2011; Infurna, Gerstorf, Ram, et al., 2011). These negative outcomes perpetuate reductions in perceived control in a cyclical downward spiral as perceived control plays the role of both antecedent and outcome of ageing-related loss.

This complex interplay between control beliefs and personal resources and outcomes aligns with the broader framework of triadic reciprocal determinism, which proposes that human functioning is determined by the reciprocal, interacting influences of personal factors (e.g., cognitive, affective, motivation, and others), behaviour, and the environment (Bandura, 1989). Within this framework, control beliefs are argued to be one of the most powerful and pervasive personal factors in determining behaviour, and partly explain why individuals experience different outcomes in environmentally comparable circumstances (Bandura, 1989). Although control beliefs tend to decline in older age, the influence of various determining factors provides opportunities to intervene in this process and promote a greater sense of control. Indeed, control beliefs have been shown to be malleable through intervention (e.g., Lachman et al., 1992; Scult et al., 2015). This could have significant implications for activity engagement. As older adults internalize age-based stereotypes and experience resource restrictions, a lowered sense of control may be associated with lowered motivation to engage in daily activities (Lachman et al., 1997). However, if control beliefs influence activity, interventions aimed at improving perceived control may promote continued engagement in later life. Given the reciprocal association between control beliefs and ageing-related outcomes, improvements in perceived control could initiate a positive feedback loop whereby positive outcomes experienced during goal-directed activity reinforce and perpetuate a higher sense of control. Control beliefs may therefore be a resource not only for initiation of activity engagement, but potentially for long term maintenance of engagement as well (Lachman et al., 1997).

6.2 Implications for Future Research on Activity Intervention

Activity participation can decline in older age due to a range of age-related changes such as reduced physical functioning or sensory loss (see 1.2.3 Age-Related Trends in Activity). Although significant functional loss is not considered part of the normal ageing process, risk factors for declining activity cannot always be prevented. Some decline in activity may therefore be expected for individuals who experience significant resource restrictions. Nonetheless, the associations of control beliefs with activity demonstrated in the thesis suggest that interventions aimed at improving control beliefs may facilitate engagement and enable older adults to continue activity participation as much as possible into later life.

6.2.1 Previous Interventions Aimed at Increasing Activity Engagement in Older Adults by Improving Control Beliefs

Considerable research has examined the effects of interventions aimed at improving exercise self-efficacy in older adults through, for example, verbal encouragement, helping participants identify previous performance accomplishments, facilitating goal-setting, and discussing methods of overcoming obstacles to activity, on physical activity in older adults (see French et al., 2014 for review). Supporting the effectiveness of self-efficacy interventions, a number of studies have shown increases in physical activity from pre- to post-test (e.g., Burke et al., 2013; Stewart et al., 2001; van Stralen, de Vries, Mudde, Bolman, & Lechner, 2009; Wilcox et al., 2006). However, these studies did not assess self-efficacy; therefore, it is difficult to speculate whether the interventions improved physical activity due to effects on self-efficacy or effects on other factors. Fewer interventions have demonstrated increases in both exercise self-efficacy and physical activity. For example, among inactive older adults with arthritis who participated in the 20-week Active Living Every Day program, change in exercise self-efficacy was associated with change in physical activity (Sperber et al., 2014). In addition, in a small pilot study of older adults with fear of falling who participated in the 8-week B-Active program, walking self-efficacy and steps taken per day significantly increased from pre to post-test (Dattilo, Martire, Gottschall, & Weybright, 2014).

Randomized controlled trials have the potential to provide the strongest support for the utility of self-efficacy interventions. Several such studies have examined physical activity outcomes. For example, among older adults with mild to moderate hypertension, participants who were randomized to receive a 6-month walking self-efficacy intervention showed greater improvements in exercise self-efficacy and walking than control participants who received usual primary care (Lee et al., 2007). Numerous interventions have not, however, shown the expected effects on exercise self-efficacy, despite some of these showing positive effects on physical activity (e.g., M. J. Allison & Keller, 2004; Callahan et al., 2014; Gallagher et al., 2016; Resnick, Luisi, & Vogel, 2008). Although preliminary research has aimed to ascertain the type of interventions that are most likely to have positive effects (see French et al., 2014, discussed below 6.2.2 Considerations for Developing Perceived Control Interventions to Promote Activity Engagement), continued research is required to better understand these discrepant findings by identifying characteristics of interventions that may be most effective in promoting control beliefs and physical activity. In addition, since previous research has focussed largely on physical activity, future research should examine the effects of self-efficacy interventions on other forms of activity such as social activity.

Recent reviews of intervention research aimed at improving social isolation, loneliness, and activity using techniques that did not target perceived control (e.g., group discussions, technology training sessions, and scheduled activity sessions) indicated mixed effects and called for further research to develop higher quality evidence for the efficacy of social activity intervention (Dickens, Richards, Greaves, & Campbell, 2011; Gardiner, Geldenhuys, & Gott, 2016). The results of this thesis indicate that, as well as promoting physical activity, enhancing perceptions of control through intervention could also be a promising way to promote social activity. There is, however, a dearth of research examining the effects of perceived control interventions on social activity in older adults. A recent randomized controlled trial targeting perceived control in older adults showed increased time spent volunteering in the intervention group at the 6-week post-test, but didn’t assess whether the intervention improved perceived control (Warner, Wolff, et al., 2014). Relatedly, research implementing the Vital Aging program, aimed at promoting healthy lifestyles, social relationships, and optimal cognition, affect, control, and coping, showed positive effects on activity engagement assessed as a composite of cultural, intellectual, and social activities, but did not assess social activities separately (Caprara, Fernández-Ballesteros, & Alessandri, 2016; Caprara et al., 2013; Mendoza-Ruvalcaba & Fernández-Ballesteros, 2016). In addition, the program showed mixed effects on the frequency of interaction with family, friends, and neighbours and self-efficacy for ageing (beliefs about one's capability to solve or cope with future problems related to their health, family, abilities, and functionality). Future research examining the effects of perceived control interventions on social activity could make an important contribution to knowledge on methods of promoting social engagement in older adults who are at risk of declining social activity.

6.2.2 Considerations for Developing Perceived Control Interventions to Promote Activity Engagement

In developing new self-efficacy interventions to promote activity engagement, researchers may find social cognitive theory (Bandura, 1977, 1997) to provide a valuable theoretical framework. According to social cognitive theory, self-efficacy is derived from four main sources; mastery experience (previous performance accomplishments), vicarious experience or modelling (observing the performance accomplishments of others), verbal persuasion (having someone affirm that the individual is capable of the task), and arousal (interpreting emotional or physical states as indicating one’s ability or preparedness for a task). Mastery experience is said to be the most important or powerful contributor to self-efficacy, followed by vicarious experience (Bandura, 1997). In the context of activity interventions, self-efficacy might be improved by helping participants identify previous successful activity experiences, providing opportunities for new mastery experiences, modelling desired activity behaviours, providing affirmation and encouragement, or teaching participants to regulate or interpret arousal experienced during activity in an adaptive way (for example, one might interpret a raised heartrate during physical activity as an indication of reaching the level of intensity required to maintain or improve fitness, rather than as an indication of physical stress or inability).

Several meta-analyses have aimed to determine which components of self-efficacy interventions are most effective at increasing self-efficacy and physical activity. For each intervention technique, analyses compared the effect sizes (change in self-efficacy or physical activity) produced in studies that included the technique with the effect sizes in studies that did not include the technique. For example, using a framework based on social cognitive theory, researchers examined which components of self-efficacy interventions were most effective at increasing self-efficacy for physical activity in non-clinical adult samples (Ashford, Edmunds, & French, 2010). Interventions that provided feedback on participants' physical activity performance or included behavioural modelling were found to produce larger effect sizes for self-efficacy than the alternative intervention approaches reviewed. Perhaps surprisingly, interventions utilizing persuasion, graded mastery (where the target behaviour becomes progressively more difficult), and barrier identification (where participants identify barriers to participation and methods to overcome them) produced smaller effect sizes than the alternative interventions. A separate meta-analysis examined the effects of self-efficacy interventions on both self-efficacy and physical activity in non-clinical adult samples (Williams & French, 2011). Techniques that improved self-efficacy also tended to increase physical activity. Interventions that included action planning (detailed planning of when and how physical activity will be performed), providing information on opportunities for physical activity (e.g., where and how participants might perform physical activity), and behaviour reinforcement (praising or rewarding effort or goal progress) demonstrated larger effect sizes for self-efficacy and physical activity than the alternative intervention approaches reviewed. In contrast, interventions that included relapse prevention (identifying methods to maintain previous increases in physical activity in the face of obstacles) and graded mastery produced significantly smaller effect sizes than the alternative interventions. Both meta-analyses focussed on younger and middle-aged adults, however, and excluded studies where the mean age of participants was greater than 60. Intervention methods may differentially affect self-efficacy and activity engagement of participants in different life stages.

Indeed, results from a meta-analysis of self-efficacy interventions in community-dwelling older adults suggest that caution is needed before applying techniques shown to be effective in younger samples to interventions for older adults (French et al., 2014). The review found that interventions that included graded mastery, providing information on opportunities for activity, and motivational interviewing (a one-on-one method of counselling) produced larger positive effects on self-efficacy in older adults than the alternative interventions reviewed. In addition, interventions that included barrier identification, behaviour reinforcement, and modelling produced larger effect sizes on physical activity than the alternative interventions. In contrast, a range of techniques were significantly associated with smaller effect sizes when present. Goal setting, behaviour self-monitoring, planning social support, and relapse prevention produced smaller effect sizes for self-efficacy, while providing normative information about others, providing information on opportunities for activity, and planning social support produced smaller effect sizes for physical activity. The results from this review differ from the previous meta-analyses (Ashford et al., 2010; Williams & French, 2011), in particular, indicating that graded mastery may be a more useful intervention strategy for older, relative to younger, adults. The review also indicates that techniques involving self-regulation (such as goal setting, self-monitoring goal-directed behaviour, planning social support, and preparing for possible future relapse) were not particularly effective (French et al., 2014). The authors suggest this may be because self-regulation techniques are cognitively demanding and may become increasingly difficult in older age when reductions in executive functioning can occur. Alternatively, self-monitoring may evoke negative responses in individuals who are required to contemplate their low level of physical activity or ability (French et al., 2014). The number of studies eligible for inclusion in the review was limited. Further research would enable a more thorough evaluation of intervention techniques using more complex analyses such as meta-regression. Additionally, the authors recommend that research examine whether participants' executive functioning or the acceptability of an intervention are related to the efficacy of the intervention.

Although research examining self-efficacy interventions for physical activity in older adults is ongoing, preliminary research aimed at developing interventions for social activity may benefit from incorporating the techniques shown to be most relevant for physical activity. For example, interventions could provide opportunities for graded mastery, facilitating engagement in progressively more difficult, unfamiliar, or self-initiated social activity. In addition, interventions could provide information on where and when participants might engage in social activities, including informing about available community resources and social groups. It may also be useful to facilitate identification of potential barriers to social activity and how to overcome them, and to provide recognition or reward for achieving activity-related goals. Though intervention techniques involving self-regulation were not found to be particularly effective in promoting self-efficacy for physical activity (French et al., 2014), systematic investigation of these techniques in the context of social activity is still warranted. Older adults may find self-monitoring of social activity to be more acceptable, as evaluating one's performance in relation to social goals may not activate negative self-perceptions of ageing to the same extent as evaluating one's performance in relation to physical goals.

While we do not attempt to provide a thorough review of all possibilities for developing self-efficacy interventions to promote activity engagement in older adults, we present some key issues for consideration. Firstly, older adults face potential barriers to activity participation that are specific to this age group and should be considered in developing age-appropriate interventions. In particular, interventions should address negative self-perceptions of ageing and maladaptive attributions that contribute to lowered control beliefs in older adults. It has been shown that older adults who endorse negative stereotypes about ageing and physical activity engage in significantly less physical activity than those who do not endorse these stereotypes (Emile, Chalabaev, Stephan, Corrion, & d'Arripe-Longueville, 2014). This effect is partially mediated through participants' views about their own ageing. Interventions such as cognitive restructuring that promote adaptive beliefs and attributions may help to reduce older adults' tendencies to attribute negative events or goal failures to internal, age-related causes, and could therefore buffer the age-related decline in control beliefs (Lachman et al., 1997). Interventions that include vicarious experience, using older adults to model successful activity participation, may also help to challenge negative age-based stereotypes. Seeing others perform the desired activity successfully and without negative consequence can positively influence individuals' beliefs about their own ability to perform the behaviour, particularly when the model is similar to the participants (Bandura, 1977).

Older age is also associated with increasing resource restrictions in psychological, cognitive, and physical domains that are not generally experienced to the same extent by younger adults. While younger adults may experience barriers related to, for example, time management and motivation, older adults are likely to experience a unique set of barriers to activity participation related to resource loss. It is important for interventions to enable older adults to manage these restrictions. For example, identifying barriers to activity participation and devising methods to overcome these barriers has been shown to be a useful approach in promoting physical activity in older adults (French et al., 2014). However, it is important to note that some barriers to activity may be insurmountable, such as severe functional or sensory limitation. In these instances, an effective approach to promoting self-efficacy and activity may be to facilitate adaptation of activity goals to ensure they are achievable and within the scope of the participants' ability (see 6.3.2 Considerations for the Definition and Measurement of Control Beliefs). It is also important to consider older adults' interpretation of their potential limitations. A recent study showed that, in a sample of community-dwelling older adults, perceived health barriers predicted physical activity even after controlling for objective health (Warner, Wolff, Spuling, & Wurm, 2017). The effect of perceived health barriers on physical activity was mediated by self-efficacy, suggesting that older adults may base their self-efficacy for activity on perceptions of physical functioning that are unduly negative. Interventions aimed at promoting adaptive beliefs and attributions, as suggested above, could be useful for older adults who cease engaging in activities that they are capable of performing.

Though previous research has focussed on interventions aimed at improving domain-specific perceptions of control, the finding that general control beliefs are associated with engagement in both physical and social activity suggests that interventions targeting general control beliefs may increase activity across multiple domains. This could have significant implications for intervention, in particular, removing the need for multiple activity-specific components for individuals who show low engagement in more than one activity domain. If individuals show lower levels of participation in more than one type of activity, a general control intervention might present a more cost-effective approach than a potentially more complex intervention targeting multiple activity domains. Future research developing perceived control interventions to promote activity engagement should examine whether interventions focussed on general perceived control are as effective in increasing activity as interventions aimed at improving activity-specific control beliefs. It is also possible that interventions aimed at improving activity-specific control beliefs could have significant effects in other domains. For example, interventions aimed at improving self-efficacy for physical activity may also increase individuals' self-efficacy for social activity or vice versa. This could perhaps occur if participants experience similar barriers across different types of activity, or if the intervention improves control beliefs more generally. Future intervention research should assess self-efficacy and activity in non-target domains in order to provide the most comprehensive evaluation of the intervention.

As mentioned previously, in order to develop successful activity interventions, researchers must ascertain the key components or techniques that are effective in improving self-efficacy and activity. This can be difficult, however, because psychosocial and behavioural interventions are complex and often include multiple components. For example, the B-Active intervention, discussed above (6.2.1 Previous Interventions Aimed at Increasing Activity Engagement in Older Adults by Improving Control Beliefs), combined an education component targeting self-efficacy and a structured walking program (Dattilo et al., 2014). Similarly, the randomized walking trial included discussions with a public health nurse aimed at improving walking self-efficacy as well as use of a pedometer for self-monitoring (Lee et al., 2007). In addition, interventions are often aimed at improving a range of psychosocial or behavioural factors, for example the Vital Aging program aimed to improve health behaviour, cognitive ability, and affective experience (Caprara et al., 2013). It is difficult in multi-faceted interventions such as these to determine which components are most important for eliciting positive outcomes.

It is suggested that evaluation of complex interventions can be facilitated by having a well-developed theoretical rationale based on existing evidence, as it is important to understand not only the expected changes, but also the likely process of change (Craig et al., 2008). Chapter 5 aimed to develop our understanding of the likely processes underlying the association of self-efficacy with activity engagement. Further research in this area could inform future interventions. It is also recommended that intervention research use multiple outcome measures, as this will better capture expected changes, as well as any unintended consequences of the intervention (Craig et al., 2008). For example, the notion that self-regulation techniques are ineffective at improving self-efficacy in older adults because they evoke unintended negative self-evaluation (e.g., French et al., 2014) could be examined with additional measures assessing participant self-perceptions, affect, or views on the acceptability and enjoyment of the intervention. Relatedly, it is important to note that interventions may be ineffective due to the way they are implemented, rather than genuine ineffectiveness of the intervention components. A thorough process evaluation should therefore be conducted to ensure that the interventions were implemented exactly as intended (Craig et al., 2008). Explicitly outlining any implementation difficulties would provide valuable information for future research aiming to develop similar self-efficacy interventions. Relatedly, a common theme across reviews of self-efficacy interventions is that intervention techniques are often inadequately reported, impeding evaluation of the findings of individual studies and the combined literature (Ashford et al., 2010; French et al., 2014; Williams & French, 2011). Future research should clearly describe interventions procedures in order to allow effective evaluation and replication.

Our finding that associations of self-efficacy with physical activity were stronger for older relative to midlife adults suggests that perceived control interventions may be more effective at increasing physical activity with advancing age. Control beliefs may be a more important protective resource for older adults who are more likely to experience a decline in physical, cognitive, or psychological resources. Indeed, having higher perceived control has been shown to be protective of declines in health in older age but not in midlife (Infurna, Gerstorf, & Zarit, 2011). However, research has also shown more complex relationships, whereby perceived control was less protective of mortality when higher functional limitations and depressive symptoms were present (Infurna & Okun, 2015). This effect was stronger for older as compared to middle-aged adults. We acknowledge that our samples in Chapters 4 and 5 were relatively healthy and included few older adults with severe functional restrictions (see 6.3.1 Strengths and Limitations of the Research Design). Perceived control may play an adaptive role in helping older adults overcome age-related changes and barriers to physical activity, providing that barriers such as functional limitations are not too severe. Research on perceived control interventions should examine whether the effects of intervention on physical activity differ based not only on age, but also on other variables such as functional limitation and their interaction with age. Although perceived control interventions may be helpful in enabling older adults to overcome a low level of resources restriction by facilitating, for example, motivation and persistence, they may be less effective for older adults with greater resource restrictions, such as limited mobility, who cannot overcome significant barriers to physical activity.

In a related vein, it has been argued that perceived control must closely approximate objective control in order to accurately predict behaviour (e.g., Ajzen, 1991). Indeed, activity engagement is determined by both perceived control and actual, objective control (or contingencies). For example, individuals with severe functional limitations may not be able to perform activities that require considerable physical resources, regardless of the time and effort they invest. In addition, individuals may not be able to participate in certain activities, for example, cultural activities such as visiting galleries or cinemas, if the required facilities are not available or if the activities are financially prohibitive. Therefore, if control beliefs influence activity engagement, we would not expect an improvement in control beliefs to enable older adults to engage in activities that are out of their volitional control. Rather, we would expect an increase in activity engagement within the limits of their potential. This view is in line with the notion that perceptions of control affect how individuals utilize existing resources (Skinner, 1995). Control beliefs may therefore be particularly important in situations where perceived control is low but where limitations can be overcome through, for example, allocating extra time and effort to the activity or asking for assistance from others. Intervention studies aimed at improving control beliefs could help identify characteristics of individuals who show low estimates of perceived control in potentially controllable situations and may therefore be most likely to benefit from intervention.

6.3 Strengths and Limitations of the Thesis

This thesis makes an original contribution to the literature by using contemporary methods to examine the association between control beliefs and activity engagement in midlife and older adults. Despite the strengths of the research (for example, the use of representative samples and longitudinal data), a number of limitations are outlined below that lead to recommendations for future research.

6.3.1 Strengths and Limitations of the Research Design

One strength of this thesis is that we examined control beliefs and activity in four independent samples. In addition, the studies in Chapters 2 and 3 used large, representative, population-based samples of midlife and older adults from Germany and Australia, respectively. The results may therefore be generalizable to midlife and older adults in these countries. However, despite the use of population-based sampling methods, some selectively occurred due to attrition over the longitudinal follow-up periods. Participants who completed more assessments reported younger age, greater perceived control, greater social activity, and better health/physical functioning at baseline. Though longitudinal selectivity is possible in all samples due to motivational factors, it may be particularly likely in older samples where a greater proportion of participants may be lost to follow-up due to illness or mortality (see e.g., Lindenberger et al., 2002). Both studies used full information maximum likelihood estimators to account for missing data (Graham, 2009), but we caution that the results should nonetheless be interpreted as conditional on selection effects (Hofer & Sliwinski, 2006).

The studies in Chapters 4 and 5 used convenience samples of midlife and older adults who accepted invitations to participate in the daily diary study and cross-sectional survey, respectively. These participants were likely to be more highly educated, highly motivated, and healthier than the general population of interest. Therefore, the results are arguably not generalizable to the broader population. For example, perceived control may be less predictive of activity if considerable constraints such as physical or cognitive limitations exist and therefore fewer activities are under the individual's objective control. Conversely, we might expect perceived control to be an important psychological resource that promotes adaptation and enables individuals to overcome barriers to activity when resources are low. Despite these limitations, the results in Chapters 4 and 5 converge with those reported in Chapters 2 and 3, suggesting that using convenience samples to examine associations between control beliefs and activity in later life represents a legitimate, if not optimal approach.

A second strength of this thesis is the use of a variety of research designs and analysis methods that enabled us to examine the association between control beliefs and activity from multiple perspectives. Notably, the use of longitudinal and microlongitudinal data allowed examination of the effects of control beliefs on long- and short-term change in activity, respectively. Studies with multiple time points such as these are critical to improving our understanding of the predictors of older adults' activity because, as outlined previously (1.4.1 Cross-sectional Research; 2.2 Introduction), cross-sectional associations could reflect the influence of activity engagement on control beliefs, rather than influence of control beliefs on activity engagement. Our results indicate that control beliefs are associated with change in activity engagement, bringing us one step closer to understanding how control beliefs may influence activity. Despite our use of longitudinal and microlongitudinal research designs, this thesis cannot provide conclusive evidence that control beliefs influence older adults' activity. The discourse surrounding statistical modelling is inherently causal when we specify the proposed direction of effects in order to examine the plausibility of hypotheses. However, despite the use of terms that imply causation, such as 'effects' and 'influences', we cannot ascribe a causal direction on the basis of the available model parameters. An important next step in examining whether changes in perceived control influence older adults' activity engagement is to develop interventions aimed at increasing perceived control and examine the effects on change in activity engagement, as outlined above (6.2 Implications for Future Research on Activity Intervention).

The data and analyses in Chapter 5 were cross-sectional. Given that this is the first study we are aware of to show that perceived ease of activity (but not SOC) partially mediates the effects of self-efficacy on older adults' activity, this chapter nonetheless provides a contribution to the literature. Future research could build on these findings and examine whether the association between longitudinal changes in self-efficacy and activity are mediated by change in perceived ease of activity, and whether these associations are evident in the context of activity intervention.

6.3.2 Considerations for the Definition and Measurement of Control Beliefs

In a recent book commemorating 50 years of research on perceived control, the authors discuss the difficulties that have arisen conceptualizing and measuring different aspects of perceived control (e.g., Frazier, Tennen, & Meredith, 2016; Nowicki & Duke, 2016). Indeed, measures used to examine control beliefs often include a combination of agent–means (e.g., self-efficacy), agent–ends (e.g., perceived control), and means–ends beliefs (contingency beliefs), and the components that are assessed in a measure are not always made clear in the name or description. For example, some studies have measured perceived control or self-efficacy by asking participants how difficult they would find a behaviour but perceived control, self-efficacy, and perceived difficulty have been shown to be conceptually distinct and differentially predict behaviour such as reading, exercising, tooth flossing, and healthy eating (Rodgers et al., 2008). Such ambiguity in defining control beliefs may be problematic because the use of different terms for the same construct means that comparable studies may not be integrated, and the use of the same term for conceptually distinct constructs can result in findings that appear inconsistent when they are not truly comparable (see e.g., Skinner, 1996 for discussion).

The measures used in this thesis are no exception to the complexities that arise in measuring control beliefs, and this arguably makes it difficult to compare the results across studies. The Generalized Self-Efficacy Scale (Schwarzer & Jerusalem, 1995) used in Chapters 4 and 5 has been validated in numerous studies and translated into many languages (e.g., Luszczynska, Gutiérrez-Doña, & Schwarzer, 2005; Luszczynska, Scholz, & Schwarzer, 2005; Scholz, Dona, Sud, & Schwarzer, 2002; Schwarzer & Jerusalem, 1995). This measure clearly defines self-efficacy as examining one's perceived ability to cope with adversity and to solve problems and achieve goals. Although the Dispositional Hope Scale used in Chapter 2 does not have 'control' or 'efficacy' in the title, the items are conceptually very similar to those in the Generalized Self-Efficacy Scale. In addition, the Dispositional Hope Scale showed convergent validity through strong associations with scores on the Generalized Self-Efficacy Scale (see 2.3.2.2 Perceived control) and has previously been shown to measure the same underlying construct as the Generalized Self-Efficacy Scale (Zhou & Kam, 2016). Hope is defined as generalized perception that goals can be met (Snyder et al., 1991) and the scale has been operationalized as measuring general control in a number of studies (Schöllgen et al., 2011; Wiest, Schüz, & Wurm, 2013; Wurm et al., 2007), though it would perhaps be more consistent to describe the scale as a measure of general self-efficacy.

There is less clarity in the operationalization of the expectancy scale of Desired Control Measure (Reid & Ziegler, 1981) used in Chapter 3. This measure has been said to assess perceived control (e.g., Bisconti, Bergeman, & Boker, 2006; see also Chapter 3), personal control (e.g., M. M. Baltes, Wahl, & Schmid-Furstoss, 1990), and self-efficacy (e.g., Lang, Featherman, & Nesselroade, 1997). Some researchers have defined the scale as a measure of perceived control but describe high and low scores as internal and external control (Wagner, Gerstorf, Hoppmann, & Luszcz, 2013; Windsor, Anstey, Butterworth, Luszcz, & Andrews, 2007). We do not use this terminology because, according to Skinner's (1996) integrative framework of control beliefs, this implies that the scale measures contingency beliefs rather than ability beliefs. The ambiguity surrounding this scale may stem from the fact that some items (e.g., I can rarely find people who will listen closely to me) do not clearly reflect a specific aspect of control beliefs.

Despite the differences between the measures of control beliefs used in this thesis, we would argue that the consistency in results across the different measures provides support for the robustness of the associations between general control beliefs and activity engagement. This in turn suggests that perceptions of control, defined broadly as one’s perceived ability to perform desired behaviours or produce desired outcomes, may promote activity in older adults. Nonetheless, greater conceptual clarity surrounding constructs of control beliefs in future research on activity engagement would improve our understanding of which components of control may be most strongly associated with activity in older adults. Studies simultaneously including multiple constructs of control would enable direct comparison of effect sizes. For example, domain-specific self-efficacy (confidence in one's ability to successfully perform the behaviour) has been shown to predict reading, tooth flossing, exercise, and eating the recommended servings of fruit and vegetables in younger adults more strongly than domain-specific perceived control (beliefs about the extent to which the behaviour is under one's control; Rodgers et al., 2008). Similarly, exercise barriers self-efficacy (confidence in one's ability to overcome barriers to physical activity) predicted engagement in physical activity in adults aged 18 to 88 years to a greater extent than exercise-specific perceived control (beliefs about the extent to which exercising is under one's control; Vo & Bogg, 2015). Future research could examine the potential generalizability of this pattern of associations and whether general self-efficacy is a more important predictor of activity engagement in older adults than general perceived control.

In acknowledging the potential issues surrounding the measurement of control beliefs, it should be noted that this thesis is based on the assumption that having greater perceived control is associated with positive outcomes, and interventions should therefore aim to increase perceived control. It has, however, been suggested that greater control beliefs may be associated with negative outcomes in some circumstances, particularly when individuals perceive control in an objectively uncontrollable situation (Evans, Shapiro, & Lewis, 1993; Lachman et al., 2011). For example, in experimental settings, individuals with higher perceived control have been found to show greater physiological stress responses when experiencing uncontrollable stressors than individuals with lower perceived control (Agrigoroaei et al., 2013). Such findings arguably stem from unrealistic perceptions of contingency (i.e., perceived internal contingency where the outcome is determined by external factors), rather than personal efficacy or capability beliefs (Skinner, 1995). For example, a study of haemodialysis patients showed that a higher internal health locus of control (a measure of contingency beliefs) was associated with less depression among participants who had not previously experienced a failed renal transplant, but was associated with greater depression among those who had experienced a failed renal transplant (Christensen, Turner, Smith, Holman, & Gregory, 1991). This may be because those with a higher internal locus of control blamed themselves for the uncontrollable transplant failure. In objectively uncontrollable situations, it would be adaptive for individuals to attribute contingency to factors other than their own ability. In these instances, individuals can maintain an overarching sense of personal control by perceiving control over specific aspects of the situation, such as their ability to elicit social support, influence their emotional and cognitive responses, or manage their experience of symptoms (Bandura, 2005; Skinner, 1995).

Relatedly, in the context of activity engagement, recognising limits in one's capability (e.g., due to irreversible constraints such as physical or cognitive limitations in older age) may also be adaptive if it enables individuals to shift their focus from activities that they can no longer perform towards achievable activity goals. According to Heckhausen and colleagues' motivational theory of lifespan development (Heckhausen, Wrosch, & Schulz, 2010; Villarreal & Heckhausen, 2016), disengaging from unachievable goals helps to minimize experiences of failure or loss of control that can negatively affect motivational resources (e.g., affect and self-esteem) and undermine goal-striving in other domains. Numerous studies indicate that adapting one's goals to changes in the environment or one's capability has positive consequences on subjective well-being and mental and physical health (see Heckhausen et al., 2010 for discussion). Nonetheless, perceived control remains relevant to activity engagement as a motivational resource that enables individuals to maintain commitment to difficult but achievable activities, rather than disengaging from activities that are still within their capability. In addition, goal disengagement does not necessarily indicate a decrease in perceived control or goal-directed behaviour. Rather, goal disengagement may serve to maintain perceived control as individuals select alternative goals that are more likely to lead to successful control experiences.

6.3.3 Considerations for the Definition and Measurement of Activity

A strength of this thesis is that we measured longitudinal change in social activity, which has been relatively understudied in the context of control beliefs, and measured multiple types of activity (social, physical, and mental) in microlongitudinal and mediation studies. However, as mentioned previously (5.6.1 Limitations and Future Directions), there is no consensus on the best way to measure activity engagement. Questionnaires using lists of specific activities have the potential to omit important activities. In addition, the activities included in the questionnaires and the method of classifying them into categories may differ substantially between studies, which could mean that results are not directly comparable. Chapter 3 examined specific collective social activities, whereas Chapter 2 classed all activities as social if they were usually performed with another person. Chapters 4 and 5 used similar items describing types of activities according to their characteristics, rather than utilizing a list of specific activities. However, Chapter 5 used the full ACQ (Bielak, 2017) and therefore included more items for social, physical, and mental activity than Chapter 4. It has been suggested that activity-specific and activity characteristic questionnaires provide unique information about activity engagement, which has been demonstrated in their differential prediction of cognitive ability (Bielak, 2017).

Despite these differences, the results for social activity were similar across all four studies, with each study demonstrating the potential positive adaptive value of control beliefs for social activity. In addition, physical activity was related to self-efficacy in Chapters 4 and 5, and mental activity was not related to self-efficacy in either chapter. Although the studies may not be entirely comparable, the consistent findings broadly suggest that control beliefs may be relevant for promoting engagement in activities that require greater social and physical resources (e.g., supportive social networks, physical functioning), perhaps because they present greater potential barriers to participation (as discussed above, 6.1 Summary of Results and Original Contributions). Control beliefs may be less relevant for activities that require predominantly cognitive resources. Alternatively, control beliefs may be predictive of more challenging mental activities that were not included in our measures (see 4.5.1 Within-Person Self-Efficacy and Activity). The development of a standard measure of activity remains an important goal for future research in order to enable direct comparison across studies and provide a clearer picture of the predictors of older adults' engagement.

It is important to note that self-report measures of activity rely on accurate recall but can be prone to under- or over-estimation. For example, among adults aged 20 to 91 who estimated the number of hours they spent performing 22 activities per week, although the average estimate of weekly activity corresponded to 14 hours per day, a number of individual estimates corresponded to over 24 hours per day (Salthouse, 2006; Salthouse, Berish, & Miles, 2002). In a study of older adults, weekly recall of physical activity was significantly higher than the sum of daily recall over the same week (though the authors suggest the weekly questionnaire may have led to overestimation of activity due to the items and response options; Atienza, Oliveira, Fogg, & King, 2006). In addition, studies have shown both under- and over- reporting of physical activity as compared to direct or objective methods such as accelerometry and heart rate monitoring (see Prince et al., 2008 for review). This reporting bias has the potential to attenuate or overestimate examined relationships.

With respect to the thesis, participants may have had difficulty accurately estimating monthly (Chapters 2 and 3) or weekly (Chapter 5) activity participation. The daily questionnaire approach used in Chapter 4 may have elicited more accurate responses because it only required recall over the previous 24 hours. Future research may benefit from using a measurement burst design, where daily diary ‘bursts’ are repeated over longitudinal assessments. This could more accurately capture longitudinal change by estimating average levels of control beliefs and activity engagement during each burst period, rather than relying on a single measurement at each longitudinal time-point (see e.g., Sliwinski, 2008). As mentioned above (4.5.4 Limitations and Future Directions), measurement burst designs also have the advantage of examining change in within-person variability over time. This would provide further information on developmental processes surrounding control beliefs and how the within-person relationships between control-beliefs and activity change over time in older age. Such methods could be combined with objective measures of physical activity to provide complementary information about activity engagement and assess the accuracy of self-reported activity.

A further limitation of the activity measures is that the ordinal response options did not allow us to calculate the exact number of occurrences or time spent in each type of activity. We also note that summing the frequency or time spent in each type of activity may obscure some of the more nuanced changes in activity that occur over time. For example, when faced with limitations or constraints, older adults may replace difficult activities with similar, easier activities (e.g., Duke et al., 2002) or increase time spent in remaining activities (e.g., Atchley, 1998). Our activity measures indicated overall activity in each category and therefore did not allow examination of change within categories. Despite the issues inherent in summing ordinal scales, it is common in activity research to sum scores from ordinal frequency (e.g., Buchman et al., 2009; Janke et al., 2006) and time scales (e.g., Bielak, 2017; Paganini-Hill et al., 2011), and we argue that this approach nonetheless allowed us to effectively examine general levels and changes in activity and their association with control beliefs.

We also note that it may be useful to measure variety in older adults' activity. Participation in a greater variety of lifestyle and physical activities has been shown to more strongly predict reduced risk of cognitive decline and dementia than greater frequency of activity or energy expenditure (Buchman et al., 2009; Carlson et al., 2012). It has also been suggested that engaging in a wide variety of leisure activities with social, physical, and mental components may be more beneficial in reducing dementia risk than engaging in only one type of activity (Karp et al., 2006). Control beliefs may be more strongly associated with positive outcomes in older adults if they facilitate engagement in a wide variety of activities, than if they facilitate increased frequency of participation in a smaller activity repertoire. In particular, engaging in novel activities that provide greater intellectual stimulation is purported to have greater benefits for cognitive functioning than participating in well-rehearsed or regular activities (Park et al., 2014). Therefore, control beliefs may be especially beneficial if they motivate older adults to participate in new activities that are not part of their usual routine. We examined a variety of activity domains and were able to demonstrate that control beliefs are differentially related to different types of activity. With the exception of Chapter 2 (where we conceptualized social activity as a latent variable comprising variety and frequency), however, we did not examine the variety of activities within a given domain. In addition, we did not assess whether participants tended to seek new activities and experiences or maintain their regular activities. It may be useful for future research examining the association between control beliefs and activity to complement measures of frequency or duration of activity with measures of variety and novelty of activity.

In acknowledging the potential issues surrounding the measurement of activity engagement, we recognize that this thesis reflects the assumption that engaging in more activity is beneficial and adaptive for older adults. We note, however, that socioemotional selectivity theory suggests that it may be emotionally adaptive for older adults to reduce ties with peripheral network members in order to focus on closer, more meaningful relationships (Carstensen et al., 1999). This could potentially result in a decline in social activity but not in network satisfaction or perceived social support. Nonetheless, given the associations of social activity with positive outcomes in physical, emotional, and cognitive domains (see 1.2.2 Benefits of Activity), continued engagement in social activity, even with fewer network members, is likely to be beneficial.

We also note that activities may have differential effects on subjective well-being depending on characteristics of the individual such as why they participate. Research has shown that, among older adults, activities done for social reasons were positively related to well-being, while those done to pass the time were negatively related to well-being (Everard, 1999). Recent research has also shown that the level of autonomy in social participation (i.e., whether the activity is voluntary or obligatory) better predicts self-rated health than the frequency of social participation among young-old adults (Tomioka, Kurumatani, & Hosoi, 2017). Future research examining the association of perceived control with various categories of activity could consider these individual differences by examining whether perceived control is differentially associated with older adults' most valued or meaningful activities.

6.4 Conclusion

In sum, the results from this thesis suggest that control beliefs are positively related to social and physical (but not mental) activity in midlife and older adults, and that perceived ease of activity (but not use of adaptive strategies) may mediate this association. These findings help to build a comprehensive understanding of the association between control beliefs and activity in older adults and indicate possibilities for future research that have the potential to translate our findings into practice. Although our results cannot provide causal conclusions, they nonetheless suggest that having greater control beliefs may facilitate activity in later life. Future research should examine whether interventions aimed at improving control beliefs influence social activity, and whether interventions aimed at general control beliefs are as effective in promoting activity as those aimed at activity-specific beliefs. Future research should aim to ensure conceptual clarity in measures of control beliefs. Development of a standard measure of activity engagement, as well as consideration of different conceptualization of 'more' activity (i.e., variety, frequency, time spent), would also be useful. Continued research on the effects of control beliefs on older adults' activity engagement is a worthy endeavour with the potential to promote activity engagement and, in turn, improve the health and well-being of older adults.

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APPENDIX A

Sensitivity Analyses for Chapter 4

Table A.1

Odds Ratios [and 95% Confidence Intervals] from Multilevel Ordered Logit Models Predicting Light Physical Activity[a]

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]
Age	0.98	[0.93, 1.03]	0.98	[0.93, 1.03]	0.99	[0.94, 1.04]	0.98	[0.93, 1.03]	0.98	[0.93, 1.03]	0.98	[0.93, 1.03]
Male	1.00	[0.53, 1.88]	1.00	[0.53, 1.88]	1.05	[0.56, 1.96]	0.97	[0.51, 1.84]	1.04	[0.55, 1.94]	1.04	[0.55, 1.96]
Partnered	1.15	[0.64, 2.09]	1.16	[0.64, 2.11]	1.23	[0.69, 2.23]	1.16	[0.64, 2.11]	1.24	[0.69, 2.23]	1.20	[0.66, 2.17]
Retired	1.57	[0.90, 2.75]	1.56	[0.89, 2.74]	1.58	[0.91, 2.74]	1.60	[0.91, 2.80]	1.61	[0.92, 2.81]	1.65	[0.94, 2.92]
Education	1.06	[1.00, 1.13]	1.06	[1.00, 1.13]	1.07	[1.00, 1.14]	1.06	[1.00, 1.13]	1.07	[1.01, 1.14]*	1.07	[1.00, 1.14]*
Self-rated health	0.90	[0.67, 1.21]	0.92	[0.68, 1.26]	0.95	[0.71, 1.27]	0.87	[0.64, 1.18]	0.89	[0.65, 1.22]	0.86	[0.62, 1.19]
Pain(BP)			1.00	[0.99, 1.02]					0.99	[0.98, 1.01]	1.00	[0.98, 1.02]
Symptoms(BP)					1.32	[1.05, 1.66]*			1.44	[1.10, 1.88]**	1.38	[1.02, 1.87]*
Self-efficacy(BP)							1.03	[0.94, 1.14]	1.06	[0.96, 1.16]	1.06	[0.96, 1.16]
Pain(WP)			1.00	[0.98, 1.01]					1.00	[0.89, 1.01]	1.00	[0.98, 1.02]
Symptoms(WP)					0.97	[0.85, 1.01]			0.93	[0.79, 1.09]	0.96	[0.82, 1.13]
Self-efficacy(WP)							0.98	[0.89, 1.08]	0.98	[0.88, 1.08]	0.97	[0.88, 1.07]
Pain(BP)*Age											1.00	[0.99, 1.01]

(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Symptoms(BP)*Age						0.98 [0.93, 1.03]
Self-efficacy(BP)*Age						1.00 [0.98, 1.02]
Pain(WP)*Age						1.003 [1.000, 1.01]*
Symptoms(WP)*Age						1.02 [0.99, 1.06]
Self-efficacy(WP)*Age						1.00 [0.98, 1.01]
Intercept variance	2.23 [1.58, 3.14]*	2.23 [1.58, 3.14]*	2.13 [1.50, 3.01]*	2.23 [1.58, 3.15]*	2.13 [1.50, 3.01]*	2.16 [1.53, 3.06]*
-2LL	2927.80	2909.01	2903.79	2880.10	2872.12	2861.32
AIC	2955.80	2941.01	2935.79	2912.10	2912.12	2913.32
BIC	3022.99	3017.70	3012.48	2988.67	3007.83	3037.74

Note: Models 1-6 did not show significant omnibus effects. OR = odds ratio, CIs = confidence intervals, WP = within-person, BP = between-person, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria. Random effects significance indicated by 95% CIs. Light physical activity range = 0-7.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

[a]Models were built up in the following order:

Model 1 Baseline covariates

Model 2 Baseline covariates + within- and between-person pain

Model 3 Baseline covariates + within- and between-person symptoms

Model 4 Baseline covariates + within- and between-person self-efficacy

Model 5 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy

Model 6 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy + age interaction

Table A.2

Odds Ratios [and 95% Confidence Intervals] from Multilevel Ordered Logit Models Predicting the 3-Item Physical Activity Measure[a]

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]
Age	0.96	[0.91, 1.02]	0.96	[0.91, 1.02]	0.96	[0.91, 1.02]	0.96	[0.90, 1.01]	0.95	[0.90, 1.01]	0.95	[0.90, 1.01]
Male	1.57	[0.77, 3.22]	1.58	[0.77, 3.24]	1.61	[0.79, 3.31]	1.52	[0.75, 3.08]	1.57	[0.78, 3.19]	1.53	[0.75, 3.12]
Partnered	1.25	[0.63, 2.45]	1.26	[0.64, 2.47]	1.29	[0.66 2.53]	1.23	[0.63, 2.39]	1.27	[0.65, 2.47]	1.26	[0.65, 2.47]
Retired	1.36	[0.72, 2.57]	1.36	[0.72, 2.56]	1.37	[0.73, 2.57]	1.37	[0.74, 2.56]	1.39	[0.74, 2.58]	1.42	[0.75, 2.67]
Education	1.09	[1.02, 1.18]*	1.09	[1.02, 1.18]*	1.10	[1.02, 1.18]*	1.10	[1.02, 1.18]*	1.10	[1.03, 1.19]*	1.11	[1.03, 1.19]**
Self-rated health	1.26	[0.90, 1.76]	1.28	[0.90, 1.82]	1.29	[0.92, 1.80]	1.15	[0.82, 1.62]	1.16	[0.81, 1.65]	1.15	[0.80, 1.65]
Pain(BP)			1.00	[0.98, 1.02]					1.00	[0.97, 1.02]	1.00	[0.97, 1.02]
Symptoms(BP)					1.13	[0.87, 1.46]			1.22	[0.91, 1.64]	1.19	[0.85, 1.67]
Self-efficacy(BP)							1.11	[1.004, 1.24]*	1.13	[1.02, 1.17]*	1.13	[1.02, 1.26]*
Pain(WP)			1.01	[0.99, 1.02]					1.01	[0.99, 1.02]	1.01	[0.99, 1.02]
Symptoms(WP)					1.04	[0.91, 1.8]			1.02	[0.87, 1.19]	1.03	[0.88, 1.21]
Self-efficacy(WP)							1.07	[0.97, 1.17]	1.07	[0.97, 1.17]	1.06	[0.96, 1.17]
Pain(BP)*Age											1.00	[0.99, 1.00]
Symptoms(BP)*Age											0.98	[0.93, 1.04]
Self-efficacy(BP)*Age											1.01	[0.99, 1.03]

(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Pain(WP)*Age						1.004 [1.002, 1.01]**
Symptoms(WP)*Age						1.02 [0.99, 1.05]
Self-efficacy(WP)*Age						1.02 [1.003, 1.04]*
Intercept variance	3.13 [2.31, 4.25]*	3.13 [2.30, 4.25]*	3.09 [2.27, 4.20]*	3.00 [2.20, 4.09]*	2.94 [2.16, 4.03]*	2.99 [2.19, 4.08]*
-2LL	3992.62	3964.16	3963.80	3930.10	3927.46	3907.89
AIC	4038.62	4014.16	4013.80	3980.10	3985.46	3977.89
BIC	4149.00	4134.00	4133.63	4099.74	4124.25	4145.38

Note: OR = odds ratio, CIs = confidence intervals, WP = within-person, BP = between-person, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria. Random effects significance indicated by 95% CIs. 3-item physical activity potential range = 0-24, actual range = 0-18.

*p < .05, **p < .01, ***p < .001

[a]Models were built up in the following order:

Model 1 Baseline covariates

Model 2 Baseline covariates + within- and between-person pain

Model 3 Baseline covariates + within- and between-person symptoms

Model 4 Baseline covariates + within- and between-person self-efficacy

Model 5 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy

Model 6 Baseline covariates + within- and between-person pain, symptoms, and self-efficacy + age interactions

APPENDIX B

Supplementary Lagged Analyses for Chapter 4

Table B.1

Odds Ratios [and 95% Confidence Intervals] from Supplementary Lagged Multilevel Ordered Logit Models Predicting Social Activity (Model 1), Physical Activity (Model 2), and Mental Activity (Model 3) at T from predictors at T - 1

	Model 1 Social Activity	Model 2 Physical Activity	Model 3 Mental Activity
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
WP predictors at T - 1			
Pain	0.98 [0.95, 1.01]	0.99 [0.96, 1.03]	1.00 [0.97, 1.03]
Symptoms	0.88 [0.69, 1.11]	0.93 [0.70, 1.24]	0.92 [0.72, 1.17]
Self-efficacy	1.05 [0.91, 1.22]	0.98 [0.83, 1.16]	0.94 [0.81, 1.09]
Pain*Age	1.00 [0.996, 1.01]	1.004 [0.999, 1.01]	1.00 [0.999, 1.01]
Symptoms*Age	1.01 [0.97, 1.06]	0.99 [0.92, 1.06]	0.97 [0.93, 1.02]
Self-efficacy*Age	1.01 [0.98, 1.04]	1.02 [0.98, 1.05]	1.02 [0.99, 1.05]
WP predictors at T			
Pain	0.98 [0.95, 1.01]	1.04 [1.002, 1.07]*	1.00 [0.97, 1.04]
Symptoms	1.24 [0.90, 1.72]	1.18 [0.81, 1.71]	1.19 [0.86, 1.66]
Self-efficacy	1.04 [0.88, 1.22]	1.14 [0.95, 1.37]	0.91 [0.77, 1.07]
Pain*Age	1.00 [0.99, 1.0003]	1.01 [0.999, 1.01]	1.00 [0.998, 1.01]
Symptoms*Age	1.02 [0.96, 1.08]	0.96 [0.91, 1.01]	1.00 [0.94, 1.06]
Self-efficacy*Age	0.99 [0.96, 1.02]	0.99 [0.96, 1.03]	0.99 [0.96, 1.03]
BP Predictors			
Pain	1.01 [0.98, 1.03]	1.01 [0.98, 1.03]	0.99 [0.97, 1.01]
Symptoms	1.16 [0.84, 1.62]	1.28 [0.88, 1.86]	1.27 [0.91, 1.77]
Self-efficacy	1.03 [0.95, 1.11]	1.07 [0.98, 1.17]	1.08 [0.99, 1.16]
Pain*Age	1.00 [0.999, 1.004]	1.00 [0.998, 1.01]	1.00 [0.99, 1.001]
Symptoms*Age	1.09 [1.02, 1.16]*	0.99 [0.93, 1.07]	1.01 [0.95, 1.08]
Self-efficacy*Age	1.01 [0.996 1.02]	1.01 [0.99, 1.03]	1.00 [0.99, 1.02]

(continued)

	Model 1 Social Activity	Model 2 Physical Activity	Model 3 Mental Activity
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
Covariates			
Activity at T - 1[a]	1.22 [1.12, 1.31]***	1.36 [1.21, 1.53]***	1.34 [1.25, 1.48]***
Day	0.73 [0.35, 1.52]		0.96 [0.47, 1.99]
Day^2	1.03 [0.95, 1.12]		1.01 [0.93, 1.09]
Age	0.99 [0.95, 1.04]	0.95 [0.90, 1.004]	1.00 [0.96, 1.05]
Male	1.18 [0.69, 2.04]	1.61 [0.87, 3.00]	1.42 [0.81, 2.47]
Partnered	0.77 [0.46, 1.29]	1.15 [0.65, 2.03]	0.51 [0.29, 0.89]*
Retired	0.66 [0.40, 1.09]	1.62 [0.96, 2.74]	0.83 [0.51, 1.33]
Education	1.03 [0.97, 1.08]	1.01 [0.95, 1.07]	1.00 [0.94, 1.06]
Self-rated health	1.13 [0.86, 1.48]	1.23 [0.90, 1.68]	1.09 [0.82, 1.44]
Intercept variance	0.31 [0.04, 2.04]	0.31 [0.05, 2.04]	0.33 [0.03, 3.54]
-2LL	1206.74	1648.23	1903.22
AIC	1276.74	1732.23	2001.22
BIC	1414.73	1897.83	2194.42

Note: WP = within-person, BP = between-person, OR = odds ratio, CIs = confidence intervals, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria. Random effects significance indicated by 95% CIs.

[a] The outcome activity at T - 1

*p < .05, **p < .01, ***p < .001

Table B.2

Odds Ratios [and 95% Confidence Intervals] from Supplementary Reverse-Lagged Multilevel Ordered Logit Models Predicting Pain at T from Social Activity (Model 1), Physical Activity (Model 2), and Mental Activity (Model 3) at T - 1

	Model 1	Model 2	Model 3
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
WP predictors at T - 1			
Social activity	1.08 [0.97, 1.20]		
Physical activity		0.93 [0.80, 1.08]	
Mental activity			1.01 [0.92, 1.12]
Social activity*Age	1.00 [0.98, 1.03]		
Physical activity*Age		0.99 [0.96, 1.01]	
Mental activity*Age			1.02 [0.99, 1.03]
Symptoms	0.85 [0.65, 1.12]	0.83 [0.64, 1.09]	1.00 [0.65, 1.12]
Self-efficacy	0.95 [0.80, 1.14]	0.97 [0.81, 1.16]	0.95 [0.79, 1.13]
Symptoms*Age	1.02 [0.97, 1.07]	1.02 [0.96, 1.07]	1.00 [0.95, 1.06]
Self-efficacy*Age	0.98 [0.95, 1.02]	0.99 [0.97, 1.03]	0.98 [0.95, 1.02]
WP predictors at T			
Social activity	1.01 [0.91, 1.12]		
Physical activity		1.06 [0.92, 1.22]	
Mental activity			0.96 [0,86, 1.05]
Social activity*Age	1.00 [0.98, 1.02]		
Physical activity*Age		0.97 [0.95, 0.998]*	
Mental activity*Age			1.01 [0.99, 1.03]
Symptoms	5.32 [3.50, 8.09]***	5.19 [4.43, 7.86]***	5.61 [3.65, 8.60]***
Self-efficacy	1.03 [0.83, 1.28]	1.01 [0.82, 1.25]	1.01 [0.82, 1.25]
Symptoms*Age	1.03 [0.96, 1.12]	1.04 [0.96, 1.12]	1.02 [0.95, 1.11]
Self-efficacy*Age	1.02 [0.98, 1.07]	1.03 [0.99, 1.08]	1.02 [0.98, 1.07]

(continued)

	Model 1		Model 2		Model 3	
	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]
BP Predictors						
Social activity	1.06	[0.91, 1.23]				
Physical activity			0.95	[0.78, 1.14]		
Mental activity					0.99	[0.89, 1.10]
Social activity*Age	1.00	[0.97, 1.02]				
Physical activity*Age			0.97	[0.94, 1.001]		
Mental activity*Age					1.01	[0.99, 1.02]
Symptoms	9.00	[5.02, 16.14]***	8.48	[4.78, 15.03]	9.79	[5.36, 17.91]***
Self-efficacy	1.07	[0.95, 1.28]	1.09	[0.97, 1.23]	1.08	[0.96, 1.23]
Symptoms*Age	1.04	[0.96, 1.13]	1.04	[0.96, 1.13]	1.03	[0.95, 1.12]
Self-efficacy*Age	1.03	[1.01, 1.05]**	1.03	[1.01, 1.05]**	1.02	[1.004, 1.05]
Covariates						
Pain at T - 1	1.11	[1.09, 1.14]***	1.12	[1.09, 1.15]***	1.12	[1.09, 1.15]***
Age	1.01	[0.95, 1.08]	0.99	[0.93, 1.06]	1.01	[0.95, 1.08]
Male	2.31	[1.02, 5.23]*	2.05	[0.44, 4.74]	2.62	[1.12, 6.07]*
Partnered	1.63	[0.76, 3.51]	1.67	[0.80, 3.50]	1.42	[0.64, 3.19]
Retired	0.61	[0.30, 1.22]	0.60	[0.30, 1.17]	0.56	[0.27, 1.14]
Education	1.08	[1.0004, 1.17]*	1.10	[1.01, 1.18]*	1.08	[1.003, 1.17]*
Self-rated health	0.73	[0.49, 1.10]	0.73	[0.49, 1.09]	0.76	[0.51, 1.15]
Intercept variance	1.58	[1.74, 3.36]	1.69	[0.80, 3.56]	1.69	[0.80, 3.56]
-2LL		1387.88		1382.72		1386.60
AIC		1505.88		1500.72		1504.60
BIC		1738.51		1733.35		1737.22

Note: WP = within-person, BP = between-person, OR = odds ratio, CIs = confidence intervals, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria.

Random effects significance indicated by 95% CIs.

*$p < .05$, **$p < .01$, ***$p < .001$

Table B.3

Odds Ratios [and 95% Confidence Intervals] from Supplementary Reverse-Lagged Multilevel Ordered Logit Models Predicting Physical Symptoms at T from Social Activity (Model 1), Physical Activity (Model 2), and Mental Activity (Model 3) at T - 1

	Model 1		Model 2		Model 3	
	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]
WP predictors at T - 1						
Social activity	1.08	[0.97, 1.19]				
Physical activity			0.96	[0.83, 1.11]		
Mental activity					0.98	[0.89, 1.07]
Social activity*Age	0.99	[0.97, 1.01]				
Physical activity*Age			0.99	[0.97, 1.02]		
Mental activity*Age					0.99	[0.98, 1.01]
Pain	0.96	[0.93, 0.99]*	0.96	[0.93, 0.99]*	0.96	[0.93, 0.99]*
Self-efficacy	0.99	[0.84, 1.18]	1.00	[0.84, 1.18]	1.00	[0.84, 1.19]
Pain*Age	1.01	[1.001, 1.01]*	1.01	[1.001, 1.01]*	1.01	[1.001, 1.01]*
Self-efficacy*Age	0.99	[0.96, 1.02]	1.00	[0.96, 1.03]	0.99	[0.96, 1.03]
WP predictors at T						
Social activity	1.16	[1.04, 1.29]**				
Physical activity			1.05	[0.92, 1.21]		
Mental activity					1.07	[0.97, 1.18]
Social activity*Age	1.00	[0.98, 1.02]				
Physical activity*Age			1.00	[0.97, 1.03]		
Mental activity*Age					1.01	[0.99, 1.02]
Pain	1.07	[1.04, 1.11]***	1.07	[1.03, 1.10]***	1.07	[1.04, 1.11]***
Self-efficacy	0.95	[0.79, 1.15]	0.95	[0.78, 1.14]	0.96	[0.97, 1.05]
Pain*Age	1.00	[0.995, 1.01]	1.00	[0.995, 1.004]	1.00	[0.99, 1.004]
Self-efficacy*Age	1.01	[0.97, 1.05]	1.01	[0.97, 1.05]	1.01	[0.97, 1.05]

(continued)

	Model 1		Model 2		Model 3	
	OR	[95% CIs]	OR	[95% CIs]	OR	[95% CIs]
BP Predictors						
Social activity	0.93	[0.82, 1.07]				
Physical activity			1.16	[0.98, 1.37]		
Mental activity					0.98	[0.89, 1.07]
Social activity*Age	1.02	[0.99, 1.04]				
Physical activity*Age			1.00	[0.97, 1.03]		
Mental activity*Age					1.00	[0.98, 1.01]
Pain	1.07	[1.04, 1.10]***	1.06	[1.03, 1.09]***	1.06	[1.04, 1.09]***
Self-efficacy	0.90	[0.81, 0.99]*	0.88	[0.80, 0.97]*	0.90	[0.81, 0.99]*
Pain*Age	1.00	[0.998, 1.01]	1.005	[1.0003, 1.01]*	1.01	[1.001, 1.01]*
Self-efficacy*Age	1.01	[0.99, 1.02]	1.01	[0.99, 1.02]	1.01	[0.99, 1.03]
Covariates						
Symptoms at T - 1	2.40	[1.86, 3.10]***	2.38	[1.85, 3.06]***	2.38	[1.84, 3.09]***
Age	1.06	[0.996, 1.12]	1.07	[1.004, 1.13]*	1.06	[0.997, 1.12]
Male	0.41	[0.20, 0.83]*	0.38	[0.19, 0.74]**	0.42	[0.21, 0.83]*
Partnered	1.04	[0.53, 2.03]	1.05	[0.56, 2.00]	1.05	[0.53, 2.09]
Retired	1.09	[0.58, 2.03]	1.06	[0.58, 1.92]	1.11	[0.60, 2.04]
Education	0.90	[0.84, 0.96]**	0.89	[0.83, 0.95]**	0.89	[0.84, 0.96]**
Self-rated health	0.84	[0.58, 1.21]	0.84	[0.59, 1.20]	0.86	[0.60, 1.23]
Intercept variance	0.93	[0.35, 2.45]	0.79	[0.27, 2.29]	0.89	[0.33, 2.43]
-2LL	736.92		747.61		747.29	
AIC	798.92		809.61		809.29	
BIC	921.15		931.84		931.51	

Note: WP = within-person, BP = between-person, OR = odds ratio, CIs = confidence intervals, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria.

Random effects significance indicated by 95% CIs.

*$p < .05$, **$p < .01$, ***$p < .001$

Table B.4

Odds Ratios [and 95% Confidence Intervals] from Supplementary Reverse-Lagged Ordered Logit Models Predicting Self-efficacy at T from Social Activity (Model 1), Physical Activity (Model 2), and Mental Activity (Model 3) at T - 1[a]

	Model 1	Model 2	Model 3
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
WP predictors at T - 1			
Social activity	0.94 [0.86, 1.03]		
Physical activity		1.03 [0.91, 1.17]	
Mental activity			0.99 [0.91, 1.08]
Social activity*Age	0.99 [0.97, 1.01]		
Physical activity*Age		1.00 [0.98, 1.03]	
Mental activity*Age			0.98 [0.97, 1.001]
Pain	1.00 [0.97, 1.03]	1.00 [0.97, 1.03]	1.01 [0.98, 1.04]
Symptoms	1.08 [0.85, 1.37]	1.10 [0.86, 1.40]	1.05 [0.82, 1.34]
Pain*Age	0.99 [0.99, 0.998]*	0.99 [0.99, 0.998]*	1.00 [0.90, 1.001]
Symptoms*Age	1.00 [0.96, 1.05]	1.01 [0.96, 1.06]	1.01 [0.96, 1.06]
WP predictors at T			
Social activity	0.98 [0.89, 1.08]		
Physical activity		1.10 [0.97, 1.24]	
Mental activity			0.99 [0.91, 1.08]
Social activity*Age	0.98 [0.96, 0.997]*		
Physical activity*Age		1.02 [0.997, 1.05]	
Mental activity*Age			0.98 [0.96, 0.997]*
Pain	0.99 [0.96, 1.02]	0.99 [0.96, 1.20]	1.00 [0.97, 1.03]
Symptoms	0.87 [0.61, 1.23]	0.87 [0.62, 1.22]	0.86 [0.61, 1.21]
Pain*Age	1.00 [0.997, 1.01]	1.00 [0.997, 1.01]	1.00 [0.998, 1.01]
Symptoms*Age	1.04 [0.97, 1.11]	1.04 [0.97, 1.11]	1.04 [0.98, 1.12]

(continued)

	Model 1	Model 2	Model 3
	OR [95% CIs]	OR [95% CIs]	OR [95% CIs]
BP Predictors			
Social activity	1.02 [0.92, 1.12]		
Physical activity		0.97 [0.86, 1.09]	
Mental activity			0.98 [0.94, 1.02]
Social activity*Age	1.01 [0.99, 1.02]		
Physical activity*Age		1.02 [0.99, 1.04]	
Mental activity*Age			1.01 [0.99, 1.02]
Pain	1.03 [1.01, 1.05]**	1.03 [1.01, 1.05]**	1.03 [1.01, 1.05]*
Symptoms	0.74 [0.54, 0.998]*	0.75 [0.55, 1.02]	0.73 [0.54, 0.99]*
Pain*Age	1.00 [0.998, 1.01]	1.00 [0.998, 1.01]	1.00 [0.998, 1.03]
Symptoms*Age	0.99 [0.94, 1.05]	0.99 [0.94, 1.05]	1.00 [0.95, 1.06]
Covariates			
Self-efficacy at T - 1	2.42 [2.17, 2.70]***	2.42 [2.17, 2.70]***	2.39 [2.15, 2.67]***
Age	0.99 [0.95, 1.03]	0.99 [0.95, 1.04]	0.98 [0.94, 1.02]
Male	1.20 [0.73, 1.97]	1.19 [0.71, 1.98]	1.01 [0.62, 1.67]
Partnered	0.95 [0.60, 1.53]	1.02 [0.64, 1.62]	1.32 [0.81, 2.16]
Retired	1.21 [0.78, 1.88]	1.25 [0.81, 1.93]	1.30 [0.84, 2.00]
Education	0.95 [0.90, 0.99]*	0.95 [0.90, 0.999]*	0.95 [0.91, 1.002]
Self-rated health	1.40 [1.09, 1.80]**	1.39 [1.08, 1.80]*	1.34 [1.04, 1.72]*
-2LL	1178.52	1655.93	1172.20
AIC	1252.52	1254.56	1246.20
BIC	1398.40	1400.44	1392.08

Note: WP = within-person, BP = between-person, OR = odds ratio, CIs = confidence intervals, LL = log likelihood, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria.

[a] Random intercept variance was not significant and did not improve model fit, therefore random effects were not included

*p < .05, **p < .01, ***p < .001

APPENDIX C

Email to Organisations Requesting Assistance with Participant Recruitment

Subject: Flinders Centre for Ageing Studies Research Participation

Dear [NAME],

We are contacting you as the [POSITION of ORGANISATION] in order to introduce Rachel Curtis, a PhD student in the School of Psychology at Flinders University. Rachel is undertaking research leading to the production of a thesis and possibly other publications in the area of leisure activity. Specifically, her study focuses on how midlife and older adults choose and participate in leisure activities.

We would like to invite members of your organisation who are 50 years of age or older to participate in this study. Participants would be asked to complete one questionnaire that will take approximately 20-25 minutes. Participants will be asked some questions about themselves, including how they go about choosing and participating in leisure activities and the types of leisure activities they participate in. Participants will also be asked some questions about their recent experience of different emotions, for example whether they felt afraid or lonely. As compensation for the time taken to complete the questionnaire, participants will receive a voucher of $5 value for their choice of Coles, Kmart, Officeworks, or Target.

Participation is anonymous as we do not ask for identifying information. Participation is voluntary and participants are entirely free to discontinue participation at any time or to decline to answer particular questions. This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 7382).

If you think members of your organisation may be interested in participating in this project, we would be grateful if you would either:
1) Include an advertisement in an upcoming online or print newsletter,
Or;
2) Forward this email to your organisation members.

We have provided 2 versions of the advertisement. The online version contains a link to the online survey and can be placed in online newsletter or websites. The print version can be used for any printed correspondence. If you are able to promote our study in one of these ways, we also ask that you please complete the attached form and email or post it back to us.

For further information and to access the survey, please click on this link (or copy and paste into your internet browser).

<Link>

If you have any enquiries regarding this project, or to request a paper copy of the information sheet and questionnaire, please contact Rachel via email (rachel.curtis@flinders.edu.au) or phone 8201 3064. You can also contact me via email (tim.windsor@flinders.edu.au).

Thank you for your time and consideration.

Yours sincerely,

Dr Tim Windsor
Director, Flinders Centre for Ageing Studies
School of Psychology, Flinders University

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

APPENDIX D

Letter from Organisations Confirming Assistance with Participant Recruitment

Flinders UNIVERSITY

Rachel Curtis

Flinders University
School of Psychology

GPO Box 2100
Adelaide SA 5001

Tel: 08 8201 3064
rachel.curtis@flinders.edu.au

CRICOS Provider No. 00114A

PERMISSION FOR STUDY PROMOTION

Project: "Leisure activity in midlife and older adults"

I ...., as the president/secretary/other nominee of

.... *(insert organisation)* give permission for the promotion of the study 'Leisure Activity in Midlife and Older Adults' conducted by Rachel Curtis and the Flinders Centre for Ageing Studies, through newsletters or other correspondence with organisation members.

Signature...Date.......................................

APPENDIX E

Study Advertisement: Print and Email Version

Research Participation
LEISURE ACTIVITY

Are you 50 years of age or older? If yes, we would love to hear from you!

The Flinders University Centre for Ageing Studies invites you to participate in a research project on leisure activity in midlife and older adults. Participation involves completing a survey that will take 20-25 minutes. You will be asked some questions about yourself, including how you go about choosing and participating in leisure activities. You will also be asked some questions about your recent experience of different emotions, for example whether you felt afraid or lonely.

Participants will receive a $5 voucher for Coles, Officeworks, Target or Kmart. This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee.

For more information or to register your interest, please email rachel.curtis@flinders.edu.au or phone 8201 3064.

Research Participation
LEISURE ACTIVITY

Are you 50 years of age or older? If yes, we would love to hear from you!

The Flinders University Centre for Ageing Studies invites you to participate in a research project on leisure activity in midlife and older adults. Participation involves completing a survey that will take 20-25 minutes. You will be asked some questions about yourself, including how you go about choosing and participating in leisure activities. You will also be asked some questions about your recent experience of different emotions, for example whether you felt afraid or lonely.

Participants will receive a $5 voucher for Coles, Officeworks, Target or Kmart. This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee.

For further information about the survey or to participate, please click on this link (or copy and paste into your internet browser).

<Link>

For enquiries, email rachel.curtis@flinders.edu.au

APPENDIX F

Letter of Introduction: Print Version

Flinders University
School of Psychology
GPO Box 2100
Adelaide SA 5001
Tel: 08 8201 3064
rachel.curtis@flinders.edu.au
CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear [NAME],

[We are contacting you because you have previously expressed an interesting in taking part in research projects being conducted by the Flinders Centre for Ageing Studies] OR [Thank you for responding to the advertisement for our research project on leisure activity].

This letter is to introduce Rachel Curtis, a PhD student in the School of Psychology at Flinders University. Rachel is undertaking research leading to the production of a thesis or other publications in the area of leisure activity. Specifically, her study focuses on how midlife and older adults choose and participate in their leisure activities.

We would like to invite you to participate in this project by completing the enclosed questionnaire that will take approximately 20-25 minutes. You will be asked some questions about yourself, including how you go about choosing and participating in your leisure activities and the types of leisure activities you participate in. As compensation for the time taken to complete the questionnaire, you will receive a $5 voucher for your choice of Coles, Kmart, Officeworks or Target stores.

Be assured that any information provided will be treated in the strictest confidence and no respondents will be individually identifiable in the resulting thesis or other publications. Participation is voluntary and you are entirely free to discontinue your participation at any time or to decline to answer particular questions. This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 7382).

For more information, please see the enclosed information sheet.

If you have any enquiries regarding this project, please contact Rachel via email (rachel.curtis@flinders.edu.au) or phone (8201 3064). You can also contact me via email (tim.windsor@flinders.edu.au).

Thank you for your time.

Yours sincerely,

Dr Tim Windsor
Director, Flinders Centre for Ageing Studies
School of Psychology, Flinders University

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project Number 7382). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au.

Letter of Introduction: Email Version

Dear [NAME],

[We are contacting you because you have previously expressed an interesting in taking part in research projects being conducted by the Flinders Centre for Ageing Studies] OR [Thank you for responding to the advertisement for our research project on leisure activity].

This email is to introduce Rachel Curtis, a PhD student in the School of Psychology at Flinders University. Rachel is undertaking research leading to the production of a thesis or other publications in the area of leisure activity. Specifically, her study focuses on how midlife and older adults choose and participate in their leisure activities.

We would like to invite you to participate in this project by completing a one-off online questionnaire that will take approximately 20-25 minutes. You will be asked some questions about yourself, including how you go about choosing and participating in your leisure activities and the types of leisure activities you participate in. As compensation for the time taken to complete the questionnaire, you will receive a $5 voucher for your choice of Coles, Kmart, Officeworks or Target stores.

Be assured that any information provided will be treated in the strictest confidence and no respondents will be individually identifiable in the resulting thesis or other publications. Participation is voluntary and you are entirely free to discontinue your participation at any time or to decline to answer particular questions. This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 7382).

If you would like some further information on this study or would like to participate, please click on the link below (or copy and paste the link into your internet browser). This will direct you to the information sheet. From there, you can choose whether or not you wish to continue to the questionnaire.

<Link>

If you have any enquiries regarding this project, or would like to request a paper copy of the information sheet and questionnaire, please contact Rachel via email (rachel.curtis@flinders.edu.au) or phone (8201 3064). You can also contact me via email (tim.windsor@flinders.edu.au).

Thank you for your time.

Yours sincerely,

Dr Tim Windsor

Director, Flinders Centre for Ageing Studies

School of Psychology, Flinders University

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project Number 7382). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au.

APPENDIX G

Information Sheet: Print Version

Flinders University
School of Psychology
GPO Box 2100
Adelaide SA 5001
Tel: 08 8201 3064
rachel.curtis@flinders.edu.au
CRICOS Provider No. 00114A

INFORMATION SHEET

Project: "Leisure activity in midlife and older adults"

Researcher:
Ms Rachel Curtis
School of Psychology,
Flinders University
Email: rachel.curtis@flinders.edu.au

Supervisors:
Dr Tim Windsor
Email: tim.windsor@flinders.edu.au

Emeritus Professor Mary Luszcz
Email: mary.luszcz@flinders.edu.au

Description of the study:

This study is part of the project entitled *Leisure activity in midlife and older adults.* This project will investigate whether individuals' views about themselves and their activity are related to how they go about participating in leisure activity and the types of leisure activities they choose to do. This study will give us an insight into the beliefs and characteristics of individuals that influence participation in different kinds of activity.

This project is supported by Flinders University School of Psychology and has been approved by the Flinders University Social and Behavioural Research Ethics Committee. This research will lead to the production of a thesis and possibly other publications.

What will I be asked to do?

If you are 50 years of age or older, you are invited to complete a once-off questionnaire that will take approximately 20-25 minutes. You will be asked some questions, including beliefs about yourself, how you go about choosing and participating in your leisure activities and the types of leisure activities you participate in. Please complete the survey in one sitting in an environment that is free of distractions. There are no right or wrong answers. Please ensure you read the instructions carefully and answer all questions honestly as possible.

What benefit will I gain from being involved in this study?

You may not gain any direct benefits from being involved in the study, however your participation may lead to a better understanding of factors that help people participate in leisure activity.

Will I be identifiable by being involved in this study?

You will not be asked to provide any identifying information in the questionnaire. Your responses will therefore be anonymous and no respondents will be identifiable in the thesis or any publications.

Are there any risks or discomforts if I am involved?

You will be asked some questions about your recent experience of different emotions, for example whether you felt afraid or lonely. However, the researchers do not anticipate that you will experience any discomfort from completing the questionnaire. If, however, the research raises any issues that you would like to discuss with someone, please contact Lifeline (Phone: 13 11 14; www.lifeline.org.au).

Will I receive payment if I participate?

As compensation for the time taken to complete the questionnaire, you will receive a $5 voucher for Coles, Kmart, Officeworks, or Target. Once you complete the survey, please fill in the form on the final page and return, along with your questionnaire, via post using the reply-paid envelope. The page will ask for your name, address and chosen store. This page will be removed from your questionnaire as soon as we receive it and will not be stored with your responses.

How do I agree to participate?

Participation is voluntary and you are entirely free to discontinue your participation at any time or to decline to answer particular questions. If you agree to participate, please complete the questionnaire and return via post, using the reply-paid envelope enclosed.

Thank you for taking the time to read this information sheet.

If you have any questions or concerns, please contact Rachel Curtis via email at rachel.curtis@flinders.edu.au or phone 8201 3064.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 7382). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Information Sheet: Online Version

INFORMATION SHEET

Project: "**Leisure activity in midlife and older adults**"

Researchers:

Ms Rachel Curtis
School of Psychology
Flinders University
GPO Box 2100 Adelaide SA 5001
Tel: 08 8201 3064
Email: rachel.curtis@flinders.edu.au

Supervisors:

Dr Tim Windsor
Email: tim.windsor@flinders.edu.au

Emeritus Professor Mary Luszcz
Email: mary.luszcz@flinders.edu.au

Description of the study:

This study is part of the project entitled "Leisure activity in midlife and older adults". This project will investigate whether individuals' views about themselves and their activity are related to how they go about participating in leisure activity and the types of leisure activities they choose to do. This study will give us an insight into the beliefs and characteristics of individuals that influence participation in different kinds of activity.

This project is supported by Flinders University School of Psychology and has been approved by the Flinders University Social and Behavioural Research Ethics Committee. This research will lead to the production of a thesis and possibly other publications.

What will I be asked to do?

If you are 50 years of age or older, you are invited to complete a once-off online questionnaire that will take approximately 20-25 minutes. You will be asked some questions, including beliefs about yourself, how you go about choosing and participating in your leisure activities and the types of leisure activities you participate in. Please complete the survey in one sitting in an environment that is free of distractions. This survey needs to be done on a computer; it is not suitable for mobile devices. There are no right or wrong answers. Please ensure you read the instructions carefully and answer all questions honestly as possible.

Will I be identifiable by being involved in this study?

You will not be asked to provide any identifying information in the questionnaire. Your responses will therefore be anonymous and no respondents will be identifiable in the thesis or any publications. Your responses will be collected and transmitted to the researchers through the software platform Qualtrics, which has a high level of security. In addition, this research will utilise a feature of the Qualtrics software that ensures that IP addresses are not collected.

Are there any risks or discomforts if I am involved?

You will be asked some questions about your recent experience of different emotions, for example whether you felt afraid or lonely. However, the researchers do not anticipate that you will experience any discomfort from completing the questionnaire. If, however, the research raises any issues that you would like to discuss with someone, please contact Lifeline (Phone: 13 11 14; www.lifeline.org.au).

Will I receive payment if I participate?

As compensation for the time taken to complete the questionnaire, you will receive a $5 voucher for Coles, Kmart, Officeworks, or Target. Once you complete the survey, you will be redirected to another webpage where you will be asked to enter your name, email address, and your choice of store. This information will not be stored with your survey responses, so your responses remain anonymous.

How do I agree to participate?

Participation is voluntary and you are entirely free to discontinue your participation at any time or to decline to answer particular questions. If you agree to participate, please click "next" (below) to continue to the questionnaire on the next page.

If you would like to participate in the study but would prefer to complete a pen-and-paper version of the survey, please contact the study coordinator (details below) to arrange for a survey to be sent to you.

Thank you for taking the time to read this information sheet.

If you have any questions or concerns, please contact Rachel Curtis via email at rachel.curtis@flinders.edu.au or phone 8201 3064.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 7382). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

APPENDIX H

Participant Questionnaire

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Please complete the survey in one sitting in an environment that is free of distractions. Ensure you read the instructions carefully and answer all questions as honestly as possible. Please select one response from multiple choice items and type in the boxes provided.

What is your age?

Are you male or female?

- Male
- Female

Which state or territory do you live in?

- South Australia
- Australian Capital Territory
- New South Wales
- Victoria
- Queensland
- Northern Territory
- Western Australia
- Tasmania

What is your marital status?

- Married
- Partnered
- Separated
- Divorced
- Widowed
- Never married

How many years of education have you had? (add together all primary school, secondary/high school, college/university, and any other education or qualification)

What is your employment status?

- Employed full time
- Employed part time
- Unemployed looking for work
- Unemployed not looking for work
- Retired
- Other (please specify)

In what year did you retire?

How old were you when you retired?

Next

Flinders UNIVERSITY

Now we'd like to ask some questions about your health.

How would you rate your overall state of health at the present time?

- Very bad
- Bad
- Average
- Good
- Very good

Is your hearing [including when you are wearing a hearing aid, if applicable]...

- Excellent
- Very good
- Good
- Fair; or
- Poor?

Is your vision [including when wearing glasses or contact lenses, if applicable]...

- Excellent
- Very good
- Good
- Fair
- Poor; or
- Registered or legally blind?

The following questions are about activities you might do during a typical day. Does your **health now limit you** in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	○	○	○
Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○	○	○
Lifting or carrying groceries	○	○	○
Climbing several flights of stairs	○	○	○
Climbing one flight of stairs	○	○	○
Bending, kneeling, or stooping	○	○	○
Walking more than one kilometre (0.62 miles)	○	○	○
Walking several blocks	○	○	○
Walking one block	○	○	○
Bathing or dressing yourself	○	○	○

Next

Using the scale from 1 to 7, where 1 means no control and 7 means complete control, please **rate how much control** you have over these aspects of your life.

	No control 1	2	3	4	5	6	Complete Control 7
Social activity (e.g. meeting friends, attending a social club or seniors centre)	○	○	○	○	○	○	○
Physical activity (e.g. going for walks, doing sports)	○	○	○	○	○	○	○
Mental activity (e.g. doing crosswords, reading a book or newspaper)	○	○	○	○	○	○	○
Your health	○	○	○	○	○	○	○

Next

Here we present a list of statements describing how people sometimes feel. Please indicate how often you felt this way **during the past week**. Many of these statements may not apply to you but we have to ask them of everybody to get a comparison.

	Rarely or none of the time	Some of the time	Quite a bit of the time	Most or all of the time
I was bothered by things that usually don't bother me	○	○	○	○
I had trouble keeping my mind on what I was doing	○	○	○	○
I felt depressed	○	○	○	○
I felt that everything I did was an effort	○	○	○	○
I felt hopeful about the future	○	○	○	○
I felt afraid	○	○	○	○
My sleep was restless	○	○	○	○
I was happy	○	○	○	○
I felt lonely	○	○	○	○
I could not "get going"	○	○	○	○

Next

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Below are ten statements about yourself which may or may not be true. Please **indicate your agreement** with each item.

	Not at all true	Hardly true	Moderately true	Exactly true
I can always manage to solve difficult problems if I try hard enough	○	○	○	○
If someone opposes me, I can find the means and ways to get what I want	○	○	○	○
It is easy for me to stick to my aims and accomplish my goals	○	○	○	○
I am confident that I could deal efficiently with unexpected events	○	○	○	○
Thanks to my resourcefulness, I know how to handle unforeseen situations	○	○	○	○
I can solve most problems if I invest the necessary effort	○	○	○	○
I can remain calm when facing difficulties because I can rely on my coping abilities	○	○	○	○
When I am confronted with a problem, I can usually find several solutions	○	○	○	○
If I am in trouble, I can usually think of a solution	○	○	○	○
I can usually handle whatever comes my way	○	○	○	○

Next

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Now we would like you to think about your **leisure activities**. Leisure activity is any activity that you choose to do for enjoyment or to pass the time. Some examples are physical activity (e.g., going for walks, doing sports), social activity (e.g., meeting friends, attending a social club or seniors centre), and mental activity (e.g., doing crosswords, reading a book or newspaper). There are many other leisure activities that you might do. We are interested in leisure activities that involve some active participation, so please do not include passive activities such as napping and watching television. It is important to know that leisure activity does **not** include activities that you have to do, such as paid employment, housework, and basic personal care.

We are interested in learning about how you go about accomplishing your leisure activities. That is, how do you decide what leisure activities are important to you? And how do you go about accomplishing what you want in your leisure activities?

In the following, we present examples of two different ways people might behave. Imagine there are two people talking about what they would do in a particular situation. We would like you to decide which person is most similar to you - in other words, which one behaves most like the way you probably would.

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **1** of 12

Which person is most similar to you?

- Person A: I concentrate all my energy on a few leisure activities
- Person B: I divide my energy among many leisure activities

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

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After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **2** of 12

Which person is most similar to you?

- Person A: I always focus on one important leisure activity at a given time
- Person B: I am always working on several leisure activities at once

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **3** of 12

Which person is most similar to you?

- Person A: When I think about what I want in life, I commit myself to one or two important leisure activities
- Person B: Even when I really consider what I want in life, I wait and see what happens instead of committing myself to just one or two leisure activities

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **4** of 12

Which person is most similar to you?

- Person A: When I can't participate in my leisure activities as well as I used to, I choose just one or two important activities
- Person B: When I can't participate in my leisure activities as well as I used to, I still try to keep involved in all my activities

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **5** of 12

Which person is most similar to you?

- Person A: When I can't do important leisure activities the way I used to, I look for a new main activity
- Person B: When I can't do important leisure activities the way I used to, I distribute my time and energy among many other activities

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

Flinders UNIVERSITY

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **6** of 12

Which person is most similar to you?

- Person A: When I can't do a leisure activity as well as I used to, I think about what exactly is important to me
- Person B: When I can't do a leisure activity as well as I used to, I wait and see what comes

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

Flinders UNIVERSITY

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **7** of 12

Which person is most similar to you?

- Person A: I keep working on the leisure activities I have planned until I achieve my goals
- Person B: When I do not succeed right away at my leisure activities, I don't try other possibilities for very long

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

Flinders UNIVERSITY

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **8** of 12

Which person is most similar to you?

- Person A: I make every effort to achieve a given goal in my leisure activities
- Person B: I prefer to wait for a while and see whether goals related to my leisure activities will work out by themselves

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **9** of 12

Which person is most similar to you?

- Person A: If a leisure activity matters to me, I devote myself to it
- Person B: Even when a leisure activity matters to me, I still have a hard time devoting myself fully to it

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **10** of 12

Which person is most similar to you?

- Person A: When I can't participate in a leisure activity as well as I used to, I keep trying other ways until I can achieve the same satisfaction or result that I used to
- Person B: When I can't participate in a leisure activity as well as I used to, I accept it

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

Flinders UNIVERSITY

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **11** of 12

Which person is most similar to you?

- Person A: When I can't participate in a leisure activity as well as I used to, I ask others for help or advice
- Person B: When I can't participate in a leisure activity as well as I used to, I decide what to do about it myself, without involving other people

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

Flinders UNIVERSITY

After you decide **which person is most similar to you** (Person A or Person B), we would like you to indicate **how much you think you would behave like the person you chose**.

Question **12** of 12

Which person is most similar to you?

- Person A: When it becomes harder for me to participate in my leisure activities, I keep trying harder until I can do them as well as before.
- Person B: When it becomes harder for me to participate in my leisure activities than it used to be, it is time to let go of that expectation.

How much do you think you would behave like this person?

- A little
- Moderately
- A lot
- Exactly

Next

Flinders UNIVERSITY

Using the scale from 1 to 7, where 1 means very easy and 7 means very difficult, please **rate how difficult** would find these activities if you were asked to do them.

	Very easy 1	2	3	Neither easy nor difficult 4	5	6	Very difficult 7
Social activity (e.g. meeting friends or attending a social club or seniors centre)							
Physical activity (e.g. walking or playing sports)							
Mental activity (e.g. doing crosswords or reading a book or newspaper)							

Next

In this section, you will find a list that can be used to describe a range of activities that people might do in their everyday lives. We would like you to tell us how much time you spend **in a typical week** participating in these types of activities.

Do not worry if you cannot give an exact figure. Select the response that most nearly describes the total amount of time you **typically spend in a week** doing these activities.

Actively reading, either online (e.g., emails) or in paper-form (e.g., newspapers, letters, mail).

Writing (of any kind, e.g., emails, stories, letters).

Interacting with your closest confidantes (i.e., those few who you are closest to; e.g., spouse, children) either talking face-to-face, on the phone, or video calls such as via Skype. Please do not include pets.

Interacting with people who are not your closest confidantes (i.e., any person not included in the previous question) either face-to-face, on the phone or video calls such as via Skype.

Next

Flinders UNIVERSITY

Please continue to indicate how much time you spend **in a typical week** doing these activities.

Organizing or planning (e.g., your agenda or schedule, materials, food, other peoples' activities).

Solving a problem on your own (e.g., work, car, finances, research, travel).

Actively participating in conversations or meetings that focused on solving a problem (e.g., group decisions, your or another's personal or social problem, politics).

Working on complex decisions (i.e., requires lots of thought, have to consider multiple factors, and there will be different consequences depending on what you choose).

Next

Please continue to indicate how much time you spend **in a typical week** doing these activities.

Meeting new people (i.e., where face-to-face introductions took place).

Actively listening to information (e.g., attending a lecture, listening to talk radio at home or in the car, tv news). Please do not include time where the information was only on in the background.

Attending community events (e.g., going to a concert or play, visiting a museum or gallery, sporting events, religious events).

Doing a hobby you know well that doesn’t require very much conscious attention (e.g., something that is automatic for you to do).

Next

Please continue to indicate how much time you spend **in a typical week** doing these activities.

Learning a new skill (e.g., language, hobby, technique, sport, cooking, instrument).

Doing an activity that requires you create something (i.e., there are no set rules to it) (e.g., painting, acting, photography, creating music, cooking without a recipe where you create as you go).

Playing physical or mental games against an opponent (e.g., tennis, basketball, pool, chess, Scrabble, some card games, some board games). Please do not include online computer games.

Mental games that you play on your own where you test your knowledge or vocabulary (include paper-form, and online games).

Next

Flinders University

Please continue to indicate how much time you spend **in a typical week** doing these activities.

Mental games that you play on your own where you test your memory, reasoning, or spatial abilities? (include paper-form, and online games).

Leading, coaching, supervising, teaching or mentoring others (this does not have to be a formal role).

Going out shopping in person (grocery, clothes, anything). Please also include time if no purchases were made.

Shopping online. Please also include time if no purchases were made.

Next

Please continue to indicate how much time you spend **in a typical week** doing these activities.

Finding or researching information using the internet, or reference books/materials.

Doing a physical activity alongside or while interacting with other people.

Doing things that were outside your normal daily routine.

Next

Flinders UNIVERSITY

The next 3 questions focus on different levels of **physical activity or exercise**. Please answer according to how various physical activities you may have done make **you** feel. The exercise can be formal (e.g. gym) or informal (e.g. walking).

Do not worry if you cannot give an exact figure. Select the response that most nearly describes the total amount of time you **typically spend in a week** doing these activities.

Doing light-intensity activity or exercise? (i.e., very easy for you to do, very little increase in heart rate and breathing rate, no sweating due to activity).

Doing medium-intensity activity or exercise? (i.e., moderate increase in breathing, light sweating, but you could have pushed yourself further).

Doing vigorous-intensity activity or exercise? (i.e., breathing heavily, sweating heavily, pushing your body/heart-rate to a high intensity).

Next

Since you retired, have you started to participate in a new leisure activity on a regular basis?

- Yes
- No

Please specify the activity (activities).

Next

Thank you for completing this questionnaire! We sincerely appreciate your time.

If anything in this questionnaire has caused distress or raised issues you would like to talk about, please contact Lifeline on 13 11 14, or visit www.lifeline.org.au.

If you would like to receive a $5 voucher to compensate you for your time, please click the link below. You will be redirected to another webpage where you will be asked to enter your name, email address, and the store you would like your voucher for (Coles, Kmart, Officeworks, Target).

Be assured that this information will not be saved with your survey responses; therefore your data remains anonymous. We will not use this information for any purpose other than sending your voucher, unless requested by you for the purpose of future research. Be sure to check your junk or spam folder in case the emailed voucher is not delivered to your inbox.
Click here to enter your details

Flinders UNIVERSITY

To receive your $5 voucher, please enter your name, email address, and the store you would like your voucher for. Be assured that this information will not be saved with your survey responses; therefore your data remains anonymous. Please be sure to check your junk or spam folder in case the emailed voucher is not delivered to your inbox.

Name:

Email address:

Store choice (Please select one):

- Coles
- Kmart
- Officeworks
- Target

If you would like to be contacted for future research opportunities, please provide your age, select your state/territory of residence, and check the box below *(this is optional and is not required to receive your voucher).*

Age:

I live in (please select one):

- South Australia
- Australian Capital Territory
- New South Wales
- Victoria
- Queensland
- Northern Territory
- Western Australia
- Tasmania

I give permission for the Flinders University Centre for Ageing Studies to store these contact details in a secure database and contact me about future research opportunities (select YES if you agree).

- YES