AGING AND NEGOTIATING SOCIAL STIGMA: STEREOTYPES AND STAIRS

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ABSTRACT

Negative age-stereotypes can foster biopsychosocial health consequences within older adults; however, there is a paucity of research examining self-efficacy (a determinant of activity avoidance or uptake), and no research exploring stair navigation performances after exposure to age-stereotypes. The present work aimed to examine the influence of age-stereotype priming on stair navigation, while exploring self-efficacy as a moderator in older adults.

Older adults aged 50 years or greater were voluntarily recruited within the Greater Toronto Area. In total, 130 older adults participated, of which 90 represented the “healthy” sub-sample and 40 represented those with osteoarthritis. Psychological questionnaires and stair navigation assessments were completed after exposure to age-stereotype primes.

The following manuscripts act as independent and connected segments toward examining stereotype priming, stair navigation, and self-efficacy in older adults. Manuscript one illustrates the development of effective stereotype primes and statistical models for analyzing the effects of age-stereotypes on stair navigation and self-efficacy for stairs. The results confirmed variables and statistical methodologies to be used in further analyses, with implications for streamlining future research. Stemming from this work, manuscript two and three employ these models to examine the influence of age-stereotype priming on self-efficacy for stairs in healthy older adults from baseline to post-exposure, as well as the influence of priming on stair navigation. The results suggested negatively primed older adults experienced declines in self-efficacy for stairs, while displaying slower stair navigation compared to those positively primed. The implications speak to developing priming as an intervention tool to mitigate negative primes and enhance task-specific functionality and well-being in healthy older adults.

Building from these results, manuscript four compared the influence of stereotype priming on self-efficacy for stairs and stair navigation among healthy adults and those with osteoarthritis, the most common “age-related” condition. The results suggested a complex relationship regarding prime exposure and the health status of older adults. These findings have implications for developing primes for special populations to facilitate performance enhancements.

Overall, these findings have implications for promoting stereotype research efficiency, while acknowledging the limitations that remain to be studied by future stereotype research regarding healthy adults and those with chronic conditions.

DEDICATION

I dedicate this work, with love and gratitude to my grandmother, who inspired me daily with her wisdom, tenacity, humour, and zest for life. She taught me the true meaning of successful aging, through laughter, food, and family. You fueled my obsession with studying healthy aging, and supported me unconditionally in that effort. Your impact reverberates through your legacy, and you will forever be missed.

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General Introduction

Studying the biopsychosocial health of older adults has become increasingly vital, as adults aged 50 or greater represent the fastest growing cohort of the population. Currently, over 35% of Canadians are aged 50 years or greater, vastly outnumbering individuals aged 15 years or younger (Statistics Canada, 2012). Beyond growing in number, research has also concluded that older adults are living longer than previous generations; however, this increase in life expectancy is often accompanied by compromised health-span (the number of years living disability and disease free) and quality of life (Depp, Vahia, & Jeste, 2010; Hellström & Hallberg, 2001). Implications of these recent demographic shifts for Canada's publically funded healthcare infrastructure have begun to surface, with older adults accounting for nearly half of total Canadian healthcare expenditures (Canadian Institute for Health Information, 2011; Rizcallah, 2011). Thus, an expanding field of research has begun to focus on facilitating "successful aging"; a concept rooted in maintaining functional health and independence within physical, cognitive, psychological, and social domains of daily living (Rowe & Kahn, 1998).

With independence at the forefront, older adults are faced with unique physical, psychological, and social roles, which they must accomplish while being challenged by a youth-oriented culture reflecting deep-seeded negative stereotypes of aging (Sneed & Whitbourne, 2005). Stereotypes can be defined as cognitive categorizations of people (as well as objects and situations) based on characteristics commonly asserted to the larger social group we perceive these individuals to be members of (Allport, 1954). This method of "chunking" serves to simplify and organize information processing with the advantage of rapidly determining how to successfully interact with (or avoid) certain groups of people (or objects or situations) despite the potential disadvantage of forming overgeneralizations and misjudgments (Allport, 1954). Therefore, age-stereotypes represent the categorization of individuals based on perceived or chronological age and the common characteristics asserted to membership within a specific age-group in society (Butler, 1969). Given that “old age” is a fluid social construction, older adults are particularly inundated with stereotypes regarding cognitive and physical declines that highlight notions of “frailty” or “uselessness” with underpinnings of “inevitability” (Giles & Reid, 2005; Goloub & Langer, 2007; Horton, Baker, Pearce, & Deakin, 2010). These pervasive ideas perpetuate deficit-focused perspectives of aging that can foster defeatist attitudes and maladaptive biopsychosocial changes (Bugental & Hehman, 2007; Levy & Myers, 2004). These changes present obstacles for preserving positive aging self-perceptions and self-efficacy. Self-efficacy is of particular importance as it represents an individual’s beliefs in their ability to complete a given task based on personal assessments of previous experiences with the task and whether one possesses the motivation, physical capabilities, and cognitive resources to successfully control the outcome (Bandura, 1977). Considering negative age-stereotypes largely focus on cognitive and physical decline (Goloub & Langer, 2007), compromised self-efficacy in these broad health domains can result in task avoidance in order to circumvent potential failure (Bandura, 1977), with adverse effects for successfully completing tasks that demand physical and cognitive engagement, such as activities of daily living (Delbaere et al., 2010; Hamel & Cavanaugh, 2004; Reeves, Spanjaard, & Mohagheghi., 2009). These physical and psychosocial difficulties are generally exacerbated for older adults experiencing “double jeopardy” (Sargent-Cox, Donelly, Vanags, Aitkin, & Anstey, 2013), which denotes declines in age-related self-perceptions in conjunction with differential treatment based on membership in one or more subordinated groups that multiplies actual and perceived disadvantages (e.g., being an older female; Ridgeway, 2001). Social “double jeopardy” has largely been studied regarding the intersection of race and gender oppression, and there is a paucity of research in regards to double jeopardy experienced with age (Sheets & Liebig, 2005). Specifically of interest in the present work is the intersection between age and being diagnosed with a chronic condition, namely osteoarthritis, as a form of double jeopardy that multiplies social, psychological, and physical contexts of accomplishing activities of daily living with age (Kemp & Mosqueda, 2004; Sheets & Liebig, 2005). In particular, diverse populations of older adults who are healthy or have been diagnosed with osteoarthritis report diminished confidence in their abilities to ascend and descend the stairs, above other activities of daily living (e.g., walking or showering; Hortobágyi, Mizelle, Beam, & DeVita, 2003; Jacobs, 2016; Nelson, 2016; Startzell, Owens, Mulfinger, & Cavanagh, 2000; Talbot, Musiol, Witham, & Metter, 2005).

Stair navigation is a complex locomotor task requiring dynamic coordination between physical and cognitive systems for successful and efficient completion (Bosse et al., 2012; Oh-Park, Wang, & Verghese, 2011; Reelick, van Iersel, Kessels, & Rikkert, 2009; Winter, 1995). Given the intricate nature of stair navigation, it can become a daunting experience for older adults, especially those who have formed negative self-perceptions of aging, which are usually accompanied by reductions in self-efficacy for daily functionality (Bugental & Hehman, 2007; Herman, Inbar-Borovsky, Brozgol, Giladi, & Hausdorff, 2009; Jacobs, 2016; Reelick et al., 2009; Sneed & Whitbourne, 2005). Relatedly, fear of falling and accidental falls from stairs have become one of the most prevalent causes of injuries, and injury-related complications, accounting for 60 percent of fall-related mortalities in older populations (Peel, 2011; Reelick et al., 2009; Rizcallah, 2011; Startzell et al., 2000). This may be especially true for middle-aged adults, a group that research has found to be most impacted by negative age stereotypes in addition to the most prevalent group of individuals who fall accidentally (Clarke & Korotchenko, 2011; Hess, Hinson, & Statham, 2004; Levy, Moffat, Resnick, Slade, Ferrucci, 2016; Robertson, Saura, King, & Kallinaus, 2015). Given the potential links among self-fulfillment of negative age stereotypes, declines in self-efficacy and compromised physical and cognitive function, exploring how age-stereotypes influence elements of stair navigation in older adults is both timely and critical.

Literature Review

The Activities of Daily Living (ADLs) are a set of specific actions that individuals perform with high frequency, usually with relative ease. Basic ADLs include: bathing/dressing, toileting, eating, hygiene, and mobility, and are indicators of overall biopsychosocial functioning (Verghese, Wang, Xue, & 2008). While efficiently accomplishing ADLs may become increasingly arduous during the aging process, these declines are often an accumulation of consequences stemming from negative health behaviours, such as; physical inactivity, high fat diets, and cigarette smoking (LaCroix, Guralnik, Berkman, Wallace, & Satterfield, 1993). Given the prevalence of these negative health behaviours in our society, it is not surprising that many older adults are increasingly reporting difficulties accomplishing ADLs (Statistics Canada, 2012). Of these activities, older adults most often cite stair navigation (ascending and descending the stairs) as the most difficult to execute (Oh Park et al., 2011; Verghese et al., 2008). As a result, stair navigation has been identified as a valid and significant independent predictor of present and prospective functional decline (Jacobs, 2016; Tiederman, Sherrington, & Lord, 2007).

Stair navigation is one of the most challenging and hazardous locomotor activities older adults engage in, as it involves complex integration of higher order cortical centers connected to the peripheral and central nervous system. With both ascent and descent phases performed near maximal joint and muscle capacities, stair navigation becomes increasingly more difficult with age (Hortobgáyi, Mizelle, Beam, & DeVita, 2003; Jacobs, 2016; Winter, 1995). Evidence has suggested the ability to ascend and descend the stairs provides an accurate benchmark for evaluating physical functioning related to balance, flexibility, and prospective disability (Bergland, Sylliaas, Jarnlo, & Wyller, 2008; Costigan, Deluzio, & Wyss, 2002; Herman et al., 2009). “Age-related” complications regarding stair navigation have been associated with multi-system deconditioning, which can include but are not limited to: sarcopenia, joint and tendon stiffening, neuronal fallout, decreased visual acuity, and reduced proprioceptive sensations (Herman et al., 2009; LaCroix et al., 1993; Oh Park et al., 2011). These notions are further explored in the following section.

Stair navigation and age – A broad overview

Stair navigation can only be accomplished successfully when sufficient visual and vestibular information is continuously processed to initiate movement and adaptations to potential perturbations (Goble, Coxon, Wenderoth, Van Impe, & Swinnen, 2009). Of utmost importance is processing visual cues that provide a foundation of relevant information for facilitating safe locomotion in diverse stair environments (e.g., step boundaries, step height, lighting, and handrail locations; Silva, 2011).

Vision and stair navigation

In order to form visual cues, light passes through the hierarchical structures of the eye; the cornea acts as the window for allowing the penetration of light, which is then focused by a pliable lens, and sent to the retina where light is converted into neural signals and carried to higher order brain structures via the optic nerve (Diaw, 2012). The optic nerve carries these neural signals through the thalamus to be processed by the visual association cortex, located in the back of the occipital lobe. It is here that two cortical streams dissect the information in order to plan subsequent movements: the ventral stream processes “what” is being seen, and the dorsal stream processes “how” to conduct movements (Diaw, 2012; Mishkin, & Ungerleider, 1982). Visual acuity is the key component within the Stair-Behaviour Model developed by Templer (1992), which outlines three scanning processes required to complete stair navigation: 1. Initial conceptual scan (vision provides the basis for creating a cognitive-spatial map of stair configuration), 2. Step location scan (fixating on the step prior to step initiation), and 3. Continuous monitoring (for obstacles, changes in environment, and necessary adaptations in limb trajectory). In this sense, vision promotes the planning and initiation of stair action by informing individual requirements (e.g., how much muscle force will be required given a perceived stair height), and guides balance control during stair navigation. This forms the basis of “climbability”, which represents an individual’s assessment of their biomechanical capabilities, and whether one believes safe stair navigation is possible (Maki & McIlroy, 2007; Vickers, 2007).

Changes in vision and stair navigation with age

The perception of climbability is compromised with advancing age as vision deterioration generally begins to occur in adults entering their mid-forties (Diaw, 2012). Declines in vision with age are associated with reduced corneal moisture (which blurs vision), hardening of the lens (which distorts the image sent to the retina by absorbing more light), and reductions in acetylcholine production (the neurotransmitter that propagates neural signals from the retina; Andersen, 2012). As visual perception becomes more distorted with advancing age, the likelihood of safe stair navigation and the risk of falling decreases and increases respectively (Globe et al., 2009). These impairments have further implications regarding increased reliance on the vestibular system for accomplishing stair navigation (Wiesmeier, Dalin, & Maurer, 2015). The vestibular system relays information regarding our proprioception senses that convey the body's spatial orientation and balance (Suetterlin & Sayer, 2013).

Proprioception and stair navigation

Proprioception is processed from one's core and peripheral limbs. At the core, inner ear structures convey information regarding rotational and linear head movements using stereocilia (ear hair) and fluid that are sensitive to movement. In the periphery, limb and trunk movements are detected by stretch and pressure mechanoreceptors found in muscles and joints that send feedback to higher order motor cortices (Iawaski & Yamasoba, 2015). In regards to stair navigation, the major joint and muscle groups involved include knee and hip flexors and extensors (i.e., quadriceps femoris and hamstring), hip abductors and adductors (i.e., gluteus maximus, medius and minimus, and tensor fascia lata), and ankle plantar- and dorsi-flexors (e.g., gastrocnemius, soleus, and tibialis posterior). It is these muscle and joint networks that work to sway the centre of mass in pitch and roll planes to initiate and maintain controlled stair navigation.

Stair descent is mostly comprised of eccentric knee joint-muscle contractions (lengthening) to lower the body's center of mass, whereas ascent requires concentric contractions (shortening) of lower limb muscles to lift the body's center of mass against the forces of gravity. The lateral and medial movement of the trunk and centre of mass is largely controlled by hip joint-muscle abduction and adduction (Benedetti, Berti, Maselli, Mariani, & Giannini, 2007). The power and range of motion required by these joint and muscle groups differs during ascending and descending stance and swing phases, with significantly more flexion and muscle activation required for ascent compared to descent (Andersen, 2012). It is thus not surprising that a larger sample of older adults report difficulty during stair ascent compared to descent (45% vs. 30%; Verghese et al., 2008). Similar to visual information, proprioception is integrated by the thalamus prior to being further processed by the cerebellum, as well as primary and secondary motor cortices responsible for planning actions and movements (Iawaski & Yamasoba, 2015). Together with visual information, proprioception determines how we interact with the environment.

Changes in proprioception and stair navigation with age

While visual deterioration tends to begin at 45 years of age, it is estimated that muscle strength and proprioception senses decline at a rate of 10 percent and 0.06 degrees per year respectively after age fifty (Beneditti et al., 2007; Goble et al., 2009). Research has found a reduction in blood flow to the ears and muscles, as well as a reduction in hair cells, inner ear fluid, nerve cells, mechanoreceptors, muscle spindles diameter and sensitivity, neurotransmitters, myelin for propagating signals, and muscle denervation with advancing age that effectively increases the difficulty with processing proprioceptive information (Iawaski & Yamasoba, 2015; Lin et al., 2015; Zietz, Johannsen, & Hollands, 2011). This decline in ability to detect limb and trunk flexion and extension can increase trunk sway in the pitch plane, fostering instability, inability to adapt to perturbations, and an elevated risk of falling during stair navigation (Goble et al., 2009). In addition, as part of "normal aging processes", sarcopenia and muscle atrophy restrict the force and moments produced by muscles crossing the ankle, knee and hip joints (Buckley, Cooper, Maganaris, & Reeves, 2013; Jacobs, 2016).

In experiencing these age-related physical declines, older adults often develop adaptations within and between systems responsible for stair navigation in order to maintain stable and "safe" stair performance. However, these compensatory mechanisms may increase the likelihood of malfunctioning and injuries occurring on the stairs (Reelick et al., 2009; Reid, Novak, Brouwer, & Costigan, 2011). Compensation strategies employed during stair navigation for older adults often involve exertion of effort close to maximal capacities, muscle co-activation, slower movements, and an extended gaze fixation on one step in the hopes of better controlling balance variability (Gill et al., 2001; Hortobgáyi et al., 2003; Nadeau, McFayden, &

Malouin, 2003; Reeves, Spanjaard, Mohagheghi, Baltzopoulos, & Maganaris, 2008; Winter, 1995; Zietz et al., 2011). In reality, these compensations are maladaptations that cause subsequent stiffening of muscles and joints, reduced stamina, and ability to negotiate perturbations, resulting in inefficient balance control and an increased risk of falling (Bosse et al., 2012; Gill et al., 2001; Hortobgáyi et al., 2003; Jacobs, 2016; Nadeau et al., 2003; Oh Park et al., 2011; Reeves et al., 2008; Zietz et al., 2011).

During stair ascent, older adults tend to display significantly reduced knee extensor-ankle plantar flexor moments compared to younger adults (Benedetti et al., 2007). It is important to note that significant differences have not been found between the cadence of younger and older adults, suggesting older adults use hip extensor and ankle dorsi-flexor compensations that move the centre of mass anteriorly (Benedetti et al., 2007; Doslikova, 2015; Reeves et al., 2008). A similar pattern was found during stair descent, as older adults have been found to generate lower ankle plantar flexion moments and more knee extensor effort compared to younger adults (Benedetti et al., 2007). These adaptations are often accomplished in conjunction with co-activating antagonistic muscle groups, placing increased strain on muscles and joints that are already working near maximal capacities. This co-activation effectively slows stair navigation speed by stiffening trailing limbs for longer durations. The stiffening is then further compensated for by increasing hip forces that attempt to retain cadence by larger and faster horizontal centre of mass displacements (Buckley et al., 2013; Doslikova, 2015; Jacobs, 2016; Lee & Chou, 2007). This excessive motion of the trunk in the frontal and sagittal planes effectively shifts the centre of mass, and increases the need for lower limb abduction and adduction to maintain stability (Goble et al., 2009; Novak & Brouwer, 2011).

Considering the complex nature of these "vestibulo-ocular reflexes" in older adults, stair navigation often involves cognitive "over-activation" compared to younger adults. Older adults rely on more secondary motor cortices rather than the primary motor cortex in order to determine and initiate muscle-joint movements, such as the posterior-parietal cortex (guides voluntary movements in space) and the dorsolateral prefrontal cortex (decides which movements to make according to previous experiences and self-perceptions of the activity; Iawaski & Yamasoba, 2015; Kim, Suzuki, & Kanda, 2007). As a result, older adults use relatively more cognitive and muscle-joint resources for movement, effectively depleting gait resources more quickly, leading to slower speed, more fatigue, and increased risk of falling (Goble et al., 2009; Hortobágyi et al., 2003). Moreover, considering these muscle, joint, and cognitive compensatory mechanisms are employed in order to maintain balance regarding the centre of mass, examining stair navigation through centre of mass movement is an important indicator of functional health for older adults.

Stair navigation and aging with osteoarthritis

These cognitive, joint, and muscle stair-related compensations are even more pronounced in chronic disease populations, especially those with osteoarthritis, the most commonly diagnosed "age-related" chronic condition afflicting over 50 percent of adults aged 65 or greater (Son & Kim, 2013; Wurm, Tomasik, & Tesch-Römer, 2008). Osteoarthritis is a degenerative joint disease that involves stiffening and inflamed joints, which increase pain (and perceptions of pain) while severely restricting performance of ADLs, particularly related to stair navigation mechanical stiffness and speed (Costigan et al., 2002; Hall, Mockett, & Doherty, 2006; Jacobs, 2016; Maly, Costigan, & Olney, 2006; Rejeski, Craven, Ettinger, McFarlane, & Shumaker, 1996;

Son & Kim, 2013). Joint stiffness and muscle degradation associated with osteoarthritis can further exacerbate knee-ankle extension and flexion changes that occur with age, which further promote hip abduction and adduction compensatory strategies (Asay, Mündermann, & Andriacchi, 2009; Whitchelo, McClelland, & Wenster, 2014). These adaptations displace the centre of mass more anteriorly, which increases the risk of tripping during stair negotiation compared to healthy older adults (Asay et al., 2009; Whitchelo et al., 2014). These trends are particularly pronounced for those with knee osteoarthritis, the most common form of osteoarthritis in older adults (Litwic, Edwards, Dennison, & Cooper, 2013). Reductions and compensations in muscle-joint force and range of motion are evident even in mild cases of knee osteoarthritis, and tend to worsen over time with disease progression (Hicks-Little et al., 2012).

Aging self-perceptions, self-efficacy, and stair navigation

While a large body of research has focused on "age-related" physical complications related to stair navigation, changes in psychological well-being have also been identified as independent predictors of compromised stair navigation (i.e., depressive symptoms, perceptions of aging, self-efficacy, and fear of falling; Jacobs, 2016; Levy, Pilver, Chung, & Slade, 2014; Levy, Zonderman, Slade, & Ferucci, 2012; Tiederman et al., 2007). As a result, a recent call was put forth for more research examining how to mitigate "risky" stair navigation behaviours using cognitive and psychological interventions outside of laboratory settings (Jacobs, 2016).

Stair navigation, similar to any locomotor task, involves purposefully swaying the body in a controlled manner; however, the combination of physical deconditioning and maladaptations threaten actual and perceived balance capabilities with increasing age (Bosse et al., 2012;

Delbaere et al., 2010; Hegeman, Shapkova, Honegger, & Allum 2007; Jacobs, 2016; Winter, 1995). These negative beliefs regarding perceived capabilities and self-efficacy towards successful stair navigation, often referred to as “normal age-related processes”, tend to have reciprocal affects by further compromising one’s actual balance, most commonly in the form of “fear” (Goloub & Langer, 2007; Maly et al., 2006; Nelson, 2016; Reelick et al., 2009). Negative self-perceptions of aging have been found to significantly increase biomarkers of stress and anxiety (i.e., cortisol levels), and are linked to reduced physical functioning (Buchner et al., 2016; Cohen, Janicki-Deverts, & Miller, 2007; Levy et al., 2016a). This reduced physical functioning subsequently amplifies stress, anxiety-related activity avoidance, and fear of falling, which further exacerbate injury risk and biopsychosocial deconditioning (Hadjistavropoulos, Delbaere, & Fitzgerald, 2011; Jacobs, 2016; Reelick et al., 2009; Reid et al., 2011). This cycle has been referred to as the “Weathering Hypothesis” (Geronimus, 1992), whereby chronic objective and subjective stress results in deterioration of daily functionality and increases the risk of developing chronic conditions (Allen, 2015). To highlight this trend, Verghese and colleagues (2008) examined 310 healthy older adults aged 70 years or greater, and found that 72 percent of older adults reported the lowest self-efficacy for ascending or descending the stairs compared to any other basic ADL. The same sample of older adults displayed significantly more fear of falling, and planned stair avoidance compared to older adults not experiencing stair-related psychological hardships. Research regarding older adults with osteoarthritis has yielded similar findings, although these reductions in self-efficacy and increased fear of falling during stair navigation are even more pronounced and significantly affect successfully accomplishing physical performances (Sanders et al., 2012).

These findings regarding healthy adults and those with osteoarthritis are concerning given that reductions in self-efficacy (and associated negative perceptions and fears) require cognitive effort to be mitigated, which further jeopardizes an older adult`s ability to maintain balance during stair navigation by depleting cognitive resources and enabling maladaptive physical compensatory mechanisms (Ambrose, Paul, & Hausdorff, 2013; Davis, Campbell, Adkin, & Carpenter, 2009; Hadjistavropoulos et al., 2011; Jacobs, 2016). For example, Oh Park and colleagues (2011) found that healthy adults with lower stair self-efficacy and higher fear of falling displayed slower and more cautious navigation, which was indicative of functional decline at three years follow-up. These behaviours denote deterioration of physical functioning as more “cautious” behaviours are generally less efficient (highlighted by co-contraction of antagonistic muscles; Jacobs, 2016; Tiederman et al., 2007). In contrast, high levels of balance self-efficacy and minimal fear of falling can attenuate declines in stair navigation, as highlighted by Bergland, Sylliaas, Jarnlo, and Wyller (2008). In Bergland et al.’s (2008) study, older adults who were classified as not having fear of falling demonstrated superior step height clearance than those with stair-related anxieties. Moreover, it has been suggested that older adults experiencing stair-related difficulties have significantly slower gait and reduced grip strength, both of which are valid indicators of functional health and physical deterioration (Bosse et al., 2012; Bergland et al., 2008; Gill et al., 2001; Hadjistavropoulos et al., 2011; Stephan, Chalabaev, Kotter-Gruhn & Jaconelli, 2013; Maki, 1997). These trends may be particularly true with regards to osteoarthritis as several studies have found positive correlations between osteoarthritis pain, fear of falling, and diminished stair navigation abilities relative to healthy older adult counterparts (Jacobs, 2016; Maly et al., 2006; Rejeski et al., 1996). Given current demographic shifts in age, reductions in health-span, and the employment of physical and psychological maladaptations, the number of reported falls per year and related mortality continues to rise at unprecedented rates in diverse populations of older adults (Herman et al., 2009; Jacobs, 2016). Moreover, the hazard risk of sustaining a severe injury from stair falling is three times that of falls that occur during walking (Hurms et al., 2015). Thus, older adults represent an important at-risk population.

While the previous literature regarding negative perceptions of aging, self-efficacy and stair navigation is vital for developing a profile of task-specific functional health for older adults, existing research fails to explicate a holistic picture of biopsychosocial aging. Generalization of previous research conclusions is problematic given that these studies have typically been conducted in isolated laboratory environments that may not reflect realistic experiences of stair navigation in public settings, which is where a large proportion of falls from stairs occur (Bergland et al., 2008). Moreover, these isolated environments are removed from important cultural and social contexts of aging, which include pervasive age-stereotypes that have subtle, yet robust effects for maintaining functional health required for accomplishing daily tasks (see systematic review and meta-analyses; Horton, Baker, Pearce, & Deakin, 2008; Lamont, Swift, & Abrams, 2015; Levy, 2003). Nevertheless, one concept remains consistent throughout the diverse body of stair navigation research; self-efficacy is a primary antecedent of stable and efficient stair navigation within older adult populations (Andreoletti & Lachman, 2004; Jacobs, 2016; Maly et al., 2006; Oh Park et al., 2011; Tiederman et al., 2007). However, sustaining self-efficacy with age is not only threatened by physical and psychological deconditioning, but also the presence of aging as a pervasive stigma within society.

Ageism and age-stereotypes –A unique form of social oppression

In 1963, Erving Goffman published his seminal work, defining stigma as “the situation of an individual who is disqualified from full social acceptance” (p. 9), largely with regard to race, class and sex. While Goffman’s taxonomy was successful at increasing awareness of those being stigmatized, his framework is now considered antiquated, particularly in light of the vast array of modern inequities and social identities beyond race, class, and sex, which are subject to change over time reflecting economic, political, and cultural evolutions within society (Falk, 2001). Ultimately, it is the present culture and inherent values that determine who is stigmatized and how stigmatization operates within society. However, the extent to which being stigmatized actually influences one’s behaviours and attitudes depend on self-perceived stigma and self-relevance. Nevertheless, the effects of stigmatization are enduring, creating a perpetually vulnerable state for those who are victims of it (Weiss, Ramakrishna, & Somma, 2006).

Age stigma operates within the same principles of other stigmas as it contains a “mark” of appearance (represented by aesthetic interpretations of one’s chronological age), and a specific set of stereotyped characteristics that are ascribed to older individuals as part of the inferior “out-group” (with “young” representing the dominant “in-group”). Age stereotypes, which are internalized as early as age three and continue to be consciously and subconsciously integrated across a lifespan of exposure (Levy, 2009; Seefeldt, Jantz, Galper, & Serock, 1977), are some of the most prevalent stereotypes within and between societies and cultures. While the presence of both positive and negative age stereotypes is acknowledged, the vast majority are negative and often pertain to physical and cognitive decline (Chappell, 2003; Cuddy, Norton, &

Fiske, 2005; Horton et al., 2008; Hummert, Garstka, Shaner, & Strahm,1994; Lamont et al., 2015; Nelson, 2016; Seefeldt et al., 1997; Williamson & Fried, 1996).

Age stereotypes are the foundation for ageism, which involves differential treatment purely based upon age (Butler, 1969). Ageism is a form of social oppression similar to racism or sexism, but is unique considering it remains the only form of social oppression where the oppressors within the “in-group” eventually move into the oppressed “out-group” as their lifespan continues (Bugental & Hehman, 2007; Levy, 2003, 2009). In addition, there seems to be less awareness, more acceptance, and fewer social sanctions actively working against ageism in current societies and cultures as the casual utilization of inherently ageist products is increasingly prominent (e.g., “over the hill” birthday cards, anti-aging cream, etc.; Bugental & Hehman, 2007; Levy et al., 2012). Currently, over 90% of Canadians report having experienced some form of ageism, with 63 percent of these individuals being 65 years or older (International Federation on Ageing, 2013). The Bio-Social-Cognitive Model of Ageism (Bugental & Hehman, 2007) elucidates these statistics beyond ageism as a social issue, but also a major public health issue that requires immediate attention. The model posits that biological “cues” of aging, such as aches and pains, provide the basis for age-stereotypes that are perpetuated over time by ageist expressions and practices. These stereotypes then act in a self-fulfilling manner, whereby conscious and subconscious age-related anxieties deteriorate biopsychosocial well-being over time, reinforcing the original stereotypes that catalyzed age-related anxieties in the first place. This model also explains why older adults believe “normal” processes of aging include disability, dependence, and sickness, and how these stereotypes become self-fulfilling prophecies with major functional health implications (Bugental & Hehman, 2007). In addition, ageism is a social issue that exists within healthcare settings, whereby physicians and nurses may dismiss older patients' complaints of pain as "inevitable" processes of aging, and often unnecessarily utilize "elderspeak" when communicating with older adults (Bugental & Hehman, 2007; Davis, Bond, Howard, & Sarkisian, 2011; Sarkisian et al., 2002). Thus, biopsychosocial declines related to stereotype internalization, in combination with demographic shifts and restricted access to proper medical treatment, reinforce that ageist stereotypes are a major public health issues for current and future generations (Blackwood & Sweet, 2015; Macarthur Foundation Research Network on an Aging Society, 2010; Nelson, 2016; Statistics Canada, 2012).

The effects of ageism and negative stereotypes

In order to attenuate current and future trends of negative ageism and discrimination, an in-depth exploration is warranted as to how negative stereotypes are intra- and inter-generationally perpetuated and how their influences can be moderated. In Seefeldt et al.'s (1977) study of preschool aged children to children aged 12, all participants were able to correctly organize a set of photos in order of "youngest" to "oldest" strictly based on the aesthetic appearance of a man in the photos. More interestingly, the vast majority of these adolescents characterized the oldest man as "frail", and "unproductive", and expressed fears and apprehensions towards aging. Thus, while the presence of positive stereotypes regarding aging is acknowledged within society (such as being "wise"), it appears as if aging is largely categorized as a negative process stemming from a very young age. These negative perceptions of aging tend to intensify across one's lifespan. Hummert, Garstka, Shaner, and Strahm (1994) explored this notion by instructing three groups of adults (university students aged 18-29 years, middle aged adults 45-55 years, and older aged adults 65 years or greater) to compile a list of positive and negative stereotypes related to someone who is 65 years of age (which is the arbitrary designation of senior citizenship in Western societies). Their findings demonstrated that while positive age stereotypes were noted by all three age groups (such as being “experienced” and “kind”), the vast majority of stereotypes reported were negative (such as being “senile” or “weak”). Interestingly, the oldest age group reported a significantly higher number of negative stereotypes compared to the middle and youngest age groups, and tended to judge members of their own age cohort more harshly. These findings can be explained by Social Identity Theory whereby older adults’ intragroup judgments are more negative in order to maintain a positive individual self-perception (also known as downward social comparison; Kotter-Gruhn & Hess, 2012; Levy, 2009). Moreover, the higher reporting frequency in the oldest age group reflects internalization of stereotypes at an early age and their reinforcement over time during repeated and novel exposures to various age stereotypes across the lifespan (Levy, 2009). As repeated exposure continues for younger “in-groups” that are void of the psychological impetus to defend themselves against irrelevant depictions of aging, stereotype embodiment enables the internalization of negative age stereotypes as well as the adoption of negative aging self-perceptions (Lamont et al., 2015; Levy, 2009). These negative self-perceptions are robust predictors of diminishing self-efficacy and internal loci of control, which subsequently activate disidentification - a process whereby older adults disengage from positive health behaviours (such as physical activity) and results in physical and psychological health consequences and limitations, giving credence to negative intergenerational judgments (Bouazzaoui et al., 2016; Levy et al., 2002; Levy & Myers, 2004; Palacios, Torres, & Mena, 2009; Robertson et al., 2015). In either scenario (of downward social comparison or embodiment), the biopsychosocial consequences of adopting these cognitive processes are deleterious.

Activating age-stereotypes and biopsychosocial performance outcomes

Insofar as previous research has demonstrated, biopsychosocial outcomes can be manipulated by the delivery as well as the valence of age stereotypes. Delivery refers to the level of consciousness targeted by the presented stereotypes, namely, implicit versus explicit priming. Implicit priming involves exposing stereotypes to individuals below levels of conscious awareness or processing (e.g. word flashes on a computer screen), while explicit primes are directed at engaging conscious awareness and processing of stereotype content (e.g., constructed newspaper article; Horton et al., 2008; Levy, 1996, 2000). Within explicit delivery, there are two main methods of priming: fact-based material (overt information provided under the guise of factual research-based statements to evoke stereotypes) or stereotype-based material (providing information as commonly accepted social and cultural trends to evoke stereotypes; Lamont et al., 2015). Stereotype valence pertains to being primed with either a positive stereotype (stereotype boost), or a negative stereotype (stereotype threat) prior to completion of a specific task (Armenta, 2010). *Stereotype boost* provides an opportunity for older adults to confirm a positive stereotype regarding their age group, often leading to performance enhancements, whereas *stereotype threat* provides an opportunity for older adults to confirm a negative stereotype regarding their age group, and often leads to performance declines (Armenta, 2010; Coudin & Alexopoulos, 2010; Swift, Abrams, & Marques, 2012; Steele & Aronson, 1995). Declines in response to negative priming/stereotype threat in older adult populations have included declines in psychological, social, and cognitive performances, such as memory recall (Hess et al., 2003), hazard detection while driving (Chapman, Sargent-Cox, Horswill, & Anstey, 2014), life satisfaction (Wurm et al., 2008), mathematical reasoning (Levy, 2003), will to live (Levy, Ashman, & Dror, 2000), and subjective age (Mock & Eibach, 2011). Comparatively, much less research has focused upon the effects of negative stereotype priming within physiological and physical domains (Lamont et al., 2015; Levy, 2003). In a recent meta-analysis of 32 publications examining age-based stereotype priming, only three publications had physical outcome measures proximal to prime exposure (Lamont et al., 2015). Nevertheless, the literature that exists has highlighted stereotype threat as negatively influencing hand writing legibility (Levy et al., 2002a), grip strength (Stephan et al., 2013), cardiovascular functioning (Levy et al., 2000, 2006, 2008), and gait speed (Hausdorff, Wei, & Levy, 1999; Levy, 2002a; Swift et al., 2012).

More recently, research has highlighted longitudinal effects associated with negative self-perceptions of aging (a function of embodiment) as a robust predictor of early mortality in older populations whereby older adults attributing their health issues to "old age" were 59 percent more likely to pass-away at a two-year follow-up (Stewart, Chipperfiled, Perry, & Weiner, 2012). Further research has found that older adults citing "old age" as a cause of disability were significantly more likely to develop arthritis (Roberston et al., 2015), heart disease (Levy et al., 2000, 2006, 2008), compromised memory functioning (Hess et al., 2003; Levy et al., 2016b), slower gait (Levy et al., 2002a; Robertson et al., 2015; Sargeant-Cox et al., 2013), and hearing loss (Levy et al., 2014) at follow-up ranging from four to 20 years (Nelson, 2016). In contrast, older adults reporting more positive self-perceptions of aging were found to have a survival advantage of 7.5 years at 20 years follow-up (Levy, Slade, Kunkel, & Kasl, 2002b). Research has also highlighted distinct survival advantages for positive perceptions of aging in different health domains, specifically, a 4.5 year advantage for positive perceptions of physical aging and a 2.5 year advantage for positive perceptions of mental aging (Ng, Allore, Monin, & Levy, 2016). Moreover, stereotype boost has the potential to attenuate the previously mentioned effects of stereotype threat by prompting improvements in memory recall, gait speed and balance measures (Hausdorff et al., 1999; Hess et al., 2004). Levy and colleagues (2014) exemplified these benefits by utilizing stereotype boost as a weekly intervention aimed at improving positive perceptions of aging in older adults over a four week period followed by a battery of physical functioning tests. Their intervention significantly increased positive perceptions of aging while improving physical health to an extent that was similar to those of a standard exercise intervention. The extent to which self-perceptions of aging influence the association between stereotypes and functional health is further emphasized by Levy and Myers (2004) in their sample of 241 adults aged 50 or greater participating in the Ohio Longitudinal Study of Aging and Retirement. The follow-up data collected 20 years after initial testing demonstrated that those with negative self-perceptions of aging were significantly less likely to have a balanced diet, maintain their weight, exercise, seek medical treatment, and follow prescription medication instructions. Furthermore, a regression analysis revealed that for every unit increase in positive self-perceptions of age, there was a 0.45 increase in the number of positive health behaviours older adults were engaging in. These findings provide clarification as to why the same sample of older adults displayed an average lifespan gain of 7.5 years for those with positive age-perceptions compared to those with negative perceptions.

While stereotype boost and threat have both exemplified significant effects on older adult performances, it has yet to be determined which categories of stereotype priming (positive vs. negative and explicit vs. implicit) have a larger impact on older adult functioning (Hess et al., 2004; Horton et al., 2008, 2010; Levy & Leifheit-Limson, 2009; Meisner, 2012; Nelson, 2004). This could be attributed to the fluctuating effectiveness of stereotypes for provoking specific behaviours as moderated by specific task domains, prime valence, and relevance of stereotype content to the population of interest (Meisner, 2012).

It is also unknown whether fact-based or stereotype-based prime materials are more effective (Lamont et al., 2015). Fact-based materials provide less ambiguity and more credibility across diverse older adult populations compared to stereotype-based materials; however, fact-based information may counter-act expected behaviours by insufficiently depleting cognitive resources or provoking anxiety compared to stereotype-based materials (Lamont et al., 2015). These nuances bare similarities to health messaging strategies, and theories related to effectively constructing message content and delivery in order to motivate at-risk populations to adopt underutilized positive health behaviours (Latimer, Brawley, & Bassett, 2010). For example, Latimer and colleagues (2010) highlighted that in order to facilitate initiation and maintenance of physical activity in largely sedentary older adult populations, health messages regarding exercise adoption should contain recognizable images, a credible source, relevant content, non-threatening vocabulary (e.g., not phrasing exercise as “hard”), and concrete information (what exercises/how to exercise). As a result, manipulating stereotype content and delivery to foster actual behavior change in older adults may be contingent upon appealing to and manipulating specific self-perceptions of aging, which are significantly associated to personal relevance regarding the stereotype/task domain (Eibach, Mock, & Courtney, 2010; Levy et al., 2002a). A collection of aging self-perceptions, which can be both positive and negative, result in the formation of aging self-identities, which subsequently determine one’s lifestyle and leisure endeavors, such as continued social engagement, frequency of medical check-ups, and physical activity (Levy et al., 2002a; Palacios et al., 2009). Self-perceptions remain of utmost concern because of their susceptibility to stereotype manipulations and their overarching effects on positive self-esteem, satisfaction with life, and self-efficacy (Drerichard & Kopetz, 2005; Eibach et al., 2010; Wurm et al., 2008). Therefore, stereotype threat and boost are most effective at manipulating self-perceptions of older adults when they include domains that older adults prioritize as relevant to their aging-identities.

Considering the physical and psychological vulnerabilities that negative stereotyping can create, and stereotype self-relevance increases with inevitable movement into the “out-group”, one may wonder why negative stereotypes remain a ubiquitous and powerful tool for both inter- and intra-generational judgment, especially in lieu of the potential benefits in adopting positive stereotypes. To simplify the answer to this complicated question, stereotype schemas are generated by hardy cognitive processes that are not easily mutable given intense reinforcement of these neural networks over time, and therefore, negative stereotypes take primacy over positive experiences with out-group members (Bennett & Gaines, 2010). In situations where an older individual does not fit into personalized stereotype frameworks of what characteristics constitute older adulthood, these individuals are viewed as the “exceptions” instead of the “rule” (Bennett & Gaines, 2010; Horton, Baker, Côte, & Deakin, 2008). In addition, identity protective strategies such as downward social comparisons enable older adults to view themselves as the “exception”, while other older adults within the same age cohort represent the “rule” (Bugental & Hehman, 2007).

The perpetuation of negative stereotypes, despite counter-experiences, are exacerbated by depictions of older adults in popular media formats (e.g., television) that frequently portray deficit-aging and dismissal of older adults as incompetent and old-fashioned, usually for the purpose of evoking humourous responses from viewers (Bodner, 2009; Montepare & Zebrowitz, 2002; Ory et al., 2003). However, the age cohort representing the largest television viewership are sedentary middle and older aged adults, providing them with ample opportunity for repeated exposure to negative stereotypes and the construction of negative aging self-perceptions that promote biopsychosocial disidentification and further compromises the likelihood of successful aging (Bodner, 2009; Levy & Myers, 2004; Levy, 2009; Rowe & Kahn, 1998).

Age-stereotypes and physical performance outcomes

While the majority of the literature reviewed has focused on how stereotypes can affect cognitive, psychological, and physiological outcomes for older adults, there is a paucity of research exploring the effects of stereotype priming on dynamic physical outcomes, such as gait, which encompasses cognitive, psychological, physiological, and social domains of aging. Presently, Hausdorff and colleagues' study (1999) remains the only scientific research that has explored the proximal impact of stereotypes specific to the walking performance of older adults. Their study included a sample of 47 healthy community-dwelling older adults aged 63-82 years who were randomized into positive prime or negative prime conditions prior to the walking performance. Thirty minutes before being instructed to walk down a 45 meter hallway, participants completed a "computer game" during which the positively primed condition was implicitly exposed to positive stereotype-related terms such as "wise" and the negatively primed condition was implicitly exposed to negative stereotype-related terms such as "senile". Pre- and post-intervention measures of walking speed (a proxy measure of fitness and frailty), and percent swing time (a proxy measure of balance) were collected. After participants were instructed to walk at normal pace, an average of two walking trials was computed. The researchers found walking speed to be significantly faster for the positively primed group (9.0% ± 2.0%) compared to a small non-significant decrease in walking speed for the negatively primed group. Moreover, positively primed older adults had significantly higher swing time, which was found to be positively correlated to gait speed. This relationship remained significant even after controlling for age and other functional health measures, including subjective health, number of medications, history of falls, depressive symptoms, perceived social support, and personality. Therefore, it was determined that age-related deconditioning related to walking efficiency could be attenuated with exposure to positive stereotypes. It should be noted that since Hausdorff and colleagues' (1999) work, several relevant studies have explored walking speed; however, much of this research has used walking speed to calculate a summative score as part of a larger battery of physical testing without specifically isolating walking speed as the primary outcome (Horton et al., 2010; Levy et al., 2002a; Sargeant-Cox et al., 2013), or have focused on walking speed as a function of self-perceptions of aging without introducing a stereotype prime manipulation (Levy et al., 2014; Robertson et al., 2015).

While Hausdorff et al.'s research was novel for bridging the gap between sociocultural facets of psychological and physical constructs of aging, there were a number of limitations that should be addressed in order to improve the validity of their findings. First, the stereotype content (word flashes) did not match the specific task domain (walking), and the study did not utilize a control group, both of which are limitations for generalizing these findings (Levy & Leifheit-Limson, 2009; Meisner, 2012). Moreover, the researchers did not employ any manipulation checks to assess whether the stereotype primes were actually evoking perceptual changes related to walking behaviours (Eibach et al., 2010; Horton et al., 2010; Marx & Stapel, 2006). In addition, self-efficacy was not measured as a covariate - a major psychological concept known to affect both locomotor performances and self-perceptions of aging (Coudin &

Alexopoulos, 2010; Buchner et al., 2016; Hauck, et al, 2008; Levy & Myers, 2004; Maly et al., 2006; Tiederman et al., 2007). Last, the researchers did not conduct a follow-up study to explore the lastingness of positive or negative stereotype priming beyond the laboratory setting.

It is also perhaps important to note that much of the age-related stereotype research focuses upon individuals aged 65 years and above, likely given the arbitrary label asserted to this chronological age as “senior”. By comparison, fewer studies have included middle aged samples, who represent a transitioning cohort during which time age-stereotypes gain salience, and are uniquely sensitive and prone to experiencing stigmatization and the negative effects of age-stereotypes as they begin to assert self-relevance to these notions of biopsychosocial decline for the first time (Lamont et al., 2015; Mock & Eibach, 2011; Montepare, 2009; National Research Council, 2006; Robertson et al., 2015). Furthermore, there has yet to be research that has explored implications of stereotype priming on stair navigation of older adults. Building upon the theories, findings, and limitations of Hausdorff and colleagues’ study, and the general gaps in current stereotype and stair navigation literature, the present dissertation examined how age-stereotypes affect older adults’ self-efficacy towards stair navigation and their stair navigation performance - two concepts commonly reported to significantly diminish with age, and are known to be vital for maintaining biopsychosocial health and independence.

The following studies outline four phases of research to assess the effects of stereotype priming on measures of stair navigation and related self-efficacy in older adults. Manuscript one highlights intensive pilot testing to ensure validity and reliability of a novel research methodology in creating task-specific stereotype primes, and using motion analysis equipment in tandem with survey-based measures in order to ascertain statistically meaningful models to evaluate performance outcomes. Manuscript two then uses this method to explore the potential influence of stereotype priming on self-efficacy for stairs in healthy older adults. This manuscript includes the results of a follow-up assessment of prime recall one month after initial priming. Manuscript three explores the influence of stereotype priming on stair navigation performances of healthy older adults, while considering the potential changes in stair self-efficacy from manuscript two. Building upon these three manuscripts, the final manuscript (manuscript four) examines the impact of the same stereotype primes on older adults with osteoarthritis as a representation of older adults experiencing a physical-related version of "double jeopardy" (Clarke & Korotchenko, 2011; Ryan, Anas, & Gruneir, 2006; Nelson, 2016). These older adults with osteoarthritis are then compared to the "healthy" older adult participants that were analyzed in the previous three manuscripts.

General Methods

The following manuscripts examine the influence of stereotype priming on the stair navigation and related self-efficacy of healthy community-dwelling older adults and those with osteoarthritis aged 50 years and above. Generally, participants were recruited from several community-based and private older adult organizations and centres within the greater Toronto area via on-line and in-person promotion (i.e., Garnett A. Williams Community Centre, Lumacare, Community & Home Assistance to Seniors, York University Retirees Association, The York Circle for Alumni, The Arthritis Program at Southlake Hospital). Participants were required to be able to speak and understand English, as well as exhibit being in "good" health. Individuals were screened for any chronic conditions, relevant diseases, and/or related surgeries within the past year, assistive mobility devices (i.e., canes, walkers, and wheelchairs), uncorrected vision, depressive symptoms (via the Geriatric Depression Scale Short-Form-15 scores $\geq$ 10; Sheikh & Yesavage, 1986; Appendix A), and cognitive impairment (via Mini-Cog scores $\leq$ 2; Borson, Scanlan, Brush, Vitallano, & Dokmak, 2000). Individuals having any of these traits were generally excluded from participation, with the exception of osteoarthritis diagnosis for the purposes of the final research phase. Participants were reimbursed for parking and public transportation. All participants provided written consent prior to participation. The present research design and all materials were approved by York University's Human Research Participants Ethics Committee.

Stair navigation measures

In order to measure older adult stair navigation, the Swaystar system was used. The transducers within the Swaystar measure angular displacements (degrees) and velocities (degrees/second) in pitch and roll planes. These measures have been validated as proxies for older adults' balance by accurately assessing trunk sway and movement of the body's centre of mass (Allum & Carpenter, 2005; Reid et al., 2011). Task duration (seconds) was also collected in congruence with these angular measures to provide a more complete picture of stair ascent and descent characteristics (Allum & Carpenter, 2005; Allum, Carpenter, & Adkin, 2001; Gill et al., 2001).

Self-efficacy and related constructs

Definitions of what constitutes self-efficacy are often murky, as this concept is closely related to other psychological constructs that have the potential to moderate self-efficacy outcomes, such as self-confidence and self-esteem. The use of validated questionnaires from previous research (all with Cronbach's alpha reliability measure ≥ 0.7) were employed in order to assess stair-specific self-efficacy (primary outcome; Self-Efficacy for Stairs; Hamel & Cavanuagh, 2004), as well as related constructs to health and self-perceptions: self-confidence (English Self-Confidence Scale; Johnson & McCoy, 2000), self-esteem (Rosenberg Self-Esteem Scale; Rosenberg, 1965), general self-efficacy (General Self-Efficacy Scale; Schwarzer & Jerusalem, 1995), falls self-efficacy (Self-Efficacy for Falls-International Scale; Yardley et al., 2005), stereotype consciousness (Stigma Consciousness Questionnaire; Pinel, 1999; Hess et al., 2009), and self-perceptions of aging (Attitude Toward Own Aging Sub-Scale; Lawton, 1975). For reference, these scales are provided in Appendix A.

Stereotype primes

Positive and negative explicit stereotype primes were constructed in the form of newspaper articles stemming from a credible source which compared the stair navigation of older adults to younger adults (Appendix B). To enhance the believability (i.e., confidence in the truthfulness of message and content; Beltramini, 1988) and salience of prime content, the articles were constructed as a fact-based stereotype prime using vocabulary that previous research has found to be consistently interpreted as “stereotypically” positive or negative regarding one’s age (Hummert et al., 1994; Lamont et al., 2015; Levy & Leifheit-Limson, 2009).

Procedure

The design of this study followed the format presented in Figure 1. Initially, five community centres and five private organizations were contacted for recruitment of older adults. Of the five community centres contacted, recruitment was only successful at one location (i.e., Garnett A. Williams Community Centre), while all five private organizations contacted produced potential participants. Of the 135 older adults who volunteered for participation, five were determined to be ineligible based on the exclusion criteria for chronic conditions. The final total sample consisted of 130 older adults, 90 of which were categorized as “healthy” (the same 90 older adults were used for the analyses featured in Manuscripts 1-4) and 40 represented the sample of older adults with osteoarthritis (only used for the analyses featured in Manuscript 4). Eligible participants were asked to fill out the psychological questionnaire package on their home computers for establishing baseline data. The survey package was returned no later than one week prior to test day in order to reduce the likelihood of inadvertent questionnaire priming. Participants were then unknowingly randomized into positive (boost; n=30 healthy older adults, n=20 older adults with osteoarthritis), negative (threat; n=30 healthy older adults, n=20 older adults with osteoarthritis), or no prime (control; n=30 healthy older adults) experimental groups. It should be notes that there was no control group the sample of older adults with osteoarthritis. Participants were escorted to the principal researcher’s office at York University by a research assistant who was blind to the prime group. The research assistant escorted the participants through the building via an elevator to mitigate inadvertent practice on the specific stairs that were used for testing. Upon reaching the office, participants' height and weight were measured, and they were instructed to read the prime article (does not apply for control participants). After being fitted with the Swaystar apparatus, participants ascended and descended the stairwell twice. After re-completing the psychological surveys on a computer located inside the principal researcher's office, participants were debriefed and re-consented. An e-mail follow-up was conducted one month after test day in order to explore prime recall in healthy older adults.

Confounding variables

In congruence with previous stereotype and biomechanical research, age, sex, weight, height, ethnicity, education, income, occupational status, number of medications, history of falling, sedentary hours per week, and physical activity levels were also collected at baseline to be adjusted for within the experimental analyses (Andreoletti & Lachman, 2004; Buchner et al., 2016; Chappell, 2003; Eto, Saotome, Furuishi & Ogasawara, 1998; Davis, Campbell, Adkin, & Carpenter, 2009; Hegeman et al., 2007; Levy & Myers, 2004; Nelson, 2016; Robertson et al., 2015; Sargeant-Cox et al., 2013; Topolski et al., 2006).

Analyses

In order to maximize recruitment efficiency, power calculations from self-efficacy related research determined the minimum sample size necessary for each group in the study to produce meaningful results was 30 individuals (N=90 healthy adults). For the experimental analyses, multiple analyses of variance (ANOVA) were performed in order to ensure statistical homogeneity of participant demographic and baseline characteristics in each prime group to test for successful randomization. Significance levels for statistical tests were set at a *p*-value equal to or less than 0.05, while the *p*-values denoting significance for Bonferroni post-hoc tests were adjusted based on the number of groups that were being compared in the analysis. Analyses were conducted using SPSS 24 statistical software.

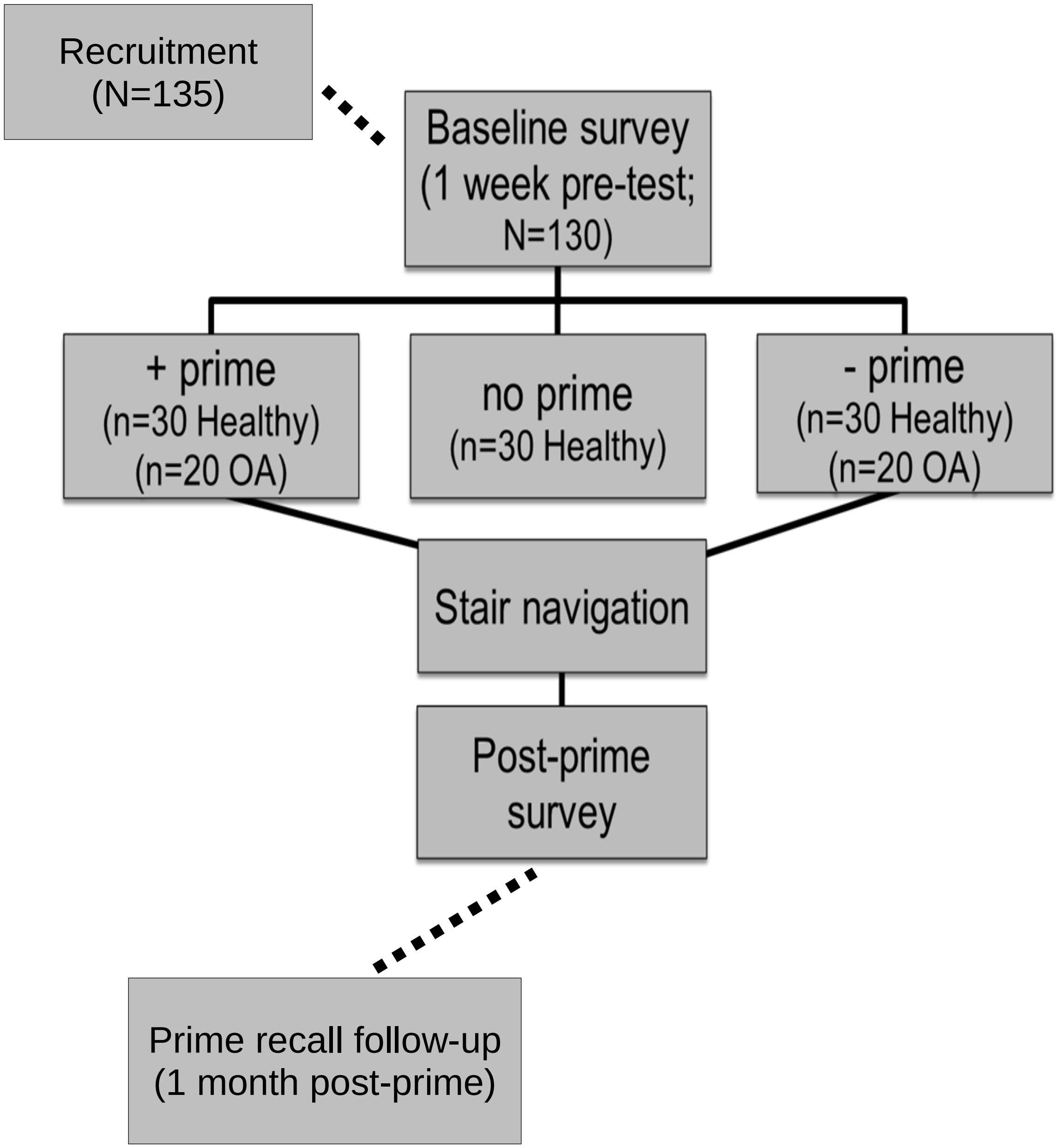

Figure 1. Study design

Manuscript 1 - Developing a novel method of measuring self-efficacy and stair performance after stereotype exposure

Summary

Ageism and negative age-stereotypes have widespread effects on cognitive, physiological, physical, and psychological functional health of older adults; however, there is a paucity of research examining self-efficacy, and no research has explored stair navigation performance after exposure to stereotype priming. These two variables are of utmost concern considering stair navigation is the most commonly reported activity of daily living that limits older adult functionality, and self-efficacy determines activity-avoidance based on perceptions of capabilities. Both stair navigation ability and self-efficacy tend to decline with advancing age, effectively compromising the psychological and physical well-being of older adults that could lead to accidental falls and injuries during daily functioning. The present study aimed to develop an exploratory model of the effects of stereotype priming on self-efficacy for stairs and stair navigation performance in older adults (aged 50 years and above; N=90). More specifically, the present study examined the effectiveness of a stereotype prime specifically constructed for salience and manipulation of age stereotypes through stair navigation. The linear regression results suggest the exploratory models for stair self-efficacy and stair navigation duration explained significant amounts of variance in the primary outcomes with significant goodness of fit. Furthermore, the stereotype prime was found to evoke more concern regarding stair navigation performance for older adults receiving a stereotype threat or boost compared to controls ($p \leq 0.017$). These findings have implications for streamlining the methodologies and

analyses associated with conducting and interpreting research intersecting the domains of stereotypes, self-efficacy, and stair navigation.

Introduction

Nearly 50 years ago, Robert Butler coined the term “ageism” as a form of social oppression marked by asserting homogenous traits to groups of older adults, which often operates in conjunction with differential treatment based solely on one’s actual or perceived age (Butler, 1969). Similar to other forms of social oppression, such as racism or sexism, ageism operates through stereotypes to dichotomize groups of individuals in society as inferior or superior; however, unlike one’s race or sex, age is a more fluid social construction, constantly evolving over time. Furthermore, the dynamic biopsychosocial effects of ageism eventually influence all members of society as one continues to age (Giles & Reid, 2005; Lamont et al., 2015; Levy & MacDonald, 2016; Levy, 2003; Nelson, 2016). While positive age stereotypes have been acknowledged (e.g., “to be old is to be wise”), the vast majority of age stereotypes are negative and commonly highlight inevitable physical, cognitive and social decline (e.g., “to be old is to be sick”, “senile”, “isolated”; Clarke & Korotchenko, 2011). Internalization of these largely negative stereotypes is understood to begin at a young age, during which time negative age stereotypes lack self-relevance, gaining salience in older ages after decades of exposure and subconscious embodiment (Hummert et al., 1994; Levy, 2009; Levy et al., 2002b; Levy & Myers, 2004, Ng et al., 2016). Once these engrained stereotypes become personally relevant, they can lead to short-term and longitudinal health consequences by altering one’s behaviours, attitudes, and perceptions of aging in a self-fulfilling fashion (Allen, 2015; Chapman et al., 2014; Hess et al., 2004; Levy et al., 2002b; Levy et al., 2014; Levy et al., 2012; Levy et al., 2016a, 2016b; Robertson et al., 2015; Sargeant-Cox et al., 2013).

With studies spanning from one day cross-sectional work to between two and 40 years of longitudinal follow-up, a large body of evidence shows older adults exposed to negative stereotypes can have significantly compromised physiological, cognitive, psychological, and physical facets of well-being, such as: reduced cardiovascular functioning (Levy et al., 2000), slower recovery from illness (Levy et al., 2006), higher cortisol levels (Cohen et al., 2007; Levy et al., 2016a), more biomarkers of Alzheimer's disease (Levy et al., 2016b), declines in memory recall (Bouazzaoui et al., 2016; Hess et al., 2003; Hess et al., 2004; Hess, Hinson, & Hodges, 2009; Horton et al., 2008; Levy et al., 2012), hazard detection while driving (Chapman et al., 2016), will to live (Levy et al., 2000), slower walking speed (Horton et al., 2008; Levy et al., 2014; Robertson et al., 2015; Sargeant-Cox et al., 2013), slower timed-up-and-go (Levy et al., 2014; Robertson et al., 2015; Sargeant-Cox et al., 2013), and weaker grip strength (Levy et al., 2002a; Levy et al., 2014; Stephan et al., 2013; Swift et al., 2012; Horton et al., 2008). In recognition of these widespread effects, the World Health Organization has recently launched a global campaign to combat ageism given that older adults represent the largest and fastest growing segment of the world's population (World Health Organization, 2016). Aligning with the World Health Organization's campaign against ageism, the key to combating these negative effects may lie in promoting positive stereotypes of aging in order to alter deeply entrenched negative perceptions of aging and subsequent health consequences (Levy & Macdonald, 2016; Meisner, 2012; Nelson, 2016).

While the impact of age-based stereotype boost (exposure to a positive stereotype and an opportunity for older adults to confirm this through performance; Armenta, 2010; Aronson & Steele, 1995) has been comparatively less researched than age-based stereotype threat (exposure to a negative stereotype and an opportunity for older adults to confirm this through performance;

Armenta, 2010; Aronson & Steele, 1995; Lamont et al., 2015), a recent longitudinal study by Levy and colleagues (2014) found that exposing older adults to a stereotype boost once a week over the span of a month resulted in significantly greater positive perceptions of aging in addition to physical functioning improvements comparable to those of an exercise intervention (McAuley et al., 2013). Moreover, stereotype boost and positive perceptions of aging have been found to buffer declines in memory (Hess et al., 2004; Levy et al., 2012), life satisfaction (Wurm et al., 2008), gait speed (Hausdorff et al., 1999; Levy et al., 2002a), and engagement in preventative health behaviours such as being involved in adequate amounts of exercise, adhering to medical treatments, and better diet (Levy & Myers, 2004). For these reasons, researchers have highlighted a significant average survival advantage of 7.5 years for older adults embodying positive age-stereotypes compared to more negative (Levy & Myers, 2004). Furthermore, research has noted significantly distinct survival advantages for positive perceptions regarding different domains of aging, namely, a 2.5 year advantage for positive perceptions of cognitive aging and a 4.5 year advantage for positive perceptions of physical aging (Ng et al., 2016).

While maintaining positive perceptions of physical aging seemingly has a greater survival advantage compared to positive perceptions of cognitive aging, significantly less stereotype research has focused on physical outcomes, and even less has focused on potential changes in psychological well-being (Lamont et al., 2015; Levy 2003). In light of these findings, several calls have been put forth regarding the need for more research focusing on physical performances rather than working memory, and how psychological variables can be altered by exposure to stereotypes (Lamont et al., 2015). Of particular interest is the notion of self-efficacy (one’s beliefs related to accomplishing specific tasks; Bandura, 1977), as it has been identified as a proximal antecedent towards establishing self-perceptions and behaviour change (Andreoletti

& Lachman, 2004; Drerichard & Kopetz, 2005; Maly et al., 2006). In conjunction with this call for stereotype research, a separate call has been put forth in the field of aging and biomechanics regarding more research that explores how cognitive variables and interventions can influence stair navigation (Jacobs, 2016) - a physical performance outcome that has been identified as an independent predictor of health status (Jacobs, 2016; Tiederman et a., 2016) and has yet to be examined in the field of stereotype research. Considering a "stereotype, self-efficacy, and stairs" study has never been conducted, the present study aims to describe and validate a novel method to stereotype exposure that will measure psychological and physical outcomes, and identify confounding variables that should be adjusted for in order to streamline current and future research models. In accordance with developing strategies to effectively combat ageism and the impact of stereotypes, the present work further aims to identify reliable and valid moderators to conduct statistically meaningful research with more efficiency.

Methods

The present study examines the variables that influence the effects of stereotype priming on stair navigation and stair self-efficacy in healthy community-dwelling older adults aged 50 years and above (N=90). Participants were voluntarily recruited from several community-based and private organizations within the greater Toronto area. Participants were screened for English fluency, any diagnosed vestibular, musculoskeletal, or neurological diseases and/or related surgeries within the past year, using assistive devices for mobility, uncorrected vision, depression (via the Geriatric Depression Scale Short-Form-15 scores ≥ 10; Sheikh & Yesavage, 1986), and cognitive impairment (via Mini-Cog scores ≤ 2; Borson et al., 2000). Participants were asked to wear closed-toe, flat shoes that they felt comfortable wearing while accomplishing activities of daily living. Eighty-six of the participants (96%) wore running shoes during the experiment (4 individuals wore flat sandals). Participants were also instructed to wear their usual corrective lenses if they reported having corrected vision in the demographic section of the questionnaire. All participants provided written consent prior to and after participation. The present research design and materials were approved by York University's Human Research Participants Ethics Committee.

Stair navigation task duration

In order to measure older adult stair navigation, the Swaystar motion analysis system (Swaystar Balance International Innovations GmbH, Switzerland) was used. The Swaystar is a small, light-weight, and relatively unobtrusive Bluetooth motion analysis system with transducers mounted on a converted motorcycle kidney belt and strapped around the lower back. The transducers within the Swaystar measure angular displacements (degrees) and velocities (degrees/second) in pitch (forward and backward) and roll (side to side) planes. Of particular interest for the aims of the present study was assessing task duration (seconds) as a representative measure of these angular variables. Task duration is positively associated with angular deviation and negatively associated with angular velocity, and has been identified as the most robust indicator of efficient stair navigation (Allum & Carpenter, 2005; Allum et al., 2001; Gill et al., 2001). In addition, duration was used for this study as opposed to the other angular measures to enhance reproducibility for other researchers who wish to test the effects of stereotype priming on stair navigation without access to the Swaystar system. For these reasons, the present study focuses on validating the psychological, demographic, and health-related variables relevant to stair ascent and descent duration. Similarly, previous stereotype research that has evaluated the physical outcomes of timed-up-and-go and walking speed have used task duration as part of their primary outcomes to be indicative of stereotype impact (Hausdorff et al., 1999; Horton et al., 2008; Levy et al., 2012; Robertson et al., 2015). Given that biomechanical processes for ascending and descending stairs are different, they were measured as separate components of stair navigation (Costigan et al., 2002; Gill et al., 2001; Herman et al., 2009; Hortobgáyi et al., 2003; Nadeau et al., 2003; Reid et al., 2011; Son & Kim, 2013; Verghese, et al., 2008; Zietz et al., 2011).

Psychological measures

Previous stereotype research has indicated that when measuring the influence of stereotype exposure on a specific task (i.e., stair navigation), it is important to consider task-specific psychological variables (Bandura, 2005; Andreoletti & Lachman, 2004; Chapman et al., 2014; Levy & Leifheit-Limson, 2009). Therefore, the primary psychological outcome variable in the present study is self-efficacy specific to stair navigation. However, since task-specific self-efficacy is closely related to other psychological constructs that influence the formation of one's self-concept (i.e., an individual's overall belief about themselves, including attributes and who and what the *self* is; Baumiester, 1999), variables such as, general self-efficacy, self-confidence, and self-esteem may also be important. These other psychological constructs more broadly measure one's overall emotional, social and physical confidence. Self-confidence relates to assuredness in abilities and judgments, whereas self-esteem is a measure of emotional self-worth (Rosenberg, Schooler, Schoenbach & Rosenberg, 1995). In addition, stereotype consciousness and self-perceptions of aging were also considered in understanding how older adults have experienced ageism and the influence these experiences may have on attitudes towards the aging process (Levy, 2003; Pinel, 1999). The use of validated questionnaires from previous research was used to represent these aforementioned psychological variables (all with Cronbach's alpha reliability measure ≥ 0.7). Each scale was assessed for reliability (via Cronbach's alpha) and construct validity (via intra-class correlations) within the present sample of healthy older adults. Each met the criteria for outliers (using interquartile ranges) and normality using principles of acceptable values for asymmetry and kurtosis (i.e., ranging between ± 2; George & Mallery, 2010). All scales can be found in Appendix A.

A) Task-specific self-efficacy was measured using the Self-Efficacy for Stairs (16 items total with 8 items each for stair ascent and descent measured on a 10-point scale ranging from no confidence (0) to complete confidence (10); SES; Hamel & Cavanuagh, 2004). The SES separately assesses specific beliefs for accomplishing both ascending and descending the stairs. For example, "How confident are you that you can negotiate stairs without losing your balance?" The SES for ascent (SESUp) was found to be a reliable measure at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.92; Cronbach's alpha post-prime = 0.93). In addition, the intra-class correlations suggest that all items were correlated in a convergent direction (ranging from 0.61-0.94). Similar reliability and validity outcomes were found for descent SES (SESd; Cronbach's alpha baseline = 0.95; Cronbach's alpha post-prime = 0.94; intra-class item correlations ranging from 0.60-0.97). Higher scores (out of 10) are indicative of greater self-efficacy for stair ascent and descent.

B) The English Self-Confidence Scale (ESCS; 18 items, seven-point Likert scale ranging from completely agree to completely disagree; Johnson & McCoy, 2000) was utilized for assessing self-confidence. The ESCS was found to be a reliable measure at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.73; Cronbach's alpha post-prime = 0.70). In addition, the intra-class correlations suggest that all items were correlated in a convergent direction (ranging from 0.33-0.86). Higher scores (out of seven) are indicative of more self-confidence.

C) The Rosenberg Self-Esteem Scale (RSES; 10 items, four-point scale ranging from strongly agree to strongly disagree; Rosenberg, 1965) was used for assessing self-esteem. The RSES was found to be a reliable measure at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.85; Cronbach's alpha post-prime = 0.88). In addition, the intra-class correlations suggest that all items were correlated in a convergent direction (ranging from 0.57-0.95). Higher scores (out of 40) are indicative of higher self-esteem levels.

D) In order to measure general self-efficacy, the General Self-Efficacy Scale was used (GSE; Schwarzer & Jerusalem, 1995). This 10-item scale assesses self-beliefs and personal agency while accomplishing a variety of life demands (four-point scale ranging from not at all true to completely true). The GSE was found to be a reliable measure at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.92; Cronbach's alpha post-prime = 0.89). In addition, the intra-class correlations suggest that all items were correlated in a convergent direction (ranging from 0.72-0.95). Higher scores (out of 40) are indicative of higher general self-efficacy.

E) Self-Efficacy for Falls-International was used for assessing another form of general self-efficacy specific to fear of falling (FSE-I; 16 items, four-point scale from very concerned to not all concerned; Yardley et al., 2005). The FSE was found to be reliable at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.87; Cronbach's alpha post-prime = 0.86). In addition, the intra-class correlations suggest that all items were correlated in a convergent direction (ranging from 0.68-0.98). Higher scores (out of 64) are indicative of having more self-efficacy and less fear of falling.

F) In recognition that not all stigmatized individuals experience stigmatization similarly, the construct of stigma consciousness yields insight into how individuals interpret personal stigma (Pinel, 1999). The Stigma Consciousness Questionnaire (SCQ; 10 item, seven-point Likert scale ranging from strongly agree to strongly disagree; Pinel, 1999; Hess et al., 2009) was employed to reflect the extent to which a stigmatized individual believes that his or her stigmatized identity affects daily interactions with others. The SCQ was found to be a reliable measure at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.76; Cronbach's alpha post-prime = 0.75). In addition, the intra-class correlations suggest that all items were correlated in a convergent direction (ranging from 0.43-0.85). Higher scores (out of seven) are indicative of age stigma having a larger impact on one's daily life.

G) Similar to the SCQ, aging self-perceptions were measured using the Attitude Toward Own Aging Sub-Scale (ATOA) to assess individualized perceptions of the aging process. The ATOA consists of five “yes” or “no” questions measured as a subset of the Philadelphia Geriatric Center Morale Scale (ATOA; Lawton, 1975). The ATOA was found to be a reliable measure for healthy older adults at baseline as well as post-prime exposure (Cronbach’s alpha baseline = 0.72; Cronbach’s alpha post-prime = 0.73). In addition, the intra-class correlations suggest that all items were correlated in a convergent direction (ranging from 0.36-0.84). Higher scores (out of five) are indicative of having better perceptions of aging.

Confounding variables

In congruence with previous stereotype and biomechanical research, the following demographic and health information were collected at baseline and adjusted for in the analyses where significantly associated with the primary variables of interest (i.e., SESUp, SESd, ascent time, and descent time): age, sex, weight, height, ethnicity, highest level of education, total household income, occupational status, number of medications currently being taken, number of falls in the past year, sedentary hours per week (summative value of self-reported hours per week engaging in television viewing, computer use, reading, passive transportation, socializing, playing games/puzzles, and passive hobbies), and self-reported physical activity levels measured using the Rapid Assessment of Physical Activity (Andreoletti & Lackman, 2004; Buchner et al., 2016; Chappell, 2003; Eto et al., 1998; Davis et al., 2009; Hegeman et al., 2007; Levy & Myers, 2004; Nelson, 2016; Robertson et al., 2015; Sargeant-Cox et al., 2013; Topolski et al., 2006).

Stereotype primes

Modeled after the work of Horton and colleagues (2010) and Hess and colleagues (2003), stereotype exposure was manipulated using an explicit positive or negative stereotype prime in the form of a newspaper article printed from an on-line news resource (Appendix B). The prime article was carefully constructed using strategies to enhance credibility, believability, age-relevance, and task-specificity regarding stair navigation (Lamont et al., 2015; Latimer et al., 2010). The article included both text and images to enhance ecological validity regarding the layout of newspaper articles (Kotter-Gruhn & Hess, 2009). The positive and negative prime texts (respective word counts of 184 and 185) were essentially the same with minor syntax changes to evoke a stereotype threat or boost for older adults. The vocabulary chosen for the prime material was based upon prominent stereotype words older adults have previously reported within the work of Levy and Leifheit-Limson (2009) and Hummert and colleagues (1994). Specifically, all wording was the same with the exception of one portion of the article. The stereotype boost read,

> **"..recent experiments at Sinai Hospital have found that older persons are more successful at accomplishing this task than younger persons – both more efficiently and with less injuries. In a recent interview with Dr. Sam Page (of Orthopedics at Sinai Hospital), the orthopedic surgeon explained, "These improvements in stair performance observed in older adult populations could be attributed to age-related accumulations of experience, resiliency, and fitness". Dr. Page went on to clarify, "It is the development of these attributes that largely account for the abundance of successfully aging older adults within the population". Thus, it would appear that older persons have more adaptability and mastery for accomplishing stair-related tasks compared to their younger counterparts."**

Whereas the stereotype threat article read,

> **"..recent experiments at Sinai Hospital have found that older persons are less successful at accomplishing this task than younger persons – both less efficiently and with more injuries. In a recent interview with Dr. Sam Page (of Orthopedics at Sinai Hospital), the orthopedic surgeon explained, "These declines in stair performance observed in older adult populations could be attributed to age-related**

> **amplifications of frailty, shakiness, and general inability". Dr. Page went on to clarify, "It is the development of these attributes that largely accounts for the abundance of non-successfully aging older adults within the population". Thus, it would appear that younger persons have more adaptability and fitness for accomplishing stair-related tasks compared to their older counterparts."**

To ensure further cognitive processing of the prime beyond simply reading the article, participants were asked to answer a series of three questions pertaining to the prime content: 1. What does the acronym ADL stand for? 2. Which ADL is thought to be the most important? 3. Who is better at performing this ADL? In accordance with previous research (Marx & Stapel, 2006), manipulation checks were also used in order to examine whether the primed articles elicited a perceived threat or boost regarding stair navigation. This manipulation check included two questions answered on a seven-point Likert scale: 1. Were you worried that your ability to perform well on the task was affected by your age? (referred to as personal concern), and 2. Were you worried that if you performed poorly on the task, the researcher would attribute your poor performance to your age? (referred to as researcher concern). Moreover, article credibility was assessed as a measure of content and source believability (Beltramini, 1988). Participants were asked, "How would you rank the credibility of this article?" on a 10-point scale, ranging from not credible at all (0) to very credible (10).

Procedure

After consenting to voluntarily participation, older adults completed the on-line baseline demographic and health questionnaire package one-week in advance of participation, which also included an array of psychological scales. Participants were then randomized into a control, positive (boost), or negative (threat) experimental group without their knowledge, and asked to read the prime article at their own pace (with prime group being the primary predictor variable in this study). Participants who were randomized into the control group followed the same procedure, but did not receive a stereotype prime to read. Participants were then fitted with the Swaystar apparatus and asked to perform stair navigation at their usual pace. It should be noted that handrail use was not permitted during stair navigation as this allows for upper limb loading, which can interrupt sway signals and is falsely registered as a participant falling by the Swaystar software (Allum & Carpenter, 2005; Zietz et al., 2011).

The stairwell, which was located in a public space within a building on the York University campus (located in Toronto, Ontario), consisted of five steps that were in accordance with Ontario governing building code guidelines (stair rise 17.8 cm, stair depth 26 cm, stair width 146 cm), and had an 165 centimeter long landing platform at the top and bottom of the stairwell. A piece of tape was placed at the same length of the stair depth (i.e., 26 cm) from the first step at the bottom and top of the stairwell to indicate a standard starting point for ascent and descent. Duration of stair navigation and related measures were collected via the principal researcher pressing a record button for the Swaystar as participants began ascent or descent in response to the auditory cue, "go". A subsequent button was pressed to stop the recording once both the participants' feet had reached the landing platform at the top or bottom of the stairwell. Upon completing ascent, participants waited for the next auditory cue of initiation. Participants ascended and descended the stairwell twice, and an average of these two trials was used to represent quantitative characteristics of stair navigation. This data represents a refined measure of time from stair task initiation until completion, which was obtained by altering the time-window for each trial using the Swaystar trunk angular displacement plots recorded during navigation. The time-window was selected from the moment the plots displayed trunk angular displacement above the relatively flat lines representing standing-rest positions in pitch and roll planes to the moment when the plot lines returned to rest position. Participants then re-completed the survey package from baseline, and were debriefed given the quasi–deceptive nature of the study. Written and verbal consent was obtained again after debriefing.

Analyses

Psychological scales

After statistical confirmation of normality, reliability, and construct validity for the psychological scales, repeated measures analyses of variance further confirmed that none of the general psychological scales had significantly changed from baseline to post-prime exposure in any of the groups (all $p \geq 0.05$). Thus, bivariate correlations of baseline values (using Pearson r values) were conducted in order to ascertain which of these scales were significantly associated with the primary physical and psychological outcomes (i.e., stair navigation duration and self-efficacy for stairs). Similar correlational analyses were conducted regarding the continuous or categorical-binary and categorical-ordered confounding variables collected at baseline (i.e., sex, income, education, physical activity levels). The scales and variables that emerged as significantly correlated to the primary outcomes were then used to develop a linear regression model for each of the primary outcomes in order to examine goodness of fit and amount of variance explained by the each model. All analyses were assessed for significance using a *p*-value less than or equal to 0.05.

Stereotype prime

In order to assess the validity of the stereotype primes at evoking a stereotype threat or boost, an analysis of variance with Bonferroni post-hoc testing was conducted across the positive, negative, and control groups regarding each manipulation check (i.e., personal concern and researcher concern). Considering the analysis of variance was conducted across three groups, the Bonferroni adjusted *p*-value for significance was set to 0.017. A bivariate correlation (using Pearson r values) was conducted to assess the association between article credibility and personal and researcher concern. A t-test was used to examine differences between the positive and negative group regarding article credibility. These analyses were assessed for significance using a *p*-value less than or equal to 0.05.

Results

Descriptive statistics in the form of means, standard deviations (SD), and the range for the primary outcome variables as well as psychological scales are displayed in Table 1a, while descriptive statistics for sample demographic and health variables are displayed in Table 1b. The mean age of the 90 older adults in the sample was 66.0 years (±7.9 years), ranging from 50 to 83 years. On average, older adult stair ascent time was significantly slower than stair descent time (4.4 seconds of ascent ± 0.6 seconds vs. 4.0 seconds of descent ± 0.7 seconds, $t(89)=6.4$, $p=0.001$). Of note, the majority of the sample was retired (54.4%), highly educated (50.0% had achieved a post-secondary degree, while 30.0% had achieved a graduate degree), and reported being in the highest income brackets (63.4% reported total household earnings of $60,000 or greater). In addition, the majority of these older adults reported being sedentary or under-active (54.4%), and spending nearly eight hours a day engaging in sedentary behaviours.

Correlations among the primary outcomes and general psychological variables are displayed in Table 2a. Significant and unacceptable levels of multicollinearity were found among the ESCS, RSES, and GSE (≥0.7), which indicates that these variables are essentially measuring the same constructs and would likely statistically wash-out their respective effects regarding the primary outcomes. Therefore, the GSE was chosen as the scale to be representative of these multicollinear scales in the final model for analysis as the GSE was the only scale of these three that was significantly correlated to all the primary outcome variables. While the ATOA and SCQ scales were not significantly correlated with the primary outcomes, the FSE-I qualified for SESUp and SESd model inclusion given its significant positive correlation to these two scales. Non-significant repeated measures analyses of variance illustrated that the GSE and FSE-I values did not change after exposure to the boost or threat, and thus, the baseline values of these scales were used as the confounding variables adjusted for in the exploratory model of analyses. Notably, SESUp and SESd were both significantly negatively correlated with stair ascent and descent time, indicating that stair navigation time decreases as self-efficacy for stairs increases.

Correlations among the primary outcomes and demographic/health variables are displayed in Table 2b. Age, sex (male = 0, female = 1), number of medications, and number of falls in the past year were all significantly negatively correlated with SESUp and SESd, indicating that increases in these variables were associated in declines in self-efficacy for stairs during ascent and descent. Age was also positively correlated to stair ascent and descent time, along with sedentary hours per week, indicating that increases in these variables were associated with slower stair ascent and descent time. Considering occupational status and ethnicity are strictly categorical confounding variables, correlations would be statistically inappropriate. Therefore, these two variables were transformed into binary variables based on their descriptive majorities (i.e., Caucasian vs. non-Caucasian, and working (full- or part-time) vs. retired); however, these variables were not significantly correlated to any of the primary outcome variables and as such were not included in the final exploratory model in this study.

Stemming from these correlational analyses, the final exploratory models for testing the primary outcome measures of self-efficacy for stair ascent and descent and the models' goodness of fit are displayed in Table 3. The final exploratory models for testing SESUp includes SESd baseline, GSE baseline, FSE-I baseline, age, sex, number of medications, and number of falls in the past year. This model was found to have significant goodness of fit ($F(7,82)=72.73$, $p=0.0001$), while accounting for 86 percent of the variance in SESUp. Similar trends were found regarding the model for SESUp after prime exposure. The final exploratory model for testing SESd included the same variables with the exception of SESUp at baseline instead of SESd. This model was found to have significant goodness of fit ($F(7,82)=75.35$, $p=0.0001$), while accounting for 85 percent of the variance in SESd at baseline. Similar trends were found regarding the model for SESd after prime exposure. The final models for testing the primary outcome measures of stair ascent and descent time and the models' goodness of fit are also displayed in Table 3.

The final exploratory models for testing stair ascent and descent time included: SESUp post-prime (mulitcollinear with SESUp baseline), SESd post-prime (mutlicollinear with SESd baseline), GSE baseline, age, and sedentary hours per week. This model was found to have significant goodness of fit for stair ascent time ($F(7,82)=2.66$, $p=0.01$), while accounting for 21 percent of the variance in this outcome. This model was also found to have significant goodness of fit for descending the stairs ($F(7,82)=5.34$, $p=0.0001$), while accounting for 28 percent of the variance in stair descent time.

In order to examine the effectiveness of priming, analyses of variance were conducted regarding prime manipulation checks (Figures 2a and 2b). Prime group was found to have a significant overall effect on experiencing personal concern regarding their age and ability to navigate the stairs ($F(2,87)=20.39$, $p=0.001$). Prime group was also found to have a significant overall effect on experiencing concern regarding the researcher potentially attributing poor stair navigation performance to their age ($F(2,87)=15.83$, $p=0.001$). The Bonferroni post-hoc tests (with Bonferroni adjusted *p*-values of significance) indicated that for both forms of concern, the control group reported significantly lower levels compared to older adults in the positive and negative prime groups (personal concern: $M_{control} = 1.2 \pm 0.6$ vs. $M_{positive} = 2.5 \pm 1.6$ and $M_{negative} = 3.4 \pm 1.6$, $p=0.001$; researcher concern: $M_{control} = 1.3 \pm 1.1$ vs. $M_{positive} = 2.2 \pm 1.4$ and $M_{negative} = 3.3 \pm 1.6$, $p=0.001$). The positive and negative prime groups did not significantly differ from each other in terms of personal or researcher concern ($p \geq 0.017$). In addition, personal concern and researcher concern were significantly correlated with each other (r=0.70, $p=0.001$); however these manipulation checks were not significantly correlated with article credibility. Article credibility was also not significantly correlated with any of the primary outcome variables. Nevertheless, a t-test between the experimental groups of older adults ($n_{eachgroup}=30$) who were exposed to priming indicated that those is the negative prime rated the article as significantly more credible than the positive prime group ($M_{positive} = 4.9 \pm 1.9$ vs. $M_{negative} = 8.2 \pm 1.5$, $t(58)=7.1$, $p=0.001$; Figure 3).

Discussion

The present study outlines the statistical process of validating a novel method of stereotype priming regarding stair navigation self-efficacy and performance. The present analyses were conducted with aims of streamlining the development of multivariate models to be used to enhance the efficiency of further analyses on the data collected during the present study.

In regards to the final exploratory models, the SESUp/SESd, GSE, FSE-I, age, sex, number of medications, and number of falls in the past year significantly accounted for 86 and 85 percent of the variance that could be explained in self-efficacy for stair ascent and descent respectively, with significant goodness of fit indices. Therefore, the proposed model depicts a valid representation of the confounding psychological, demographic, and health variables that are associated with self-efficacy for stairs in the present study. The significant positive bivariate correlations for the GSE, FSE-I, and SESUp/SESd, in congruence with the findings that general psychological scales did not significantly change from baseline to post-prime exposure, corroborates previous research that has found general self-efficacy measures tend to influence task-specific self-efficacy, but are not specific enough to be affected by task-specific stereotype primes (Boripuntaku & Sungkarat, 2016; Levy & Leifheit-Limson, 2009; Rosenberg et al., 1995; Meisner, 2012). This also suggests that the prime article evoked sufficient task-specificity considering self-efficacy for stair ascent and descent were the most strongly correlated psychological variables to stair navigation durations.

In regards to the demographic and health variables that qualified for model inclusion, number of falls in the past year was most strongly correlated with SESUp/SESd in a negative direction. This indicates that as the number of reported falls increases, older adult self-efficacy for stair ascent and descent declines. The number of falls per year is also inherently connected to the FSE-I, which is a valid measure of fear of falling (Davis et al., 2009). Fear of falling, the number of falls, and falls self-efficacy as well as self-efficacy for stairs and stair performance are all understood to decline with increasing age and more negative perceptions of aging, often stemming from ubiquitous negative age-stereotypes highlighting physical decline (Peel, 2011; Levy et al., 2002, 2012; Reelick et al., 2009; Rizcallah, 2011; Sargeant-Cox et al., 2013; Startzell et al., 2000). Changes in psychological well-being and age perceptions have also been found to be independent predictors of compromised stair and general mobility (i.e., self-efficacy and fear of falling; Jacobs, 2016; Levy et al., 2012, 2014; Oh Park et al., 2011; Tiederman et al., 2007). Similar trends regarding negative age perceptions and subsequent declines in self-efficacy for physical tasks have been observed for number of medications, which was the second strongest correlation to SESUp/SESd (Robertson et al., 2015).

The results of the present study also support the inclusion of sex as an important confounding variable regarding self-efficacy for stairs. While research has found that females are socialized to be more sensitive to intellectual stereotypes compared to males (Spencer, Steele, & Quinn, 1999), the present study suggests that females may also be particularly sensitive to stereotypes of age that focus on physical functionality compared to their male counterparts. This could once again be connected to socialized notions of females being physically weaker than males, especially in regards to athletic performance (Chalabaev, Sarrazin, Fontayne, Boiché, & Clément-Guillotin, 2013). Interestingly, sex was not significantly associated with stair ascent or descent time, suggesting there may be a subtle yet meaningful interaction between sex and self-efficacy for stairs that needs to be addressed in future work. In addition, while physical activity levels were not significantly correlated with stair ascent and descent time, the number of sedentary hours older adults were engaging in on a weekly basis proved to be the confounding variable with the strongest correlation to stair navigation durations. Surprisingly, sedentary hours were not significantly correlated to physical activity levels, corroborating previous research suggesting that sedentary time is an independent predictor of functional health that is perhaps more robust than physical activity levels (Dogra & Stathokostas, 2012). For example, the Canada Fitness Survey found significant positive associations between daily sitting time (e.g., television watching, office-work, computer use, etc.) and all-cause mortality (e.g., heart diseases and cancer) in both physically inactive and physically active men and women (Katzmarzyk, Church, Craig, & Bouchard, 2009).

Similar to SESUp/SESd, the exploratory models developed for stair ascent and descent were found to be statistically meaningful, and can be employed in streamlining the collection of data for this stereotype domain and outcome measures. In addition to establishing the exploratory models for the primary outcome variables, the stereotype prime constructed specifically to convey stereotype salience was found to significantly evoke emotions of concern regarding ability to perform based on one’s age in both the positive and negative prime groups. This is particularly interesting for the positive prime group of older adults, who expressed significantly more concern regarding age-based inability compared to those in the control group (and were not significantly different than older adults who were negatively primed). This suggests that the positive prime group may be subject to the “choking under pressure” phenomenon, which posits that high group-based expectations may evoke stereotype threat as opposed to the intended stereotype boost, and subsequently result in performance decrements (Baumeister, Hamilton, & Tice, 1985). This notion should be monitored closely in further research. In addition, the positively primed group rated the stereotype boost article as significantly less credible than those in the negatively primed group who received the stereotype threat article. This suggests that messages promoting positive stereotypes are perceived as counter-intuitive and may explain why the positively primed group expressed performance concerns similar to those in the negatively primed group exposed to the more societally pervasive negative age-stereotypes (Levy & Macdonald, 2016; Nelson, 2016). Given these notions, there is potential that the stereotype boost information may be cognitively discarded more readily and have less impact on older adult self-efficacy for stairs and stair navigation performance post-prime exposure compared to older adults exposed to the stereotype threat condition. Further research is required in order to determine whether the positively primed group potentially performs counter to outcome expectations of stereotype boost.

The present findings have implications for future research in developing statistically meaningful models for exploratory analyses in this stereotype research domain that has yet to be studied. The findings suggest the utilization of general self-efficacy and related constructs is not significantly affected by task-specific stereotype manipulation, and advocates for the use of task-specific scales when possible (i.e., self-efficacy for stairs in the present study). Building from methodologies of previous research, the results of this work answers the call put forth by several research outlets, imploring for research measuring physical outcomes proximal to stereotype exposure. In addition, the results promote considerations for using different measures of self-efficacy, and the appropriateness of using other facets of psychological well-being and prime credibility in the development of novel stereotype prime analyses. After validating the use of a novel stereotype prime for evoking emotions related to stair navigation performance, the findings have further implications for the use of this type of prime in future research. In addition, the present findings highlight which types of demographic and health variables are important to consider in future analyses of the data collected in the present study as well as the future work of other researchers in age-stereotypes domain.

Conclusion

The present study advocates for the use of task-specific self-efficacy as a primary psychological outcome when using a task-specific stereotype prime prior to a physical performance. These considerations, in addition to choosing robust demographic and health related confounding variables, aid in the development of statistically meaningful models for exploratory analyses in stereotype research domains. Future work needs to explore further statistical validation techniques in the case of cross-sectional stereotype research for increased efficiency in conducting research and analyzing data. As well, future work needs to closely examine the potential for specific stereotype primes and outcome domains to elicit results that may be counter to expected performances. Altogether, these research processes will aid in producing evidence that may help in the development of strategies to combat ageism and its negative effects.

Table 1a. Descriptive statistics for stair navigation and psychological scales (N=90)

Variable	Mean (SD)	Min-Max	Range
Stair navigation			
Ascent (sec)	4.4 (0.6)	2.6-6.0	3.6
Descent (sec)	4.0 (0.7)	2.3-5.8	3.5
Baseline psychological scales			
SESUp	8.5 (1.5)	2.5-10.0	7.5
SESd	8.4 (1.5)	1.0-10.0	9.0
ESCS	5.2 (0.6)	3.1-6.8	3.7
RSES	36.1 (3.8)	25.0-40.0	15.0
GSE	34.7 (4.2)	26.0-40.0	14.0
FSE-I	56.8 (6.8)	31.0-64.0	33.0
SCQ	3.8 (1.0)	1.0-6.1	5.1
ATOA	4.0 (1.0)	1.0-5.0	5.0

Table 1b. Descriptive statistics for sample demographic and health variables (N=90)

Variable	Mean (SD) or n (%)	Min-Max	Range
Demographic variables			
Age (years)	66.0 (7.9)	50.0-83.0	33.0
Sex			
Male	43.0 (47.8)		
Female	47.0 (52.2)		
Ethnicity			
Caucasian	58.0 (64.4)		
Chinese	12.0 (13.3)		
Southeast Asian	3.0 (3.3)		
Middle Eastern	3.0 (3.3)		
Japanese	1.0 (1.1)		
Korean	1.0 (1.1)		
Highest level of education			
Some high school	1.0 (1.1)		
High school degree	3.0 (3.3)		
Some post-secondary school	10.0 (11.1)		
Post-secondary degree	45.0 (50.0)		
Some graduate school	4.0 (4.4)		
Graduate degree	27.0 (30.0)		
Total household income (annual dollars/year)			
≤20,000	4.0 (4.4)		
20,000-39,999	9.0 (10.0)		
40,000-59,999	20.0 (22.2)		
60,000-79,999	29.0 (32.3)		
≥80,000	28.0 (31.1)		
Occupational status			
Working full-time	24.0 (26.7)		
Working part-time	17.0 (18.9)		
Retired	49.0 (54.4)		

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Variable	Mean (SD) or n (%)	Min-Max	Range
Health variables			
Height (cm)	167.1 (9.0)	144.0-189.0	45.0
Weight (lbs)	157.3 (29.2)	96.0-257.0	161.0
Number of falls in the past year	0.3 (0.6)	1.0-3.0	2.0
Number of medications	1.1 (1.1)	0.0-4.0	4.0
Sedentary hours (per week)	55.6 (41.7)	1.3-224.0	
Physical activity level			
Sedentary	13.0 (14.4)		
Under-active	36.0 (40.0)		
Active	41.0 (45.6)		

Table 2a. Correlations among primary outcomes and general psychological scales (N=90)

	ESCS (1)	RSES (2)	GSE (3)	ATOA (4)	SCQ (5)	FSE-I (6)	SESUp (7)	SESd (8)	Ascent time (9)	Descent time (10)
1	-	0.71*	0.74*	0.10	-0.11	0.25*	0.24*	0.24*	-0.08	0.30*
2		-	0.75*	0.09	0.09	0.18	0.13	0.14	-0.21*	-0.25*
3			-	0.03	0.31*	0.38*	0.30*	0.33*	0.28*	0.35*
4				-	0.43*	0.30*	0.09	0.07	-0.06	-0.05
5					-	0.50*	0.01	0.04	0.01	-0.01
6						-	0.50*	0.45*	-0.10	-0.07
7							-	0.97*	-0.30*	-0.30*
8								-	-0.32*	-0.30*
9									-	0.70**
10										-

Notes: **p*-values significant ≤0.05; ESCS = English self-confidence scale; RSES = Rosenberg self-esteem scale; GSE = General self-efficacy; ATOA = Attitudes towards own aging; SCQ = Stigma consciousness questionnaire; FSE-I = Falls self-efficacy international scale; SESUp = Self-efficacy for stair ascent; SESd = self-efficacy for stair descent

Table 2b. Correlations among the primary outcome variables and continuous demographic and health variables (N=90)

	Age (1)	Sex (2)	Education (3)	Income (4)	Height (5)	Weight (6)	Meds (7)	Falls (8)	PA level (9)	SA (10)	SESUp (11)	SESd (12)	Ascent time (13)	Descent time (14)
1	-	-0.05	-0.04	-0.19	-0.07	-0.02	0.30*	0.25*	-0.08	0.31*	-0.32*	-0.31*	0.30*	0.40*
2		-	0.09	-0.11	-0.75*	-0.47*	0.02	0.26*	-0.11	0.06	-0.27*	-0.31*	0.15	0.10
3			-	0.24*	-0.11	-0.18	-0.39*	0.09	-0.01	-0.02	0.03	0.06	0.02	0.04
4				-	0.05	0.08	-0.04	0.06	-0.19	0.05	0.13	0.11	0.06	-0.06
5					-	0.60*	-0.01	-0.20	0.07	-0.15	0.16	0.18	-0.12	-0.02
6						-	0.13	-0.12	0.04	0.03	0.10	0.09	0.06	0.10
7							-	0.17	-0.27*	-0.19	-0.34*	-0.36*	0.17	0.19
8								-	-0.10	-0.14	-0.42*	-0.45*	0.16	0.06
9									-	0.06	0.14	0.14	-0.11	-0.09
10										-	0.03	0.06	0.46*	0.34*
11											-	0.97*	-0.30*	-0.30*
12												-	-0.32*	-0.30*
13													-	0.70*
14														-

Notes: **p*-values significant ≤0.05; Sex (male = 0, female = 1); Meds = number of medications; Falls = falls in the past year; PA level = physical activity level; SA = sedentary activities; SESUp = Self-efficacy for stair ascent; SESd = Self-efficacy for stair descent

Table 3. Linear regression model summaries for primary outcomes (N=90)

Primary outcome model	**R**	**R^2**	**df regression**	**df residual**	***F*-statistic**	***p*-value**
SESUp baseline[a]	0.93	0.86	7	82	72.73	0.0001**
SESUp post-prime[b]	0.83	0.69	7	82	25.55	0.001**
SESd baseline[c]	0.93	0.85	7	82	75.35	0.0001**
SESd post-prime[d]	0.88	0.78	7	82	34.05	0.001**
Stair ascent time[e]	0.46	0.21	7	82	2.66	0.01**
Stair descent time[e]	0.59	0.28	7	82	5.34	0.0001**

Notes: * significance at *p*-value ≤ 0.05, ** significance at *p*-value ≤ 0.01; [a]Model includes: age, sex, number of falls in the past year, number of medications, GSE baseline, FSE-I baseline, SESd baseline; [b]Model includes: age, sex, number of falls in the past year, number of medications, GSE baseline, FSE-I baseline, SESd post-prime; [c]Model includes: age, sex, number of falls in the past year, number of medications, GSE baseline, FSE-I baseline, SESUp baseline; [d]Model includes: age, sex, number of falls in the past year, number of medications, GSE baseline, FSE-I baseline, SESUp post-prime; [e]Model includes: age, sedentary hours per week, GSE baseline, SESUp baseline, SESUp post-prime, SESd baseline, SESd post-prime

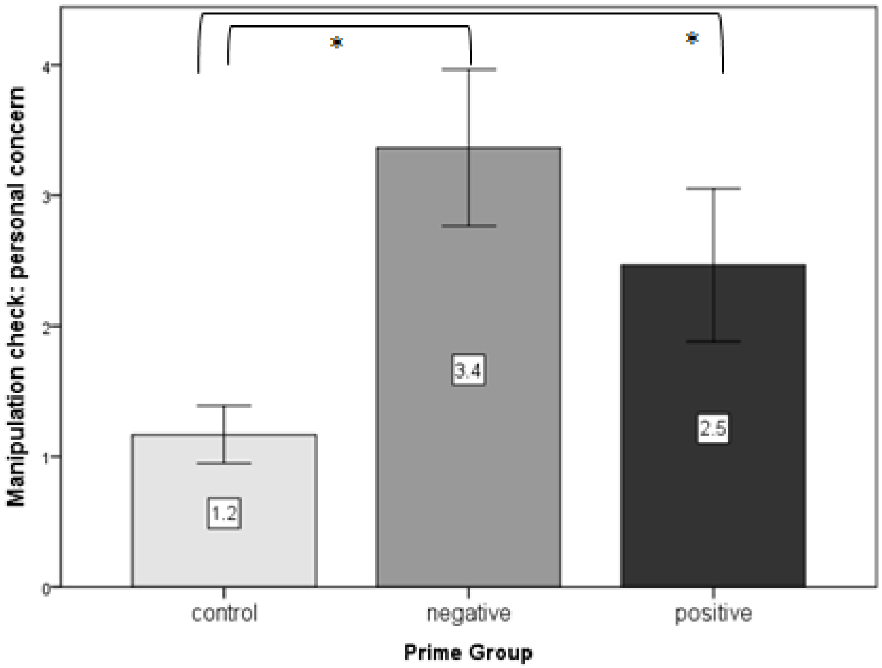


Figure 2a. Analysis of variance for personal concern after exposure to stereotype prime across prime group

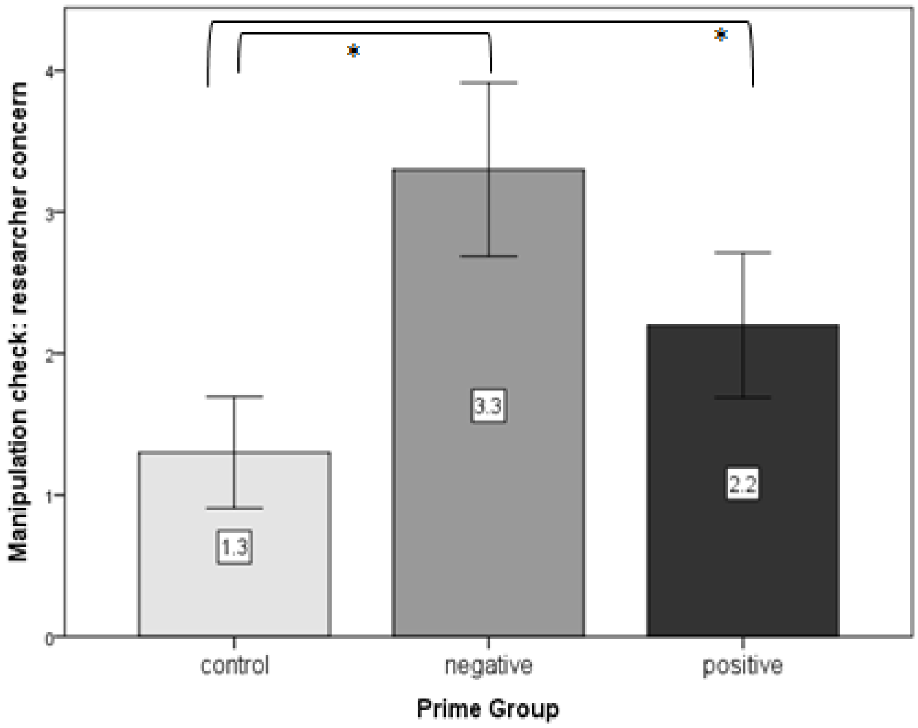


Figure 2a. Analysis of variance for researcher concern after exposure to stereotype prime across prime group

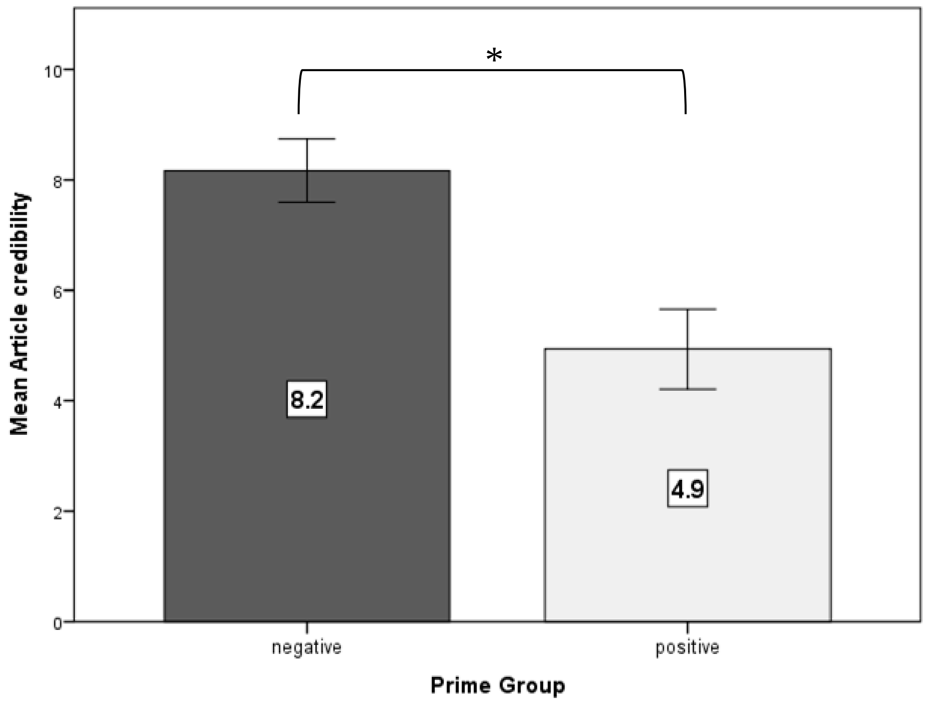


Figure 3. Mean differences in article credibility between prime groups after exposure to prime article (N=60)

Manuscript 2 - Beliefs about the next steps: How positive and negative stereotypes influence self-efficacy for stairs in older adults

Summary

Self-efficacy is an important construct that lays the foundation for whether actions are avoided or completed. Stereotype research regarding age has consistently over-looked the role that task-specific self-efficacy may play in influencing the relationship between prime-performance outcomes. The present study aimed to examine the impact of task-specific stereotype priming on stair-related self-efficacy before and after performing stair navigation – an important activity of daily living that older adults consistently report the most difficulty accomplishing. The study further aimed to assess prime longevity in order to determine the lastingness of prime information received during the experiment. The results revealed that healthy older adults who were negatively primed experienced significant reductions in their self-efficacy for navigating the stairs in both ascent and descent relative to their positively primed counterparts. However, prime longevity was found to be significantly lower in the positive group relative to the negative group. This has implications for using positive stereotype primes as a potential tool for mitigating declines in older adult health and well-being often experienced after exposure to negative age-stereotypes.

Introduction

Self-efficacy reflects an individual's beliefs and perceptions of confidence for coordinating and carrying out specific actions, and impacts whether that action is taken (Bandura, 1982). Self-efficacy is influenced by a person's performance history (i.e., "I have successfully climbed the stairs many times before") and self-statements (i.e., "I can overcome physical challenges"; Bandura, 1997). Inherent to this self-perception of capabilities is the notion that one's thoughts and perceptions regulate behaviour, which has been evidenced in diverse research domains highlighting the moderating effects of self-efficacy on physical, psychological, and cognitive performances (Bouazzaoui et al., 2016; Maly et al., 2006; Wurm et al., 2008). In fact, much of this research has found self-efficacy to be a better predictor of capabilities than one's actual capabilities (Chapman et al., 2014; Maly et al., 2006; Oh Park et al. 2011; Tiederman et al., 2007). In essence, maintaining high levels of self-efficacy fosters holistic health benefits, such as enhanced social networks, memory recall, faster walking speed, more engagement in physical activity, greater life satisfaction, less depressive symptoms, and higher quality of life (Maly et al., 2006; Perkins, Multhaup, Perkins, & Barton, 2007; Rippon, 2016).

While self-efficacy represents personal judgments of one's biopsychosocial capabilities, it is not immune to cultural influences, whereby stereotyped expectations regarding one's socialized status can cause continuous reappraisals of self-perceptions (Berg, Hassing, McClearn, & Johansson, 2006). One of the strongest predictors of negative self-efficacy reappraisal is increasing age, during which perceived age discrimination increases, and aging expectations and self-perceptions decline accordingly with implications for functional disengagement (Angus & Reeve, 2006; Rippon, 2016). As such, negative aging expectations and self-perceptions have been the subject of a growing field of work within stereotype research. Age-stereotypes and aging self-perceptions research has largely been dominated by cognitive-based studies testing older adults working memory performance (Lamont et al., 2015). Comparatively less work has focused on psychological and physical performance outcomes related to age-stereotypes and self-perceptions, despite “old age” being the most commonly reported cause of limitations in quality of life, physical functioning, and activities of daily living (Moser, Spagnoli, & Santos-Eggimann, 2011). Furthermore, Sarkisian and colleagues (2002) demonstrated that over 50 percent of older adults expect aging to be a process defined by dependency, aches and pains, and less energy. These kinds of expectations tend to act in a self-fulfilling and bi-directional manner, where reduced self-efficacy and negative aging self-perceptions predicts reduced physical functioning capacity, and vice versa (Rippon, 2016). This notion has been examined by cross-sectional and longitudinal research in older adults, highlighting that decreased self-efficacy and more negative perceptions of aging predicts short-term and long-term reductions in gait speed, grip strength, reaction time, and instrumental activities of daily living (activities not necessary for fundamental functioning, but foster independence; e.g., preparing meals; Levy et al., 2002a, 2014; Moser et al., 2011; Robertson et al., 2015; Sargeant-Cox et al., 2013). In turn, these physical declines effectively exacerbate the declines in self-efficacy that had originally been attributed to compromised functionality.

Stair navigation, a valid proxy measure for overall functioning that has been identified by older adults as the most difficult daily task to accomplish with age, has yet to be researched within age-stereotype contexts. It is estimated that older adult muscle strength declines as a function of normal age-related deterioration at an average rate of 10 percent per year after the age of 50 (Reeves et al., 2008). While these declines at a relatively early age have been found to be somewhat negligible with respect to walking, the same could not be concluded about actual and perceived stair navigation performances (Reeves et al., 2008). Due to normal age-related declines in muscle strength and joint range of motion, 45 percent of non-disabled older adults have reported difficulties climbing the stairs, and 30 percent reported difficulties during descent (Verghese et al., 2008). In recognition of these difficulties, healthy older adults tend to adopt compensatory stair navigation strategies that are not used by younger adults, such as slower stair navigation speed, stiffening muscles and joints, and employing effort close to maximal capacities (Benedetti et al., 2007). However, the use of these compensation strategies to enhance safe stair navigation have actually been found to put older adults at higher risk of further muscle and joint deterioration, stair falling, and related injuries and complications (Lee & Chou, 2007).

While self-efficacy has been found to moderate stair navigation speed and related balance measures (Maly et al., 2006; Rejeski et al., 1996), changes in self-efficacy have yet to be examined as the primary outcome when faced with a salient stereotype regarding this daily physical action that older adults often struggle to negotiate. Positive stereotypes regarding physical aging have been acknowledged (e.g., being more practiced); however, the vast majority of physical age-stereotypes focus on negative processes (e.g., weakness and frailty; Nelson, 2016). Given older adults are the largest and fastest growing segment of the population, and considering pervasive negative age-stereotypes in society primarily focus on the inevitability of physical decline (Lamont et al., 2015), it is timely and important to explore how older adult self-efficacy is influenced by these ubiquitous negative ideas of aging. To this end, the present study aims to examine the impact of age-stereotypes regarding stair navigation on stair-related self-efficacy. A secondary aim was to assess prime longevity to determine whether these stereotyped messages older adults receive during experimentation persist over time; a concept that has been consistently under-acknowledged within stereotype research despite the implications for older adults once removed from study (Lamont et al., 2015).

Methods

The present study examines the influence of stereotype priming on stair-specific self-efficacy before and after ascending and descending a set of five stairs in healthy community-dwelling older adults aged 50 years and above (N=90). In order to examine stereotype prime manipulation, 30 older adults were into a positive prime, negative prime, or a control group (no prime received). Stair self-efficacy, along with other psychological scales used as confounding variables, were completed one-week prior to the in-person assessment of stair navigation and re-completion of the baseline scales. The recruitment methods, screening process, and study procedure used for this sample are outlined in further detail within the General Methods and Manuscript one.

Primary outcome variable

Stair self-efficacy was measured using the Self-Efficacy for Stairs survey, which consistent of 16 items (8 items for self-efficacy for stair ascent and 8 items for self-efficacy for stair descent) measured on a 10-point scale ranging from no confidence (0) to complete confidence (10); Hamel & Cavanuagh, 2004). Self-efficacy for stair ascent (SESUp) was found to be a reliable measure at baseline as well as post-prime exposure (Cronbach's alpha baseline =

0.92; Cronbach's alpha post-prime = 0.93). Similar pre-post prime reliability were found for self-efficacy for stair descent (SESd; Cronbach's alpha baseline = 0.95; Cronbach's alpha post-prime = 0.94). The total score for SESUp and SESd reflects an average of the eight items for each scale, with higher scores (out of 10) representing greater self-efficacy for stair ascent and descent.

Confounding variables

As per the analyses and results within Manuscript one, the following confounding variables were validated for use and included in the analyses of SESUp and SESd: age, sex, number of medications, number of falls, GSE scores, FSE-I scores, and prime credibility (where appropriate). Stair ascent time and descent time (measured in seconds) were also included as confounding variables in predicting changes from baseline to post-prime SESUp and SESd scores.

Prime longevity

In order to explore prime longevity, a one month follow-up via e-mail was conducted whereby the 60 primed healthy participants (30 positively prime vs. 30 negatively primed) were asked to recall specific information presented to them within the stereotype prime articles. Of particular interest was recalling the prime group they were exposed to by answering, "Who is better at performing this activity of daily living?" For older adults who were exposed to the positive prime, the correct answer was “older adults”, whereas the correct answer for the negative prime exposure was “younger adults”.

Analyses

To test in-group differences, a repeated measures analysis of co-variance was conducted for both SESUp and SESd with significance set at $p \leq 0.05$. To test differences between prime groups, analyses of variance and co-variance were conducted, with Bonferroni post-hoc tests set with an adjustment for multiple comparisons at a *p*-value of 0.017. In addition, a hierarchical linear regression was conducted to test the model and relative associations of each variable regarding SESUp and SESd (using Unstandardized Beta values (B), 95% confidence intervals (CI), and significance set at $p \leq 0.05$). Last, a logistic regression was used to assess the likelihood of recalling the prime if older adults were previously exposed to the positive prime versus the negative prime (using exponentiated Beta values for odd ratios (OR), at the 95% confidence interval (CI), and significance set at $p \leq 0.05$).

Results

In total, 90 healthy participants aged 50 years and above were tested (M_{age} = 66.0 years ± 7.9 years, range: 50-83 years). Thirty participants were in each of the positive, negative, or control conditions. At follow-up, only the participants randomized into the positive and negative experimental groups were contacted to assess prime longevity (N=60). None of the groups’ demographic, health, and psychological variables was significantly different at baseline, indicating successful randomization (Table 4).

To examine whether SESUp and SESd changed from pre- to post-prime exposure within groups, a two by three repeated measures analysis of co-variance was performed. The results revealed a significant effect for prime group by time on mean SESUp scores ($F(2,87)=4.41$, $p=0.02$) while adjusting for age, sex, number of medications, number of falls, GSE scores, and FSE-I scores. This indicates that prime group had different effects on SESUp depending on which prime group participants were randomized into. To break down this interaction, contrasts were performed comparing the experimental prime groups to the control group who received no prime. This revealed a significant interaction when comparing the negative prime to the control group ($F(1,59)=12.82$, effect size=0.22). Although both the positive and control group seemingly improved from pre- to post-prime exposure, there was no statistically significant difference between their baseline and post-prime scores, nor were the positive and control groups significantly different from each other in their improvements. However, there was a significant interaction when comparing the negative prime group to the positive group ($F(1,59)=13.25$, effect size=0.25). Looking at the interaction graph, these effects reflect that being exposed to a negative prime significantly lowered older adults SESUp scores compared to older adults were exposed to a positive prime or no prime (Figure 4a).

Similar significant trends were observed for the repeated measures analysis of co-variance regarding SESd scores from baseline to post-prime exposure ($F(2,87)=4.10$, $p=0.03$) while adjusting for age, sex, number of medications, number of falls, GSE scores, and FSE-I scores. These results revealed that prime group significantly determined changes in SESd from baseline to post-prime exposure. Contrasts comparing the experimental prime groups to the control group revealed a significant interaction when comparing the negative prime to the control group (F(1,59)=9.62, effect size=0.19). While both positive and control groups descriptively enhanced their SESd scores from baseline to post-prime exposure, they were not significantly different regarding score improvement over time. However, a significant interaction effect was found when comparing the negative prime group to the positive group (F(1,59)=10.36, effect size=0.22). As highlighted by the interaction graph, being exposed to a negative prime significantly lowered SESd scores relative to older adults exposed to a positive prime or no prime (Figure 4b).

To expand upon these results, analyses of variance (ANOVA) and co-variance (ANCOVA) were conducted on SESUp and SESd post-prime scores between each prime group. These results are displayed in Table 5a and 5b. After adjusting for confounding variables, the ANCOVA model of between prime group differences for SESUp scores remained significant ($F(2,87)=10.91$, p=0.001, η^2=0.21). Bonferroni post-hoc tests revealed these results were driven by significant differences between the control group and the negative group ($M_{control}$ = 8.8±1.3 vs. $M_{negative}$ = 7.4±1.8, p=0.001), as well as significant differences between the positive and negative group ($M_{positive}$ = 8.9±1.0 vs. $M_{negative}$ = 7.4±1.8, p=0.001). The control and the positive group SESUp scores were not significantly different from each other post-prime (Table 5a). Similar trends were found regarding SESd scores. After adjusting for confounding variables, the ANCOVA model of between prime group differences for SESd scores remained significant ($F(2,87)=11.35$, p=0.001, η^2=0.21). Bonferroni post-hoc tests revealed these results were once again driven by significant differences between the control group and the negative group ($M_{control}$ = 8.7±1.3 vs. $M_{negative}$ = 7.1±1.8, p=0.001), as well as significant differences between the positive and negative group ($M_{positive}$ = 8.7±1.0 vs. $M_{negative}$ = 7.1±1.8, p=0.001). The control and the positive group SESd scores were not significantly different from each other post-prime (Table 5b). It is worth noting that interactions between all confounding variables and prime group were tested, but none emerged as significant.

To further assess the association between the positive and negative prime group and SES scores, linear regressions were conducted (Table 6a and 6b). In regards to SESUp post-prime, being in the positive prime group increased SESUp post-prime score by 12.8 percent after adjusting for confounding variables (B=1.28, p=0.001), which significantly accounted for 24.0 percent of the variance in SESUp scores after prime exposure (Table 6a). Similarly, SESd post-prime scores increased by 16.8 percent in the positively primed group after adjusting for confounding variables (B=1.68, p=0.001), accounting for 24.0 percent of the variance in SESd scores after prime exposure (Table 6b).

Finally, prime longevity was assessed by chi-squared analysis regarding correct recall rates within the positive and negative groups (Figure 5). The analysis revealed that those in the negatively primed condition reported correct recall significantly more than those in the positively primed group (63.3% vs. 46.7%, p=0.001). The logistic regression further revealed that those in the positive group were 25.0 times less likely to correctly recall the prime than those in the negative group (β=0.04, p=0.03; Table 7). The only other variable that was found to be significant in this analysis was article credibility. The regression revealed that for each unit increase in prime credibility rating, participants were 2.52 times more likely to recall the prime correctly (β=2.52, p=0.02). Given these results, a t-test was conducted testing the difference in prime credibility reported between the positively primed and negatively primed group. The results revealed that those exposed to the negative prime rated the article as significantly more credible than those in the positive prime group ($M_{positive} = 4.9 \pm 1.9$ vs. $M_{negative} = 8.2 \pm 1.5$, $t(58)=7.1$, $p=0.001$).

Discussion

The present study examined whether task-specific self-efficacy could be altered after exposure to a positive or negative task-specific explicit stereotype prime in healthy older adults. The results revealed that changes in baseline self-efficacy for stair ascent and descent scores were dependent on which prime condition participants were exposed to. Prime group accounted for over 20 percent of the variance in SESUp and SESd score changes from baseline to post-prime manipulation. Specifically, older adults who were negatively primed reported significantly lower self-efficacy for stair ascent and descent compared to older adults who were positively primed or not primed (i.e., controls). The results further revealed that self-efficacy for stair scores of older adults in the control and positive groups did not significantly change from baseline to post-prime exposure.

These results suggest that negative age-stereotype primes may have more influence on older adult task-specific self-efficacy than positive primes, which did not elicit any significant changes in stair self-efficacy. These findings have important implications for older adults considering negative stereotypes are understood to have short-term and long-term effects on physical, cognitive, physiological, and psychological well-being. Considering self-efficacy diminishes with age in accordance with ‘age-related’ biopsychosocial declines (Berg et al., 2006), the notion that self-efficacy may be further reappraised and compromised as a result of exposure to negative age-stereotypes is concerning. Negative perceptions as a result of continued negative stereotype embodiment have been reported in an abundance of stereotype research to significantly predict functional disability in later life (Buchner et al., 2016; Levy et al., 2014; Moser et al., 2011; Rippon, 2016; Robertson et al., 2015; Sargeant-Cox et al., 2013). Further research is warranted to investigate whether these changes in self-efficacy have the potential to influence actual stair navigation performance. The results also suggest that promoting positive depictions of aging may be an effective strategy for mitigating declines in task-specific self-efficacy associated with exposure to negative primes as SESUp and SESd scores did not significantly change for positively primed older adults.

The findings that the negative prime was more impactful on stair self-efficacy than the positive prime is perhaps not surprising considering previous experiments and meta-analyses have found negative primes elicit significantly greater effects on older adults behaviour outcomes compared to weak or no effects for positive priming (Hess et al., 2003; Horton et al., 2008; Lamont et al., 2015; Meisner, 2012). Theories explaining these effects highlight the pervasive nature of negative stereotypes within society, especially regarding physical and cognitive decline, compared to positive depictions of aging. Due to the seeming omnipresence of negative stereotypes, these ideas are internalized from a young age and continue to be engrained across the lifespan with increased exposure (Levy, 2008; Nelson, 2016; Seefeldt, 1977). Therefore, the typical ‘blueprint of aging’ tends to be defined as a process of biopsychosocial health decline, and when information is presented or experienced counter to this belief, it is often dismissed without further cognitive processing (Popham & Hess, 2015). Considering the present study used fact-based explicit primes, it is possible that the overt information presented was easily discernable as a positive depiction of aging which is counter to most age-related expectations. This notion may be further supported by the present findings regarding prime credibility and longevity as older adults who were positively primed rated the prime article as significantly less credible than the negative prime group, and were significantly less likely to remember the positive nature of the prime compared to the negative group. Generally, previous research has highlighted that when message credibility is compromised, the persuasiveness and attention to the information is significantly diminished (Pronpitakpan, 2004). Previous research has also found counter-stereotype information to mitigate negative perceptions of gender and race (Finnigan, Oakhill, & Garnham, 2015); therefore, these trends regarding the ineffectiveness of counter-stereotype information may be specific to age-related stereotypes and requires further research. Future work examining implicit and explicit stereotypes may also be warranted considering the mixed results as to which prime methodology is more impactful (Hess et al., 2004; Horton et al., 2008; Lamont et al., 2015; Meisner, 2012). Overt and explicit information depletes cognitive resources less than more ambiguous/implicit messages, which is theorized to be a mechanism that leads to narrowing attention and changes in performance outcomes (Lamont et al., 2015). Furthermore, while negatively primed older adults reported significantly lower self-efficacy for stairs compared to positively primed older adults, the positive prime group was significantly less likely to remember the positive nature of the prime they were exposed to (compared to negative prime recall regarding the negative nature of their prime). This may have implications for continued exposure to stereotype boosts in order to both promote memory retention of prime and psychological well-being over time, and warrants future longitudinal research.

Conclusion

The present study identified stair self-efficacy as a construct of psychological well-being that significantly declines with exposure to negative age-stereotypes pertaining to stair navigation in healthy older adults aged 50 years or greater. Further research is needed to consider how this change in self-efficacy can potentially moderate actual stair navigation performances. Findings from the present study also suggest that older adults exposed to the negative prime experienced significant reductions in stair self-efficacy compared to older adults exposed to the positive prime. Positive stereotypes should thus be further investigated as a protection strategy for potentially mitigating the influence of negative stereotypes on older adults. Notwithstanding, the present study addresses a recent call put forth regarding further examination of self-efficacy as an important outcome and independent predictor of behaviour in stereotype-outcome research (Lamont et al., 2015). The present study also extends stereotype research by proposing several questions that warrant further analyses in order to better understand current and prospective biopsychosocial functioning of older adults consistently exposed to pervasive negative stereotypes of aging in society.

Table 4. Descriptive statistics for older adults by prime group (N=90)

	Prime Group Mean (SD) or n (%)			
Variables	**Control (n=30)**	**Negative (n=30)**	**Positive (n=30)**	***p*-value**
Age (yrs)	65.6 (8.0)	68.7 (7.2)	63.7 (7.9)	0.08
Sex				
Male	15.0 (50.0)	14.0 (46.7)	14.0 (46.7)	0.95
Female	15.0 (50.0)	16.0 (53.3)	16.0 (53.3)	
Number of medications	0.8 (0.9)	1.3 (1.1)	1.0 (1.0)	0.06
Number of falls in past year	0.2 (0.5)	0.3 (0.5)	0.2 (0.5)	0.72
GSE	36.1 (3.3)	35.7 (3.2)	35.3 (3.9)	0.16
FSE-I	58.5 (4.7)	56.9 (6.8)	56.8 (6.8)	0.64
Stair ascent (sec)	4.5 (0.5)	4.7 (0.7)	3.9 (0.4)	0.001**
Stair descent (sec)	4.0 (0.5)	4.3 (0.7)	3.6 (0.6)	0.001**
Article credibility	-	8.2 (1.5)	4.9 (1.9)	0.001**
Prime recall	-	19.0 (63.3)	14.0 (46.7)	0.001**

Notes: ** significance $p \leq 0.017$; *p*-values from t-test, one-way ANOVAs or Chi-squared; GSE = general self-efficacy; FSE-I = falls self-efficacy; SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent

Table 5a. Between groups ANOVA and ANCOVA for SESUp across time by prime group (N=90)

	Prime Group			ANOVA Statistics				Bonferroni Post-hoc		
Variables	**Control (C; n=30)**	**Negative (N; n=30)**	**Positive (P; n=30)**	**F (2, 87)**	***p*-value**	**η^2**	**Model R^2**	**C x N**	**C x P**	**N x P**
Mean SESUp baseline (SD)	8.6 (1.4)	8.3 (1.6)	8.6 (1.1)	2.1	0.13	0.01	0.01	0.84	1.00	0.84
Mean SESUp post-prime[a] (SD)	8.9 (1.4)	7.3 (2.0)	9.0 (0.8)	13.1	0.01*	0.23	0.23	0.01*	1.00	0.01*
Mean SESUp post-prime[b] (SD)	8.8 (1.3)	7.4 (1.8)	8.9 (1.0)	10.9	0.01*	0.21	0.51	0.01*	0.73	0.01*

Notes: * significance $p \leq 0.017$; η^2 = effect size; SESUp = self-efficacy for stair ascent; [a]Model includes: prime group (η^2=0.23*); [b]Model includes: prime group (η^2=0.21*), age (η^2=0.05), sex (η^2=0.07), number of medications (η^2=0.006), number of falls (η^2=0.005), GSE (η^2=0.001), FSE-I (η^2=0.16*), duration upstairs (η^2=0.008)

Table 5b. Between groups ANOVA and ANCOVA for SESd across time by prime group (N=90)

	Prime Group			ANOVA Statistics				Bonferroni Post-hoc		
Variables	**Control (C; n=30)**	**Negative (N; n=30)**	**Positive (P; n=30)**	**F (2, 87)**	***p*-value**	**η^2**	**Model R^2**	**C x N**	**C x P**	**N x P**
Mean SESd baseline (SD)	8.6 (1.4)	8.3 (1.6)	8.6 (1.1)	3.5	0.06	0.07	0.07	0.96	1.00	0.96
Mean SESd post-prime[a] (SD)	8.9 (1.4)	7.3 (2.0)	9.0 (0.8)	13.0	0.01*	0.23	0.23	0.01*	1.00	0.01*
Mean SESd post-prime[b] (SD)	8.7 (1.3)	7.1 (1.8)	8.7 (1.0)	11.3	0.01*	0.21	0.53	0.01*	0.73	0.01*

Notes: * significance $p \leq 0.017$; η^2 = effect size; SESd = self-efficacy for stair decent; [a]Model includes: prime group (η^2=0.23*); [b]Model includes: prime group (η^2=0.21*), age (η^2=0.02), sex (η^2=0.10*), number of medications (η^2=0.01), number of falls (η^2=0.05), GSE (η^2=0.01), FSE-I (η^2=0.11*), duration downstairs (η^2=0.01)

Table 6a. Hierarchical linear regression for SESUp (N=60)

Model	Model R^2	Variables	B	SE	95% CI Lower Bound	95% CI Upper Bound	*p*-value
1	0.24**	Prime Group	1.73	0.40	0.93	2.53	0.001**
2	0.96**	Prime Group	1.28	0.22	0.84	1.72	0.001**
		Duration upstairs (sec)	-0.10	0.05	-0.20	-0.01	0.03*
		Article credibility	0.36	0.13	0.09	0.63	0.01**
		Age (years)	0.01	0.01	-0.02	0.03	0.68
		Sex	-0.22	0.16	-0.53	0.09	0.17
		Number of medications	-0.13	0.08	-0.28	0.03	0.10
		Falls in past year	0.71	0.16	0.38	1.03	0.001**
		GSE	0.05	0.02	0.01	0.09	0.02*
		FSE-I	-0.02	0.01	-0.05	0.00	0.10
		SESUp baseline	1.18	0.07	1.04	1.33	0.001**

Notes: ** significance $p \leq 0.01$, * significance $p \leq 0.05$; Prime group (0=negative, 1=positive); Sex (0=male, 1=female); B = unstandardized Beta values; SE = standard error; CI = confidence intervals; GSE = general self-efficacy; FSE-I = falls self-efficacy; SESUp = self-efficacy for stair ascent

Table 6b. Hierarchical linear regression for SESd (N=60)

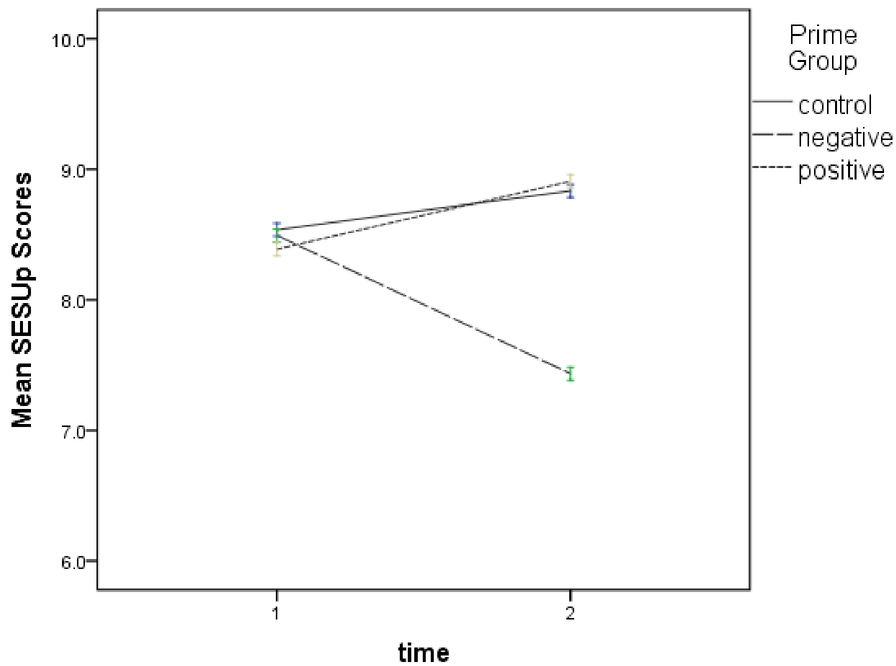
Model	Model R^2	**Variables**	**B**	**SE**	**95% CI Lower Bound**	**95% CI Upper Bound**	***p*-value**
1	0.24**	Prime Group	1.88	0.43	0.50	4.37	0.001**
2	0.86**	Prime Group	1.68	0.32	0.45	5.30	0.001**
		Duration downstairs (sec)	-0.09	0.18	0.03	0.48	0.63
		Article credibility	-0.02	0.07	-0.03	-0.31	0.76
		Age (years)	0.01	0.02	0.04	0.53	0.60
		Sex	-0.17	0.24	-0.04	-0.70	0.48
		Number of medications	-0.17	0.11	-0.10	-1.50	0.14
		Falls in past year	-0.07	0.23	-0.02	-0.32	0.75
		GSE	0.07	0.03	0.15	2.37	0.02*
		FSE-I	-0.01	0.02	-0.01	-0.16	0.87
		SESd baseline	1.04	0.11	0.71	9.63	0.01**

Notes: ** significance $p \leq 0.01$, * significance $p \leq 0.05$; B Prime group (0=negative, 1=positive); Sex (0=male, 1=female); B = unstandardized Beta values; SE = standard error; CI = confidence intervals; GSE = general self-efficacy; FSE-I = falls self-efficacy; SESd = self-efficacy for stair descent

Table 7. Logistic regression analysis for prime recall between prime groups

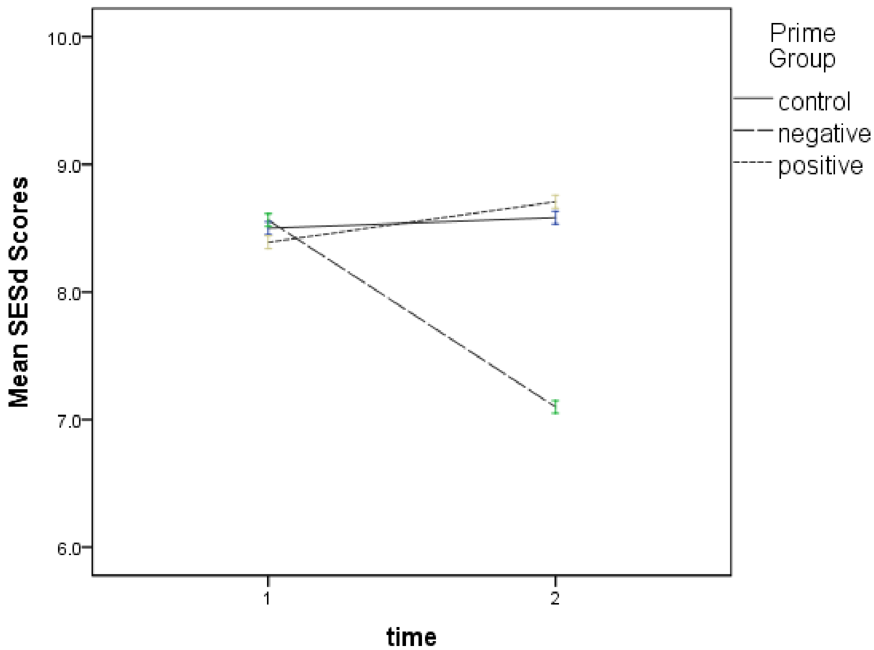
Variable	OR	95% CI Lower	95% CI Upper	*p*-value
Prime group	0.04	0.00	0.73	0.03*
SESUp post-prime	2.00	0.21	19.63	0.55
SESd post-prime	0.53	0.05	5.27	0.59
Article credibility	2.52	1.18	5.42	0.02*
Age	1.03	0.84	1.27	0.79
Sex	1.84	0.42	8.80	0.15
Number of medications	0.92	0.29	2.85	0.88
Falls in the past year	0.13	0.01	1.99	0.14
GSE	1.39	0.90	2.13	0.13
FSE-I	0.89	0.69	1.15	0.38

Notes: * significance $p \leq 0.05$; OR = odds ratio; CI = confidence interval; Prime recall (0=did not remember or incorrect, 1=remembered correctly); Prime group (0=negative, 1=positive); Sex (0=male, 1=female); SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent; GSE = general self-efficacy; FSE-I = falls self-efficacy



Notes: [b]Model adjusted for age, sex, number of medications, number of falls, GSE, and FSE-I

Figure 4a. Change in mean SESUp scores from pre- to post-prime exposure by prime group[b] (N=90)



Notes: [b]Model adjusted for age, sex, number of medications, number of falls, GSE, and FSE-I

Figure 4b. Change in mean SESd scores from pre- to post-prime exposure by prime group[b] (N=90)

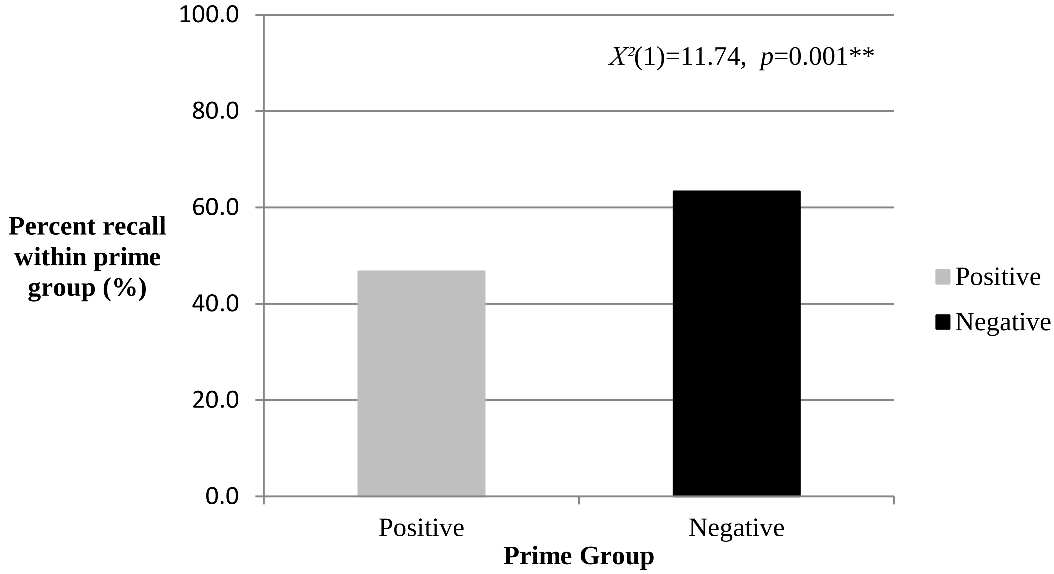


Figure 5. Percent recall of prime in healthy older adults (N=60)

Manuscript 3 - The influence of stereotype priming on stair navigation performance measures

Summary

With independence at the forefront, aging adults are faced with unique physical, psychological, and social challenges, which they must overcome while enveloped by a society that glamourizes youthfulness and devalues aging with negative stereotypes regarding inevitable decline. While research has begun to examine the effects of age stereotypes on the physical performances of older adults, no research has studied stair navigation, which is the activity of daily living most commonly reported as difficult to accomplish in older adults. The present study explored the effects of stereotype priming on stair navigation measures of speed and efficiency in older adults. The between groups analyses revealed that older adults who were positively primed ascended and descended the stairs significantly faster than older adults who received a negative prime or did not receive a prime. In addition, the positively primed group also displayed significantly higher trunk sway velocities in the medio-lateral plane, while moving their center of mass through the same amount of space as those who were negatively primed or in the control group during stair ascent and descent. These results suggest older adults who received a positive prime were able to navigate the stairs more quickly and efficiently than those who were negatively primed or did not receive a prime. Furthermore, regression analyses suggest that task-specific self-efficacy (i.e., self-efficacy for stairs) is an important variable potentially moderating the effects of stereotype priming on stair navigation. With implications for developing stereotype

interventions to improve older adult physical and psychological well-being, future work is necessary to corroborate the potential benefits of positive priming for stair navigation.

Introduction

Older adults are currently the largest and fastest growing segment of the population world-wide (Statistics Canada, 2012). These demographic shifts have raised economic and health care concerns, so much so that a mounting number of researchers now focus on how to facilitate “successful aging” (Martinson & Berridge, 2014). At its core, successful aging focuses on maintaining physical, cognitive, psychological and social well-being through independent functioning (Rowe & Kahn, 1998). Of utmost importance to maintaining functioning is accomplishing activities of daily living, which includes feeding, hygiene, and locomotion (Katz, 1983; Verghese et al., 2008). In particular, older adults report the most difficulties with stair navigation during both ascent and descent (Oh Park et al., 2011; Verghese et al., 2008). For this reason, stair navigation has been identified as a valid and significant independent predictor of present and prospective functional declines in older adults (Jacobs, 2016; Tiederman et al., 2007).

Stair navigation is a complex locomotor task requiring dynamic and continuous coordination among vestibular, visual, and somatosensory systems in order to successfully initiate action and monitor stability (Bosse et al., 2012; Oh Park et al., 2011; Reelick et al., 2009; Winter, 1995). Of particular importance is maintaining control over centre of mass movement via trunk sway during stair ascent and descent for older adults (Benedetti et al., 2007). Stair ascent requires powerful concentric contractions of knee, ankle, and hip joint-muscle groups to lift the body’s center of mass against the forces of gravity, while descent is mostly comprised of eccentric knee joint-muscle extensions, and hip muscle-joint abduction and internal rotation in order to lower the body’s center of mass in a controlled manner along with gravitational force.

While forward and backward movements and stabilizations of the centre of mass are inherently necessary during stair navigation, it is the medio-lateral planes that are of more concern considering uncontrolled sway in this plane is predictive of functional limitations and risk of falling (Benedetti et al., 2007; Maki, Holliday, & Topper, 1994). This is especially concerning given “age-related” muscle atrophy and joint deterioration that intensifies during aging, producing less force and range of motion from the muscles crossing the ankle, knee, and hip joints in older adults compared to younger adults (Buckley et al., 2013; Jacobs, 2016). These declines often force older adults to employ compensation strategies in order to maintain control over their centre of mass during stair navigation, which requires more muscle and joint effort near maximum physical capacities (Gill et al., 2001; Hortobgáyi et al., 2003; Nadeau et al., 2003; Reeves et al., 2008; Zietz et al., 2011). These effortful balance strategies also require using more cognitive resources to coordinate, effectively depleting gait resources more quickly, and leading to slower speed, fatigue, and increased risk of falling (Goble et al., 2009; Hortobgáyi et al., 2003).

Given the intricate nature of stair navigation, it can be a daunting experience for older adults, especially those who have formed negative self-perceptions of aging, which are accompanied by increased fear of falling and reductions in self-efficacy for daily functional tasks (Herman et al., 2009; Hadjistavropoulos e al., 2011; Oh Park et al., 2011; Reelick et al., 2009, 2009; Sneed & Whitbourne, 2005). Maintaining self-efficacy is of utmost importance considering it has been identified as a robust indicator of biopsychosocial functioning, and a proximal antecedent as to whether an action is chosen to be completed (Bandura, 1982; Oh Park et al., 2011; Nelson, 2016). While confronting these daily physical and psychological challenges, aging adults are also faced with unique social pressures that glamourize youthfulness and devalues aging with negative stereotypes (Sneed & Whitbourne, 2005). Older adults are inundated with negative stereotypes of aging (e.g., notions of being "frail" or "useless" with underpinnings of "inevitability"), which can further exacerbate changes in self-perceptions through self-efficacy (Nelson, 2016; Levy et al., 2012, 2014; Tiederman et al., 2007). This may be especially true in regards to physical tasks considering the most pervasive age stereotypes in society highlight negative associations between aging and general physical ability (Nelson, 2016). As such, a growing body of stereotype literature has explored how stereotype priming (exposing individuals to a stereotype stimulus to elicit a response) can influence an array of physical performance outcomes, including: grip strength, walking speed, sit-and-reach, reaction time, and functional limitations over time (Hausdorff et al., 1999; Horton et al., 2010; Levy et al., 2002, 2014; Robertson et al., 2015; Sargeant-Cox et al., 2013; Swift et al., 2012). The results of these studies have generally been mixed, with some reporting positive primes or *stereotype boost* (providing a stimulus and opportunity for older adults to confirm a positive stereotype regarding their age group) foster performance enhancements, whereas negative priming or *stereotype threat* (providing a stimulus and opportunity for older adults to confirm a negative stereotype regarding their age group) prompts performance declines, while some have found exposing older adults to stereotype manipulations has no effects on performance (Armenta, 2010; Chapman et al., 2014; Lamont et al., 2015; Stephan et al., 2013). In addition to the mixed findings, these studies have often failed to acknowledge the role of self-efficacy, and no studies have examined stair navigation. These inconsistencies have recently been recognized by Lamont and colleagues (2015) who advocated for more research on how stereotypes affect physical tasks as opposed to cognitive tasks, as well as the need to consider the role of self-efficacy as potentially influencing the relationship between stereotype exposure and performance outcomes.

Moreover, Jacobs (2016) recently put forth a different call for greater research regarding non-physical strategies that could potentially mitigate risky behaviours of stair navigation outside of laboratory settings. To this end, the present study aims to answer both these research calls by examining the influence of negative and positive stereotype priming on the stair navigation performance of older adults, while considering the role of task-specific self-efficacy.

Methods

The present study examines the effects of stereotype priming on the stair navigation measures of healthy community-dwelling older adults aged 50 years and above (N=90). Stair navigation was recorded after participants were randomly assigned to read a positive prime (n=30), negative prime (n=30), or no prime (control group did not receive a prime; n=30). All participants provided written consent one-week prior to participation after completing baseline demographic and psychological surveys. Consent was also collected after participants were de-briefed once re-completing the psychological surveys at the end of study. A comprehensive outline of participant recruitment, stair navigation and confounding measures collected, and study design are provided in the General Methods and Manuscript one.

Stair navigation measures

Five primary outcome variables were measured to assess centre of mass movement during both stair ascent and descent: duration (seconds), average roll angular deviation (degrees in 90% range), average roll angular velocity (degrees/second in 90% range), average pitch angular displacement (degrees in 90% range), and average pitch angular velocity (degrees/second in 90% range). The collection of measurements in the 90 percent range denotes removal of the bottom five percent and top five percent of angular movements to represent a more refined overall value of trunk sway that is less influenced by performance outliers. Of these collected measures, research has found task duration represents a proxy measure of overall stair locomotion as it is significantly associated with angular deviation and angular velocity, and has been identified as a robust independent indicator of stair navigation function and overall health (Allum & Carpenter, 2005; Allum, Carpenter, & Adkin, 2001; Gill et al., 2001).

Confounding variables

Several confounding variables were adjusted for within the analyses in accordance with the analyses and results of Manuscript one: age (years), time spent engaging in sedentary activities (hours/week), general self-efficacy (GSE), self-efficacy for stair ascent (SESUp), self-efficacy for stair descent (SESd), and prime article credibility (where appropriate). Of these confounding variables, SESUp and SESd were of particular interest as a potential moderator of stair navigation measures as per the results of Manuscript one which highlighted a significant interaction effect between prime group and SESUp, and prime group and SESd. Demographic variables that were analyzed and not found to be significantly associated with stair navigation in Manuscript one included: sex, education, income, occupational status, ethnicity, number of falls in the past year, number of medications currently taking, height, weight, and physical activity levels. In addition, general measures of psychological well-being and self-perceptions of aging such as self-confidence, self-esteem, attitudes towards own aging, and stigma consciousness, were also not significantly associated with stair navigation, and were therefore not included in the present analyses.

Analyses

Descriptive statistics were conducted, with one-way analyses of variance to test differences between prime groups at baseline or post-prime. In order to test between-group differences regarding stair navigation, analyses of co-variance were conducted for stair navigation measures of ascent and descent with Bonferroni post-hoc tests set with an adjusted *p*-value to indicate significant group comparisons at $p \leq 0.017$. In addition, a hierarchical linear regression was conducted for stair ascent and descent duration to examine the predictive value of prime group and self-efficacy for stairs (using Unstandardized Beta values (B), 95% confidence intervals (CI), and significance set at $p \leq 0.05$).

Results

Descriptive statistics for the study sample and confounding variables are displayed in Table 8. The groups did not differ across the demographic, health, and baseline psychological measures indicating successful randomization of participants between prime groups. The groups displayed significant differences across SESUp and SESd scores after being exposed to a positive or negative prime (or in the case of the control group, no prime; $F(2,87)=13.08$, *p*=0.001, Ƞ²=0.23). Regarding SESUp post-prime exposure, the negatively primed group reported significantly lower self-efficacy for stair ascent compared to the positive and control groups (*p*=0.001), while the positive and control group did not significantly differ from each other (*p*=1.00). Similar trends were found regarding SESd post-prime exposure; the negatively primed group reported significantly lower self-efficacy for stair descent compared to the positive and control groups (*p*=0.001), while the positive and control group did not differ from each other (*p*=1.00).

Table 9a displays the findings of the analyses of co-variance across prime groups regarding their stair navigation measures during ascent. The results revealed that only two measures of stair navigation for ascent were significantly different between groups after controlling for confounding variables, namely, duration for ascent (*F*(2,87)=5.6, *p*=0.001, Ƞ²=0.14) and roll velocity (*F*(2,87)=3.9, *p*=0.01, Ƞ²=0.12). The Bonferroni post-hoc tests (with adjusted *p*-value for significance) revealed that the positively primed group ascended the stairs significantly faster than the negative and control group ($M_{positive}$ = 3.9 seconds ± 0.4 seconds vs. $M_{negative}$ = 4.6 seconds ± 0.5 seconds and $M_{control}$ = 4.5 seconds ± 0.4 seconds, *p*=0.001). The negatively primed group and control group were not significantly different from each other regarding stair ascent duration (*p*=0.31). Moreover, the Bonferroni post-hoc tests revealed that the positively primed group had a significantly higher roll velocity compared to the negative and control group ($M_{positive}$ = 51.8 deg/sec ± 10.2 deg/sec vs. $M_{negative}$ = 41.8 deg/sec ± 8.2 deg/sec and $M_{control}$ = 40.2 deg/sec ± 9.3 deg/sec, *p*=0.01). It is worth noting that no significant interactions were found between the prime groups and any of the confounding variables.

In order to assess the predictive value of prime group and roll velocity for ascent duration, a hierarchical linear regression was conducted (Table 10a). These results highlight that the predictive value of prime group remained significant even while adjusting for confounding variables, and prime group accounted for 28.0 percent of the variance in ascent duration (p=0.001), which represents nearly half of the variance explained by the whole model (model 4, R^2=0.57, p=0.001). Specifically, older adults who were positively primed ascended the stairs 0.72 seconds faster than older adults who were negatively primed (p=0.001; model 1). However, this value changed (yet still remained significant) with the inclusion of SESUp post-prime scores in the final model, indicating older adults who were positively primed ascended the stairs 0.65 seconds faster than older adults who were negatively primed (p=0.008; model 4). Similar trends were observed regarding roll velocity during ascent, as the value changed while remaining significant from the first model to the final model in terms of the addition of SESUp. In the final model, for every degree per second velocity increases, older adults ascended the stairs 0.19 seconds faster (p=0.03, model 4). Considering the positive prime group reported significantly higher levels of SESUp after prime exposure compared to the negatively primed group, it also worth noting that SESUp remained a significant predictive variable in the final model for predicting ascent duration; for each unit of increase in SESUp scores after prime-exposure, older adults ascended the stairs 0.37 seconds faster (p=0.01).

Table 9b displays the findings of the analysis of co-variance across prime groups regarding their stair navigation measures during descent. These results similarly revealed that only two measures of stair navigation for descent were significantly different between groups after controlling for confounding variables, namely, duration for descent (F(2,87)=4.3, p=0.01, η^2=0.15) and roll velocity (F(2,87)=8.4, p=0.01, η^2=0.13). The Bonferroni post-hoc tests (with adjusted p-value for significance) revealed that the positively primed group descended the stairs significantly faster than the control and negatively primed group ($M_{positive}$ = 3.6 seconds ± 0.6

seconds vs. $M_{negative}$ = 4.1 seconds ± 0.5 seconds and $M_{control}$ = 4.0 seconds ± 0.5 seconds, *p*=0.001). The negatively primed group and control group were not significantly different from each other regarding stair descent duration (*p*=0.59). Moreover, the Bonferroni post-hoc tests revealed that the positively primed group had a significantly higher average roll velocity compared to the negative and control groups ($M_{positive}$ = 56.1 deg/sec ± 12.5 deg/sec vs. $M_{negative}$ = 43.6 deg/sec ± 6.4 deg/sec and $M_{control}$ = 50.1 deg/sec ± 10.1 deg/sec, *p*=0.01). No significant interactions were found between the prime groups and confounding variables.

In order to assess the predictive value of prime group and roll velocity for descent duration, a hierarchical linear regression was conducted (Table 10b). These results highlight that the predictive value of prime group remained significant even while adjusting for confounding variables. Prime group accounted for 22.0 percent of the variance in descent duration (*p*=0.01), which represents 35.5 percent of the variance explained by the whole model (model 4, R^2=0.62, *p*=0.001). Specifically, older adults who were positively primed descended the stairs 0.68 seconds faster than older adults who were negatively primed (*p*=0.001; model 1). However, this value changed (yet still remained significant) with the inclusion of SESd post-prime scores in the final model, indicating older adults who were positively primed descended the stairs 0.33 seconds faster than older adults who were negatively primed (*p*=0.01; model 4). Similar trends were observed regarding roll velocity during descent, as the value changed while remaining significant from the first model to the final model in terms of the addition of SESd. In the final model, for every degree per second velocity increases, older adults ascended the stairs 0.18 seconds faster (*p*=0.02, model 4). Considering the positive prime group reported significantly higher levels of SESd after prime exposure compared to the negatively primed group (Table 8), it worth noting that SESd remained a significant predictive variable in the final model for predicting descent duration; for each unit of increase in SESd scores after prime-exposure, older adults descended the stairs 0.10 seconds faster (*p*=0.05).

Discussion

The present study assessed the effects of exposure to a positive prime, negative prime or no prime on stair navigation. The results revealed that older adults who were positively primed ascended and descended the stairs significantly faster than their negatively primed and control group counterparts. The results suggest that the faster stair ascent and descent was accomplished with higher velocities in the roll plane during ascent and descent, but without significantly different angular deviations in either the pitch or roll planes. This indicates the older adults who were positively primed moved their centre of mass through the same amount of space in the medio-lateral direction as older adults who were negatively primed or did not receive a prime, however, positively primed older adults were moving through this space more quickly than the other groups. Generally, research has suggested that increases in angular velocity together with reductions in angular deviation are reflective of more efficient balance strategies during stair navigation (Allum & Carpenter, 2005; Allum et al., 2001; Gill et al., 2001). While angular roll velocities increased during both ascent and descent for positively primed older adults, there was no expected decrease in angular deviations relative to the other groups. This suggests a certain beneficial level of stair navigation efficiency was achieved in older adults related to swaying their trunks with seemingly less stiffness in the medial to lateral directions while accomplishing faster stair ascent and descent. This could be explained by negatively primed participants potentially being more concerned about falling during stair navigation as a function of stair self-efficacy reductions experiencing relative to their positively primed counterparts who did not report any significant changes in their self-efficacy for stairs. This could also be explained by increases in muscle power and joint motions of lower limbs (i.e., knee, hip, and ankle) that are not captured by the motion analysis system, which specifically focused on centre of mass deviations within the present study. Specifically in regards to medio-lateral trunk sway, research has found that the hip joint-muscle networks conducting abduction and adduction are more effortful than the knee-ankle joint-muscle networks for controlling movement of the centre of mass in this plane (Benedetti et al., 2007). These results suggest further research is required regarding hip joint-muscle range of motion and moments in older adults after being exposed to a stereotype threat or boost. Of particular interest may be power (velocity of force generation) at the hip as reductions in power influences the likelihood of developing a mobility limitation three times greater to that of declines in muscle strength (total force exerted; Bean et al., 2003). In addition, examining range of motion at the hip requires further work as hip joint mobility-restriction tends to decline by a larger degree than the knee joint between the ages of 30 to 70 years (30% hip vs. 5% knee; Loeser, 2010). Further to these findings, there were no significant differences found in terms of angular deviation or angular velocity in the pitch plane between prime groups for either stair ascent or descent. This in contrast to the significant differences found in roll angular velocity during both ascent and descent. These findings might be due to the fact that changes in medio-lateral sway are less conservative than those in the anterior-posterior pitch plane (Maki et al., 1994), suggesting that stereotype priming may influence specific aspects stair navigation in healthy older adults with implications of using stereotype priming to positively affect roll plane sway. This may be of particular importance considering roll plane sway has been found to be a better indicator of falling compared to changes in the anterior-posterior plane regarding the centre of mass (Maki et al., 1994).This speaks to the importance of maintaining hip mobility with age, which has been found to be a robust indicator of functional health and prospective disability (Bean et al., 2003; Loeser, 2010).

The present study also aimed to assess how potential changes in self-efficacy for stair ascent and descent post-prime (or no-prime) exposure can influence stair navigation measures. Considering prime self-efficacy remained a significant predictor of stair ascent and descent, and reduced the effects of prime group in the model, the results suggest that self-efficacy moderates the influence of prime group on stair navigation (where self-efficacy scores for the negative group were significantly lower post-prime exposure). Since negatively primed older adults reported significantly lower SESUp and SESd than positively primed older adults in the present study, this reduction in stair self-efficacy may explain why the negatively primed group and control group performed significantly slower stair ascent and descent, with seemingly more mechanical stiffness in the medio-lateral plane, compared to the positively primed group. These results are also indicative of a perceived stereotype threat-performance reduction trend, whereas a stereotype boost-performance enhancement trend was illustrated by positively primed older adults in terms of stair navigation (Armenta, 2010). This finding corroborates other research regarding the robust moderating effect of self-efficacy on physical performance outcomes, more so than other predictors included in analyses (Maly et al., 2006; Rejeski et al., 1996; Tiederman et al., 2007). It is interesting then that while positively primed older adults performed faster stair navigation than the control group, there were no significant differences between the positive group and the control group regarding their post-prime self-efficacies for stair ascent and descent. This suggests that while stereotype priming may have promoted statistically significant differences between group performances, these effects are quite subtle as reflected by the small to medium effect sizes found within the analyses. These results also highlight the need to use task-specific self-efficacy measures as SESUp and SESd remained significant predictors of stair ascent and descent duration, whereas more general measures of self-efficacy did not (i.e., GSE and FSE-I).

Considering this is the first study to examine the impact of stereotype priming on stair navigation, and one of the few studies to consider self-efficacy changes after exposure to stereotype priming, future research is necessary to corroborate the findings within the present study and further develop models related to how stereotype priming influences stair navigation and self-efficacy for stairs. Future research should also expand this testing method within diverse subsets of the aging population, especially for older adults diagnosed with “age-related” chronic conditions that may further influence mobility and self-efficacy decline, such as osteoarthritis (Jacobs, 2016; Maly et al., 2006). In addition, these results suggest that positive messages regarding aging can have benefits for both psychological and physical well-being in older adults, with implications for effective health messaging and strategies to combat negative age-stereotypes. The influence of positive stereotypes in enhancing stair navigation measures has substantial implications for mitigating balance impairment declines in self-efficacy for stairs in the way of mechanical stiffness and speed, which are significant predictor of negative health outcomes including mobility disability, falls, hospitalization, social isolation, poor quality of life, and early mortality that restrict the successful aging of older adults (Gill et al., 2001; Oh Park et al., 2011; Orendurff, Segal, Klute, & Berge, 2004).

Conclusion

Promotion of positive age-stereotypes may be the key to enhancing efficient stair navigation strategies in healthy older adults, while promoting task-specific self-efficacy may be the proximal antecedent to this attaining these benefits. While these results are intriguing, future research is necessary in order to corroborate and expand upon the present findings with the goal of developing a meaningful model of age stereotype-performance mechanisms for older adults. Future research is also warranted in older adults with mobility-related chronic conditions, who may be experiencing physical and psychological declines greater than those of healthy older adults. With these ideas in mind, using positive priming as a potential cognitive intervention to mitigate declines in physical health and psychological well-being of an older adult population expanding in number world-wide is both timely and crucial.

Table 8. Descriptive statistics for older adults by prime group (N=90)

Variables	Prime Group Mean (SD)			*p*-value
	Control (n=30)	Negative (n=30)	Positive (n=30)	
Age (yrs)	65.6 (8.0)	68.7 (7.2)	63.7 (7.9)	0.08
Sedentary activities (hrs/week)	67.0 (53.8)	55.5 (40.9)	44.1 (22.6)	0.13
GSE	36.1 (3.3)	35.7 (3.2)	35.3 (3.9)	0.16
SESUp baseline	8.6 (1.4)	8.3 (1.6)	8.6 (1.1)	0.13
SESUp post-prime	8.9 (1.4)	7.3 (2.0)	9.0 (0.8)	0.001*
SESd baseline	8.6 (1.4)	8.3 (1.6)	8.6 (1.1)	0.06
SESd post-prime	8.9 (1.4)	7.3 (2.0)	9.0 (0.8)	0.001*
Article credibility	-	8.2 (1.5)	4.9 (1.9)	0.001*

Notes: * significance $p \leq 0.017$; *p*-values from t-test, one-way ANOVA; GSE = general self-efficacy; SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent

Table 9a. ANOVA and ANCOVA for stair ascent navigation measures across prime group (N=90)

	Prime Group Mean (SD)			ANOVA Statistics			Bonferroni post-hoc		
Variables	**Control (C; n=30)**	**Negative (N; n=30)**	**Positive (P; n=30)**	**F(2,87)**	***p*-value**	**η^2**	**C x N**	**C x P**	**P x N**
Duration Up (sec)[a]	4.5 (0.4)	4.7 (0.7)	3.9 (0.4)	14.5	0.001*	0.25	0.59	0.001*	0.001*
Duration Up (sec)[b]	4.5 (0.4)	4.6 (0.5)	3.9 (0.4)	5.6	0.001*	0.14	0.31	0.004*	0.001*
Roll Deviation Up[a] (deg)	9.2 (3.3)	10.6 (2.3)	9.7 (2.8)	7.2	0.001*	0.14	0.001*	0.04	0.69
Roll Deviation Up[b] (deg)	9.6 (3.1)	10.0 (0.8)	10.0 (3.1)	2.4	0.06	0.02	0.06	0.10	0.80
Pitch Deviation Up[a] (deg)	14.3 (3.6)	13.2 (1.8)	11.9 (3.4)	4.8	0.01*	0.10	0.50	0.008*	0.29
Pitch Deviation Up[b] (deg)	14.0 (3.4)	13.0 (1.8)	13.2 (3.3)	1.6	0.22	0.04	0.94	1.00	1.00
Roll Velocity Up[a] (deg/sec)	40.9 (11.4)	44.3 (8.5)	49.5 (15.5)	7.0	0.002*	0.14	0.13	0.001*	0.02
Roll Velocity Up[b] (deg/sec)	40.2 (9.3)	41.8 (8.2)	51.8 (10.2)	3.9	0.01*	0.12	0.47	0.01*	0.01*
Pitch Velocity Up[a] (deg/sec)	75.8 (41.0)	64.1 (19.4)	78.0 (32.9)	1.6	0.21	0.04	0.50	1.00	0.30
Pitch Velocity Up[b] (deg/sec)	76.9 (41.0)	55.5 (22.1)	78.1 (32.9)	0.6	0.55	0.01	0.19	1.00	0.23

Notes: * significance $p \leq 0.017$; [a]Model includes: prime group. [b]Model includes: age, sedentary activities, GSE, SESUp baseline, SESUp post-prime

Table 9b. ANOVA and ANCOVA for stair descent navigation measures across prime group (N=90)

	Prime Group Mean (SD)			ANOVA Statistics			Bonferroni post-hoc		
Variables	**Control (C; n=30)**	**Negative (N; n=30)**	**Positive (P; n=30)**	**F(2,87)**	***p*-value**	**η²**	**C x N**	**C x P**	**P x N**
Duration Down (sec)[a]	4.0 (0.5)	4.3 (0.7)	3.6 (0.6)	9.4	0.001*	0.22	0.22	0.01*	0.001*
Duration Down (sec)[b]	4.0 (0.5)	4.4 (0.5)	3.6 (0.6)	4.3	0.01*	0.15	0.59	0.01*	0.01*
Roll Deviation Down[a] (deg)	6.1 (1.5)	7.3 (2.2)	6.7 (1.5)	3.9	0.07	0.08	0.02	0.42	0.59
Roll Deviation Down[b] (deg)	6.1 (1.5)	6.3 (1.6)	7.0 (2.0)	4.6	0.06	0.11	1.00	0.10	0.10
Pitch Deviation Down[a] (deg)	9.1 (1.6)	10.7 (2.6)	8.3 (2.0)	2.6	0.06	0.08	0.01*	0.36	0.36
Pitch Deviation Down[b] (deg)	9.3 (1.5)	10.6 (2.3)	8.3 (2.0)	1.2	0.08	0.05	0.33	0.38	0.34
Roll Velocity Down[a] (deg/sec)	51.9 (11.0)	49.1 (9.9)	55.2 (13.6)	10.6	0.01*	0.20	1.00	0.01*	0.001*
Roll Velocity Down[b] (deg/sec)	50.1 (10.1)	43.6 (6.4)	56.1 (12.5)	8.4	0.01*	0.13	0.07	0.01*	0.01*
Pitch Velocity Down[a] (deg/sec)	79.5 (26.4)	80.0 (33.0)	88.5 (28.9)	0.9	0.42	0.02	1.00	0.73	1.00
Pitch Velocity Down[b] (deg/sec)	82.0 (25.4)	80.2 (33.0)	87.0 (30.6)	0.8	0.46	0.02	1.00	0.31	0.56

Notes: * significance $p \leq 0.017$; [a]Model includes: prime group. [b]Model includes: age, sedentary activities, GSE, SESd baseline, SESd post-prime

Table 10a. Hierarchical linear regression for stair navigation ascent duration (N=60)

Model	Model R^2	Variables	B	SE	95% CI Lower Bound	95% CI Upper Bound	*p*-value
1	0.28**	Prime group	-0.72	0.24	-1.04	-0.42	0.001**
2	0.35*	Prime group	-0.70	0.24	-1.03	-0.45	0.001**
		Roll Velocity Up	-0.23	0.11	-0.41	-0.09	0.001*
3	0.44**	Prime group	-0.78	0.22	-1.31	-0.42	0.001**
		Roll Velocity Up	-0.22	0.17	-0.94	-0.12	0.01**
		SESUp baseline	-0.27	0.13	-0.54	-0.42	0.04*
		SESUp post-prime	-0.13	0.32	-0.31	-0.11	0.03*
4	0.57**	Prime group	-0.65	0.26	-1.23	-0.20	0.008**
		Roll Velocity Up	-0.19	0.08	-0.85	-0.05	0.03*
		SESUp baseline	-0.11	0.11	-0.35	-0.04	0.07
		SESUp post-prime	-0.37	0.14	-0.65	-0.08	0.01**
		Article credibility	0.06	0.01	0.15	-0.02	0.15
		Age	0.006	0.11	0.60	-0.02	0.60
		Sedentary activities	0.003	0.02	-0.26	0.07	0.26
		GSE	-0.04	0.01	0.04	-0.08	0.06

Notes: ** significance $p \leq 0.01$, * significance $p \leq 0.05$; Prime group (0=negative, 1=positive); B = unstandardized Beta values ; SE = standard error; CI = confidence intervals; GSE = general self-efficacy; SESUp = self-efficacy for stair ascent

Table 10b. Hierarchical linear regression for stair descent duration (N=60)

Model	Model R^2	Variables	B	SE	95% CI Lower Bound	95% CI Upper Bound	*p*-value
1	0.22**	Prime group	-0.68	0.17	-1.02	-0.33	0.001**
2	0.30*	Prime group	-0.67	0.17	-1.01	-0.27	0.001**
		Roll Velocity Down	-0.24	0.11	-0.51	-0.09	0.03*
3	0.45**	Prime group	-0.61	0.22	-1.11	-0.11	0.02*
		Roll Velocity Down	-0.20	0.08	-0.60	-0.09	0.03*
		SESd baseline	-0.13	0.14	-1.54	-0.41	0.03*
		SESd post-prime	-0.23	0.11	-1.31	-0.24	0.03*
4	0.62**	Prime group	-0.33	0.29	-1.76	-0.92	0.01**
		Roll Velocity Down	-0.18	0.10	-0.97	-0.12	0.02*
		SESd baseline	-0.04	0.02	-0.45	-0.01	0.06
		SESd post-prime	-0.10	0.04	-0.38	-0.02	0.05*
		Article credibility	0.06	0.05	-0.04	0.15	0.26
		Age	0.02	0.01	-0.01	0.04	0.15
		Sedentary activities	0.01	0.01	0.00	0.01	0.12
		GSE	-0.04	0.02	-0.08	0.01	0.12

Notes: ** significance $p \leq 0.01$, * significance $p \leq 0.05$; Prime group (0=negative, 1=positive); B = unstandardized Beta values; SE = standard error; CI = confidence intervals; GSE = general self-efficacy; SESd = self-efficacy for stair descent

Manuscript 4 - Comparing the effects of stereotype priming on stair navigation and related self-efficacy among healthy older adults and those with osteoarthritis

Summary

Osteoarthritis is the most commonly diagnosed “age-related” chronic condition and the number one cause of disability and dependency afflicting older adults worldwide. While older adults with osteoarthritis face physical challenges for accomplishing daily activities related to joint and muscle deterioration, this group is also forced to negotiate unique psychological challenges exacerbated by their health status, such as higher fear of falling and lower self-efficacy levels. This is especially true regarding stair navigation, which is the activity of daily living that older adults report the most difficulty accomplishing. In isolation, these declines in physical and psychological well-being are concerning; however, the potential role of social stigma and negative age stereotypes in encouraging these changes cannot be ignored. The present study aimed to compare older adults with osteoarthritis to same-aged healthy older adults regarding their self-efficacy for stairs and stair navigation performance after being exposed to a positive or negative stereotype prime. The results revealed that positively and negatively primed older adults with osteoarthritis were not significantly different in terms of declines in self-efficacy and cautious gait stair performances. Conversely, older adults with osteoarthritis who were positively primed appear to be at greater risk of compromised psychological and physical outcomes compared to healthy older adults receiving the same positive prime content. These findings suggest that standard methods of explicit stereotype priming may not be effective in eliciting similar performance outcomes in healthy adults compared to those with osteoarthritis,

and advocates for acknowledging intergroup suppression effects. This has implications for the use of stereotype priming and health messaging as a tool for potentially mitigating “age-related” declines.

Introduction

Osteoarthritis is the most commonly diagnosed “age-related” chronic condition afflicting over 50 percent of adults aged 65 or greater, and a robust predictor of disability and dissatisfaction in later life (Son & Kim, 2013; Wurm et al., 2008). Osteoarthritis is a degenerative joint disease defined by stiffening and inflamed joints, which can severely restrict accomplishing activities of daily living (Costigan et al., 2002; Hall et al., 2006; Jacobs, 2016; Son & Kim, 2013). Of all activities of daily living, older adults most often cite stair navigation (ascending and descending the stairs) as the most difficult to execute (Oh Park et al., 2011; Verghese et al., 2008). As a result, stair navigation ability has been identified as an independent predictor of present and prospective functional decline (Jacobs, 2016; Tiederman et al., 2007). Stair navigation is one of the most challenging and hazardous locomotor activities that older adults engage in, as it involves complex integration of higher order cortical centers connected to the peripheral and central nervous system. With both ascent and descent phases being performed near maximal joint and muscle capacities, stair navigation becomes increasingly harder to accomplish efficiently as aging progresses (Hortobgáyi et al., 2003; Jacobs, 2016; Winter, 1995).

Stair navigation can only be accomplished successfully when sufficient visual and vestibular information is continuously processed and sent to appropriate motor cortices to elicit movement initiation and adaptations to perturbations (Goble et al., 2009). However, integrating these perceptual systems in order to maintain balance becomes increasingly difficult with age. During stair ascent, older adults exhibit significantly less range of motion and muscle power in lower limbs (i.e., knee, ankle, and hip) compared to younger adults (Benedetti et al., 2007). Similar patterns have been observed for stair descent, as older adults generate less power and more effort in lower limbs compared to younger adults (Benedetti et al., 2007). This depletion of effort is often in conjunction with co-activating muscle groups, which places further strain on muscles and joints that are already working near maximal capacities. Compared to younger adults, this co-activation effectively slows stair navigation speed by stiffening muscles and joints, and usually causes increased hip moments that attempt to displace the centre of mass more conservatively in medio-lateral directions in order to propel movements (Buckley et al., 2013; Doslikova, 2015; Jacobs, 2016; Lee & Chou, 2007; Reid et al., 2007). This trend of smaller deviations in space along with slower speed is referred to as “cautious gait”, which may seem more controlled, but in actuality depletes physical and cognitive resources more quickly, leading to quicker fatigue, and increased risk of falling during stair navigation (Goble et al., 2009; Hortobgáyi et al., 2003). The joint stiffness and muscle degradation associated with osteoarthritis can further exacerbate these changes that occur with age, which encourages the employment of risky “cautious gait” compensation strategies (Asay et al., 2009; Whitchelo et al., 2014). These trends are particularly pronounced in those with knee osteoarthritis, the most common form of osteoarthritis in older adults (Litwic et al., 2013).

While accomplishing safe and efficient stair navigation is often constrained by osteoarthritis, these limitations can be further impaired by compromised psychological well-being, specific to preserving self-efficacy with age (Bosse et al., 2012; Delbaere et al., 2009; Hegeman et al., 2007; Jacobs, 2016; Winter, 1995). Self-efficacy represents individual beliefs in ability to accomplish a task via perceptions of personal capabilities, which are based on an assessment of previous experiences (performance accomplishments and vicarious experience), verbal persuasion (encouragement), and one’s physiological state (arousal and emotional reactions; Bandura, 1977, 1982). According to Bandura’s Social Cognitive Theory, situational self-efficacy is a function of interplay between personal/cognitive, environmental, and behavioural factors, and ultimately forms our beliefs regarding whether it is possible to successfully complete the action (Bandura, 1977). These beliefs have been found to be robust indicators of whether a task is undertaken or avoided (Bandura, 1982). Negative beliefs regarding perceived capabilities are not only influenced by self-perceptions, but also broader social perceptions and norms related to aging. Generally, the aging process has been depicted as a largely negative process involving inevitable physical, cognitive, and social decline within medical and popular media outlets (Hummert et. al, 1994; Lamont et al., 2015; Nelson, 2016; Seefeldt et al., 1997; Swift et al., 2010; Williamson & Fried, 1996). The consequences of consistently perpetuating these ideas within society have been found to occur once gaining salience during mid-life, when self-relevance is catalyzed after decades of integrating negative stereotypes without the psychological impetus to defend against these previously irrelevant depictions (Hummert et. al, 1994; Lamont et al., 2015; Levy, 2009). Previous research has shown that when these age stereotypes are stimulated, certain outcomes can be expected; namely, providing older adults with stereotype boost (a positive stereotype prime of aging and a subsequent performance opportunity to confirm the stereotype) can enhance performance, whereas stereotype threat (a negative stereotype prime of aging and a subsequent performance opportunity to confirm the stereotype) can negatively influence performance (Armenta, 2010; Coudin & Alexopoulos, 2010; Swift et al., 2012; Steele & Aronson, 1995). Older adult performance declines elicited in response to negative priming have been observed in diverse psychological, and cognitive measures, such as memory recall (Hess et al., 2003), hazard detection while driving (Chapman et al., 2014), life satisfaction (Wurm et al., 2008), mathematical reasoning (Levy, 2003), will to live (Levy et al., 2000), and extraversion (Moor, Zimprich, Schmitt, & Kliegel, 2006).

Comparatively, less research has focused upon the effects of negative stereotype priming on physical performances (Lamont et al., 2015; Levy, 2003). A recent meta-analysis of 32 publications examining age-based stereotype priming found only three publications had measured physical performance outcomes after exposure to a negative or positive prime (Lamont et al., 2015). Nevertheless, the literature that exists has highlighted that stereotype threat negatively influencing hand writing legibility (Levy et al., 2002a), grip strength (Stephan et al., 2013), cardiovascular functioning (Levy et al., 2000, 2006, 2008), and gait speed (Hausdorff et al., 1999; Levy, 2002a; Swift et al., 2012). Within this small body of literature, no research has explored stair navigation. Given the reported difficulties regarding performance and self-efficacy towards stair navigation in older adults, especially within older adults who have osteoarthritis, the implications of connecting these physical and psychological domains within the context of stereotype priming is both timely and necessary. Thus, the purpose of the present study was to examine the influence of stereotype priming on stair navigation performance and related self-efficacy in older adults with osteoarthritis compared to healthy older adults.

Methods

The present study examines the influence of stereotype priming on stair navigation and stair self-efficacy among community-dwelling older adults aged 50 years and above with osteoarthritis (n=40) and without osteoarthritis (“healthy” group; n=90; the same sample featured in Manuscript 1-3 for analyses). Recruitment and screening for eligibility followed the same methods utilized for the healthy sample of older adults, outlined thoroughly within the General Methods and Manuscript one (i.e., screened for vestibular, neurological, visual, and musculoskeletal diseases with the exception of having osteoarthritis, mobility aids, depressive symptoms and cognitive impairment). Similar to the healthy sample, older adults with osteoarthritis completed an on-line survey on their home computers that established baseline demographic variables as well as psychological questionnaires one-week prior to participation once deemed eligible. On participation day, older adults were unknowingly randomized into a positively primed (n=30 healthy; n=20 with osteoarthritis), negatively primed (n=30 healthy; n=20 with osteoarthritis), or control group (n=30 healthy). There was no control group for older adults with osteoarthritis. After reading the primes (found in Appendix B), or not receiving a prime in the case of the healthy control group, all participants were fitted with the Swaystar motion analysis system and performed two trials of stair ascent and descent on a stairwell located within a building at York University. Extensive information regarding stairwell characteristics and the Swaystar motion analysis system is provided in the General Methods and Manuscript one. After stair motion was recorded, all participants re-completed the psychological surveys from baseline on a computer located within the principal researcher's office. Written consent was collected prior to participation, as well as after study completion and de-briefing.

Of the 40 participants with osteoarthritis aged 50 years and above (M_{age} = 68.0 years ± 8.6 years, range: 50-81 years), 19 were male participants (57.5%), and all participants identified as Caucasian. Generally, the whole sample was found to be highly educated (87.5% post-secondary to graduate degree), from the middle-upper class (77.0% reporting income between $40-$80,000 per year), and split between working full-time (47.5%) or being retired (52.5%).

On the whole, 75 percent of the sample reported sedentary or inactive physical activity levels, with an average length of osteoarthritis diagnosis being 7.3 years (± 5.5 years). Moreover, total sample average osteoarthritis pain and symptoms scores were 31.0 (±20.7; scale of 0 to 100, with higher scores indicative of more pain) and 8.6 (±6.0; ranging from 0-32, with higher scores indicative of more functional impairment) respectively. While not purposefully recruited, all participants reported having knee osteoarthritis.

Of the 90 healthy participants featured in the analyses of Manuscript one, two, and three, the mean age was 66.0 years (±7.9 years), ranging from 50 to 83 years. The majority of the sample was retired (54.4%), highly educated (50.0% had achieved a post-secondary degree, while 30.0% had achieved a graduate degree), and reported being in the highest income brackets (63.4% reported total household earnings of $60,000 or greater). In addition, the majority of these older adults reported being sedentary or under-active (54.4%).

Stair navigation measures

In order to measure stair navigation in both healthy older adults and those with osteoarthritis, the Swaystar motion analysis system (Swaystar Balance International Innovations GmbH, Switzerland) provided five primary outcome variables that were measured to assess center of mass movement during both stair ascent and descent: duration (seconds), average roll angular deviation (degrees in 90% range), average roll angular velocity (degrees/second in 90% range), average pitch angular displacement (degrees in 90% range), and average pitch angular velocity (degrees/second in 90% range). Measuring the outcomes in the 90 percent range reflects the removal of the bottom five percent and top five percent of angular variables to reduce the influence of performance outliers in regards to trunk sway. Similar to analyses performed for the healthy sample of older adults, particular attention was given to ascent and descent duration as this measure has been acknowledged as a valid proxy representation of angular measures, and a more robust predictor of overall stair navigation functioning as well as older adult health compared to the angular measures (Allum & Carpenter, 2005; Allum, Carpenter, & Adkin, 2001; Gill et al., 2001).

Psychological measures

The primary psychological outcome variable was self-efficacy specific to stair navigation. Variables such as general self-efficacy, self-confidence, and self-esteem were collected as well given the association of these psychological constructs with task-specific self-efficacy (Baumiester, 1999). In addition, stereotype consciousness and self-perceptions of aging were also considered as a measure of understanding experiences with ageism and the influence these experiences may have on perceptions of aging (Levy, 2003; Pinel, 1999). Validated questionnaires from previous research were used to represent these psychological variables (all with Cronbach's alpha reliability measure ≥ 0.7). Similar to the healthy sample and the analyses found in Manuscript one, each scale was assessed for reliability (via Cronbach's alpha) and construct validity (via intra-class correlations) within sample of older with osteoarthritis. Each scale met the criteria for outliers (using interquartile ranges) and normality using principles of acceptable values for asymmetry and kurtosis (i.e., ranging between ±2; George & Mallery, 2010). These scales are found in Appendix A.

A) Task-specific self-efficacy was measured using the Self-Efficacy for Stairs, which is separated into self-efficacy for stair ascent (SESUp; 8 items) and self-efficacy for stair descent (SESd; 8 items; Hamel & Cavanuagh, 2004). Each of the eight items asked are the same for both SESUp and SESd with the only difference being the delineation of confidence for each facet of stair navigation asked while going up versus down the stairs. SESUp and SESd are both measured on a 10-point scale ranging from no confidence (0) to complete confidence (10), with higher scores being indicative of more self-efficacy for stair ascent or descent. SESUp and SESd are both totaled based on an average score of their respective eight items, with 10 being the highest score possible. SESUp was found to be statistically reliable for both healthy older adults and those with osteoarthritis at baseline and post-prime exposure (Cronbach's alpha baseline = 0.92 healthy, 0.96 osteoarthritis; Cronbach's alpha post-prime = 0.93 healthy, 0.97 osteoarthritis). The intra-class correlations further reinforce the scale validity given all items were correlated in convergent directions (ranging from 0.61-0.94). Similar reliability and validity outcomes were found for SESd (Cronbach's alpha baseline = 0.95 healthy, 0.95 osteoarthritis; Cronbach's alpha post-prime = 0.94 healthy, 0.95 osteoarthritis; item correlations ranging from 0.60-0.97).

B) The English Self-Confidence Scale (ESCS; 18 items, seven-point Likert scale ranging from completely agree to completely disagree; Johnson & McCoy, 2000) was used to assess self-confidence (beliefs in one's own decision-making and impressionability). The ESCS was found to be a reliable measure for healthy older adults and those with osteoarthritis at baseline and post-prime exposure (Cronbach's alpha baseline = 0.73

healthy, 0.71 osteoarthritis; Cronbach's alpha post-prime = 0.70 healthy, 0.71 osteoarthritis). In addition, the intra-class correlations suggest all items were correlated in convergent directions (ranging from 0.33-0.86). Higher scores (out of seven) are indicative of more general self-confidence.

C) The Rosenberg Self-Esteem Scale (RSES; 10 items, four-point scale ranging from strongly agree to strongly disagree; Rosenberg, 1965) was used for measuring self-esteem (emotional self-worth). The RSES was found to be a reliable measure for healthy older adults and those with osteoarthritis at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.85 healthy, 0.80 osteoarthritis; Cronbach's alpha post-prime = 0.88 healthy, 0.71 osteoarthritis). In addition, the intra-class correlations suggest that all items were correlated in convergent directions (ranging from 0.57-0.95). Higher scores (out of 40) are indicative of higher self-esteem levels.

D) General Self-Efficacy Scale was used to measure generalized self-efficacy related to one's beliefs in their ability to manage a diverse set of situations and tasks (GSE; Schwarzer & Jerusalem, 1995). Each of the 10-items within the GSE is measured on four-point scale ranging from not at all true to completely true. The GSE was found to be a statistically reliable for healthy older adults and those with osteoarthritis at baseline and post-prime exposure (Cronbach's alpha baseline = 0.92 healthy, 0.90 osteoarthritis; Cronbach's alpha post-prime = 0.89 healthy, 0.91 osteoarthritis. The intra-class correlations suggest scale validity given that all items were correlated in convergent directions (ranging from 0.72-0.95). Higher summative scores (out of 40) are indicative of having more general self-efficacy.

E) Self-Efficacy for Falls-International (FSE-I; Yardley et al., 2005) was used to measure fear of falling and one's confidence in not falling while accomplishing a diverse set of daily physical tasks. These 16 items were measured on a four-point scale ranging from very concerned to not at all concerned, with higher summative scores (out of 64) representative of more confidence in not falling and less fear of falling. FSE-I was found to be a statistically reliable measure for both healthy older adults and those with osteoarthritis at baseline as well as post-prime exposure (Cronbach's alpha baseline = 0.87 healthy, 0.89 osteoarthritis; Cronbach's alpha post-prime = 0.86 healthy, 0.90 osteoarthritis). The intra-class correlations reinforce scale validity given all items were correlated in convergent directions (ranging from 0.68-0.98).

F) The Stigma Consciousness Questionnaire (SCQ; 10 item, seven-point Likert scale ranging from strongly agree to strongly disagree; Pinel, 1999; Hess et al., 2009) was used to measure the extent to which a perceived stigmatized influences older adult daily interactions with younger adults and other older adults. The SCQ was found to be statistically reliable for both healthy older adults and those with osteoarthritis at baseline and post-prime exposure (Cronbach's alpha baseline = 0.76 healthy, 0.80 osteoarthritis; Cronbach's alpha post-prime = 0.75 healthy, 0.78 osteoarthritis). In addition, the intra-class correlations suggest scale validity given that all items were correlated in convergent directions (ranging from 0.43-0.85). Higher average scores (out of seven) are indicative of having experiencing greater age stigma.

G) Individualized perceptions of the aging process were measured using the Attitude Toward Own Aging Sub-Scale, which is a subset of five "yes" or "no" questions found within the Philadelphia Geriatric Center Morale Scale, with higher summative scores (out of 5) reflecting more positive perceptions of the aging process (ATOA; Lawton, 1975). ATOA was found to be a statistically reliable measure for healthy older adults and those with osteoarthritis at pre- and post-prime exposure (Cronbach's alpha baseline = 0.72 healthy, 0.70 osteoarthritis; Cronbach's alpha post-prime = 0.73 healthy, 0.73 osteoarthritis). Similar to the other scales, the intra-class correlations reinforced scale validity with all items correlated in convergent directions (ranging from 0.36-0.84).

Confounding variables

In congruence with previous stereotype, biomechanical, and osteoarthritis-related research, the following demographic and health information was collected for both healthy older adults and those with osteoarthritis at baseline: age, sex, weight, height, ethnicity, highest level of education, total household income, occupational status, number of medications currently being taken, the number of falls in the past year (Buchner et al., 2016; Chappell, 2003; Eto et al., 1998; Davis et al., 2009; Hegeman et al., 2007; Levy & Myers, 2004; Nelson, 2016; Robertson et al., 2015; Sargeant-Cox et al., 2013), sedentary hours per week (summative value of self-reported hours per week engaging in television viewing, computer use, reading, passive transportation, socializing, playing games/puzzles, and hobbies; Baron et al., 2007), self-reported physical activity levels (measured using the Rapid Assessment of Physical Activity; Topolski et al., 2006). Additionally, length of arthritis diagnosis, subjective arthritis pain currently experiencing (on a scale of 0 to 100, where 0 = no pain, and 100 = severe pain), and arthritis symptoms (measured via the 8 item WOMAC-SF, ranging from 0-32, with higher scores indicative of more functional impairment; Cronbach's alpha=0.87; Bilbao, Quintana, Escobar, Las Hayas, & Orive, 2011) were collected as confounding variables specific to older adults with osteoarthritis.

Similar to the development of a statistically meaningful exploratory model for testing stair navigation after prime exposure in healthy older adults featured in Manuscript one, the same methods were employed to construct the models to be used within the analyses for older adults with osteoarthritis. As such, bivariate correlational analyses (using Pearson r-values with significance set to $p \leq 0.05$) were conducted between the primary outcome variables (i.e., SESUp, SESd, stair ascent time, and stair descent time) and the confounding variables listed above to determine which variables would be included in the final statistical models (Table 11a, Table 11b, and Table 11c). Correlations among the primary outcomes and demographic/health variables are displayed in Table 11a. Age, occupational status, number of medications, number of falls in the past year, and physical activity levels were found to be significantly correlated with SESUp and SESd. Age, occupational status, and SESUp/SESd scores were also significantly associated with stair ascent and descent time. Table 11b highlights the significant correlations among characteristics of osteoarthritis (length of diagnosis, pain levels, symptoms level) and SESUp/SESd scores (but not with stair ascent and descent time). Finally, Table 11c displays the correlations among general psychological scales and the primary outcomes of interest. Significant and unacceptable levels of multicollinearity were found among the ESCS, RSES, and GSE ($r \geq 0.7$), which indicates that these variables are statistically similar constructs that would dull the respective influence of each scale. The GSE was chosen to represent the potential influence of these multicollinear scales as the GSE was the only scale of the three to be significantly correlated to all the primary outcome variables. The FSE-I also qualified for model inclusion as it was significantly associated to all the primary outcome variables (while the SCQ and ATOA were not significantly associated). Repeated measures analyses of variance revealed that the GSE and FSE-I scores did not significantly change from pre- to post-prime exposure. As a result, the average baseline scores of these scales were used as the confounding variables adjusted for in the models of analyses.

Stemming from these correlational analyses, the final exploratory models for analyzing SESUp and SESd post-prime scores were both found to have significant goodness of fit (SESUp: $F(11,28)=14.60$, $p=0.0001$; SESd: $F(11,28)=7.93$, $p=0.0001$), respectively explaining 85 and 75 percent of the variance in predicting SESUp and SESd. Similar significant findings for goodness of fit were found for the models of ascent and descent time (Ascent duration: $F(10,29)=4.97$, $p=0.001$; Descent duration: $F(10,29)=3.75$, $p=0.001$), respectively explaining 63 and 56 percent of the variance in stair ascent and descent task duration.

Stereotype prime

Features of the positive and negative primes provided for the healthy sample of older adults as well as those with osteoarthritis are outlined in the General Methods and Manuscript one, and can be found in Appendix B. The primes were created in the form of an on-line newspaper article, where the positive prime highlighted older adults being superior to younger adults in terms of stair navigation and the negative prime highlighted younger adult superiority.

To ensure the prime articles had been read and the information had been processed, all participants were asked to answer three questions regarding prime content: 1. What does the acronym ADL stand for? 2. Which ADL is thought to be the most important? 3. Who is better at performing this ADL? In answering these questions, only the response to the third question differed between groups; the positively primed should answer "older adults", whereas the negatively primed should answer "younger adults". In addition, manipulation checks were used to examine whether the prime articles elicited a perceived emotional response regarding age-related performance concerns (Marx & Stapel, 2006). This manipulation check included two questions (on a seven-point Likert scale ranging from not concerned at all to very concerned, with higher scores reflective of more concern): 1. Were you worried that your ability to perform well on the task was affected by your age? (referred to as personal concern), and 2. Were you worried that if you performed poorly on the task, the researcher would attribute your poor performance to your age? (referred to as researcher concern). After conducting a one-way analysis of variance across groups, all prime groups (i.e., healthy positive, healthy negative, osteoarthritis positive, and osteoarthritis negative) reported significantly higher personal and research concern compared to the control group ($F_{personal}(4,125)=13.30$, $p=0.001$; $F_{researcher}(4,125)=9.40$, $p=0.001$), indicating the stereotype primes were successful at eliciting an emotional response of concern. All participants who received a prime were also asked to rate the believability of the article content and source by ranking the perceived credibility on a 10-point scale, ranging from not credible at all (0) to very credible (10).

Analyses

Descriptive statistics were conducted using t-tests to assess differences in the positively and negatively primed osteoarthritis groups for baseline demographic and psychological variables as well as SESUp/SESd post-prime scores (significance set to $p \leq 0.05$). T-tests were also used to assess differences between the samples of older adults with osteoarthritis and healthy older adults regarding baseline demographic and psychological variables as well as SESUp/SESd post-prime (significance set to $p \leq 0.05$). To further examine the differences in SESUp and SESd post-prime scores across prime groups and osteoarthritis status (i.e., healthy participants vs. older adults with osteoarthritis), between groups analyses of co-variance (ANCOVA) were conducted with Bonferroni post-hoc tests (adjusted significance for comparison across five groups set to $p \leq 0.01$). Last, another set of between groups multivariate ANCOVA were conducted with Bonferroni post-hoc tests (adjusted significance for comparison across five groups set to $p \leq 0.01$) to assess the differences in stair ascent and descent navigation measures across prime groups and osteoarthritis status.

Results

Table 12a highlights the bivariate analyses conducted to assess randomization and group differences regarding baseline demographic, health, and psychological variables. The two prime groups did not significantly differ regarding these baseline variables, indicating successful randomization. Table 12a also highlights the non-significant t-test results regarding SESUp and SESd post-prime exposure, indicating that SESUp and SESd scores did not differ from each other between the positive and negative prime groups ($t_{SESUppost\text{-}prime}(38)=0.48$, $p=0.63$, $\eta^2=0.08$; $t_{SESdpost\text{-}prime}(38)=0.80$, $p=0.43$, $\eta^2=0.10$). A 2x2 (pre/post-prime vs. positive/negative prime group) repeated measures analysis of co-variance (adjusting for all confounding variables) also revealed no significant changes from baseline to post-prime exposure in either prime group for

SESUp. Further analyses revealed a non-significant interaction between prime group and time (F(1,38)=2.22, p=0.15, η^2=0.07; Figure 6a); however, there was a significant main effect for time (F(1,38)=47.71, p=0.001, η^2=0.56), which indicates that SESUp significantly declined from pre- to post-prime exposure regardless of whether older adults were exposed to a negative or positive prime (Figure 6a). Similar trends were observed for SESd; there was a significant main effect for time (F(1,38)=33.10, p=0.001, η^2=0.47), but no significant interaction effect between prime group and time (F(1,38)=2.00, p=0.17, η^2=0.05; Figure 6b).

Considering the osteoarthritis prime groups did not significantly differ from each other, a series of exploratory bivariate analyses were conducted in order to examine if older adults with knee osteoarthritis who were primed differed from older adults in the healthy population (Table 12b). Expectedly, Table 12b highlights that these two populations reported significantly different demographic, health, and psychological variables at baseline. Significant Levene's tests for equal variances revealed that these two groups had significantly different variances regarding their occupational status, physical activity levels, number of medications, number of falls in the past year, falls self-efficacy, and SESUp and SESd measures pre- and post-prime exposure ($p \leq 0.05$). Given the assumption of homogeneity of variances was violated when comparing these two populations, further exploratory analyses used corrected values in order to maintain conservative interpretation of findings. Further analyses were specifically conducted regarding the significant differences found between older adults in the experiment with and without osteoarthritis on SESUp and SESd scores post-prime exposure ($t_{SESUppost\text{-}prime}$(128)=-4.84, p=0.001, η^2=0.39; $t_{SESdpost\text{-}prime}$(128)=-4.61, p=0.001, η^2=0.38). Moreover, the exploratory bivariate analyses comparing older adults with and without osteoarthritis on stair navigation measures are highlighted in Table 12c. The results illustrated in Table 12c indicate that older adults with and without osteoarthritis were significantly different in their stair navigation performance measures, with effect sizes ranging from small to large. These results generally indicate that older adults with osteoarthritis performed stair ascent and descent slower than healthy older adults, with significantly smaller angular deviations and significantly slower angular velocities in pitch and roll planes. Given these trends, further multivariate analyses were conducted in order to determine the potential effects of prime group on SES and stair navigation measures between these two samples.

Since the assumption of homogeneity of variance was violated, the analyses of co-variance conducted across all groups used Games-Howell post-hoc tests for non-parametric analyses (with an adjusted *p*-value for significance set to $p \leq 0.01$). Parallel analyses using Bonferroni post-hoc tests with adjusted significance were also conducted. The parametric tests revealed the same results as the non-parametric tests, suggesting convergent validity between statistical methods, and therefore, Bonferroni post-hoc tests were used for analyses of co-variance across the prime groups for SESUp post-prime and SESd post-prime scores (Table 13). In regards to SESUp, prime group significantly explained 21 percent of the variance in SESUp post-prime scores. Specifically, the negatively primed healthy group and the positively primed osteoarthritis group reported significantly lower scores than all other groups ($p \leq 0.01$), and were not significantly different from each other ($p \geq 0.01$). Similar trends were found for SESd, where prime group significantly explained 25 percent of the variance in SESd post-prime scores. Again, the negatively primed healthy group and the positively primed osteoarthritis group reported significantly lower scores than all other groups ($p \leq 0.01$), and were not significantly different from each other ($p \geq 0.01$).

A multivariate analysis of co-variance was further conducted regarding stair navigation measures for ascent and descent across prime groups and osteoarthritis status (Table 14a and 14b). The significant multivariate model regarding prime group and stair ascent suggested further univariate analyses of each stair navigation ascent measure were warranted ($F(20,472)=4.70$, $p=0.001$, $\eta^2=0.17$, pillai's trace=0.66). The analyses revealed that the positively primed group of healthy older adults ascended the stairs significantly faster than all other groups ($p\leq0.01$). The positively primed and negatively primed osteoarthritis groups had significantly smaller roll angular deviations compared to the healthy positive and negative prime groups ($p\leq0.01$). This was displayed in congruence with significantly slower roll angular velocities during stair ascent compared to the healthy positive and negative prime groups ($p\leq0.01$). Similar trends were observed in terms of smaller pitch angular deviations in the positively primed and negatively primed osteoarthritis groups compared to healthy positive and negative prime groups ($p\leq0.01$); however, there were no significant group differences found in pitch angular velocity for ascending the stairs.

The multivariate model regarding prime group and stair descent was also found to be significant, warranting further univariate analyses of each stair navigation descent measure ($F(20,472)=3.13$, $p=0.001$, $\eta^2=0.14$, pillai's trace=0.47). The analyses revealed that the positively primed group of healthy older adults descended the stairs significantly faster than all other groups ($p\leq0.01$). The positively primed and negatively primed osteoarthritis groups had significantly smaller roll angular deviations compared to the healthy positive and negative prime groups during stair descent ($p\leq0.01$). This was accomplished while having significantly slower roll angular velocities during stair descent compared to the healthy positive prime group ($p\leq0.01$), but not healthy negative prime group ($p\geq0.01$). Similar trends were observed in terms of smaller pitch angular deviations in the positively primed and negatively primed osteoarthritis groups compared to healthy positive and negative prime groups during descent ($p \leq 0.01$); however, there were no significant group differences found in pitch angular velocity for descending the stairs.

Discussion

The present study assessed the influence of stereotype priming on stair navigation measures and stair self-efficacy in older adults with and without osteoarthritis. The results indicated that self-efficacy for stairs declined in older adults with osteoarthritis regardless of whether they were exposed to a positive or negative prime. This decline after exposure to the prime was not significantly different between the two groups, suggesting both groups of older adults reported reductions in their stair self-efficacy to a similar extent. This finding suggests potential suppressor effects, whereby older adults living with osteoarthritis are negatively influenced by any stereotypes as reflected in the suppressed self-efficacy scores at baseline compared to the healthy older adult groups. Previous research has indicated that suppressor effects are often caused by heightened sensitivity prior to testing given one's health status; since older adults with osteoarthritis are experiencing both age and disease related stigma, the influence of explicit priming on eliciting a conscious psychological response (i.e., stair self-efficacy) would effectively be suppressed by pre-existing and multiplicative disease and age stigma (Clarke & Korotchenko, 2011; Hubbard et al., 2012; Kemp & Mosqueda, 2007; Sheets, 2005). This may also explain why stair navigation measures were not significantly different between the positively and negatively primed osteoarthritis groups, considering both groups of older adults reported significantly lower self-efficacy for stair ascent and descent over time.

Once adjusting for covariates in the analyses of self-efficacy for stair ascent and descent scores between groups, some unexpected trends were revealed. Specifically, the negatively primed healthy older adults and positively primed older adults with osteoarthritis reported significantly lower levels of SESUp and SESd compared to the control, positively primed healthy, and negatively primed osteoarthritis groups of older adults. This suggests that negatively priming healthy older adults and positively priming older adults with osteoarthritis leads to similar outcomes, although likely operating under different stereotype prime-performance mechanisms. The SESUp and SESd decline in negatively primed older adults can be explained by stereotype threat literature, which suggests that while older adults may be desensitized to negative stereotypes given how pervasive they are within society, negative stereotypes are consistent with general negative beliefs regarding the aging process, which tend to worsen over time with increasing exposure (Levy, 2003; Levy et al., 2002, 2014, 2016; Moser et al., 2011; Ng et al., 2016). As these perceptions of aging become more negative over time, functional health and cognitive well-being have been found to decline in congruent fashion (Allen, 2015; Lamont et al., 2015; Nelson, 2016; Robertson et al., 2015). These ideas also contribute to the connection of negative stereotypes to the Weathering Hypothesis, which posits that chronic exposure to physical, psychological, or social stress can cause bodily and cognitive deterioration over time (Allen, 2015; Geronimus, 1992). For this reason, it is reasonable to say that negative stereotypes may be more impactful than positive explicit stereotypes, given negative stereotypes better fit with generalized beliefs regarding aging and inevitability of decline (Hess et al., 2003; Lamont et al., 2015; Mesiner, 2012).

The question then remains, if negative stereotypes are more pervasive and impactful than positive stereotypes regarding self-perception and self-efficacy related declines, why did the positively primed group of older adults with osteoarthritis report similar declines in SESUp and SESd to healthy older adults who were negatively primed (after adjusting for confounding variables)? This could be attributed to unexpected counter effects that can often occur when attempting to elicit a stereotype boost with information that is overtly counter to generalized negative beliefs about aging. Counter information is often dismissed without further processing in order to preserve cognitive resources (Popham & Hess, 2015). Considering the present study used fact-based explicit primes, it is possible that the overt information presented was easily processed as a positive depiction of aging that is counter to most age-related perceptions and expectations. This may be especially true for older adults with osteoarthritis, given that osteoarthritis is the most common “age-related” chronic condition that limits biopsychosocial functional health. While this information is also counter to older adults who are healthy, older adults who were positively primed did not report any changes in their self-efficacy for stairs, and performed stair navigation ascent and descent with more speed relative to the negatively primed healthy older adults and positively primed group of older adults with osteoarthritis. This suggests that while the positive stereotype prime may be easily discernable as counter-information to populations of older adults with a physical chronic condition, this may not be the same for healthy older adults. Given that the explicit prime was specific to the physical task of stair navigation, and healthy older adults were not experiencing any physical limitations, it is possible that stereotype boost works best for enhancing the performance of healthy older adults, compared to those with osteoarthritis. This is an idea that has yet to be considered by previous research since no research has compared healthy older adults and older adults with osteoarthritis on their performances after different forms of stereotype exposure. Considering older adults in the stereotype threat condition displayed diminished stair self-efficacy compared to those in the boost wherein self-efficacy levels did not change, this has implications for potentially mitigating declines in self-efficacy that tend to occur with advancing age, increased exposure to negative stereotypes, and changes in aging self-perceptions (Bouazzaoui et al., 2016; Cohen et al., 2007; Levy et al., 2014; Warmoth, Tarrant, Abraham, & Lang, 2016). Thus, further research is necessary in order to develop these findings, which could have implications for how age-related information is presented to healthy older adults versus those with osteoarthritis (i.e., broad physical activity guidelines for "seniors").

While reductions in self-efficacy for stairs were observed in both the negatively primed group and positively primed group of older adults with osteoarthritis, both of these groups also performed stair navigation differently than the healthy older adult groups. Specifically, primed older adults with osteoarthritis exhibited duration, angular deviations, and angular velocities in the pitch and roll planes during ascent and descent that were reflective of "cautious gait". This pattern was indicated by the significantly smaller ranges of medio-lateral and anterio-posterior angular deviations in conjunction with significantly slower velocity displayed in the medio-lateral plane during ascent and descent. Older adults with lower stair self-efficacy often adopt compensation strategies that include co-contracting and stiffening muscles and joints in order to reduce trunk displacement and produce slower velocities (Allum & Carpenter, 2005; Reid et al., 2011). Despite seeming more "controlled", this process depletes physical and cognitive resources more quickly, effectively increasing risk of falling for older adults (Jacobs, 2016; Oh Park et al., 2011). Considering the changes in visual, somatosensory, and cognitive resources related to safe and efficient stair navigation that tends to occur with age (e.g., less visual acuity, reduced muscle strength and power, reduced proprioception senses, and reduced joint mobility; Gill et al., 2001; Hortobgáyi et al., 2003; Nadeau et al., 2003; Reeves et al., 2008; Winter, 1995; Zietz et al., 2011), it is likely that these physical declines are especially exacerbated in older adults with knee osteoarthritis who are also experiencing age- and disease-related stigma that diminishes their task self-efficacy. Joint stiffness and muscle degradation associated with knee osteoarthritis (even in mild cases) exaggerates knee-ankle extension and flexion limitations in power and range of motion that tends to occur with age, which effectively promotes more effortful compensatory strategies at the hip in order to control the centre of mass during stair navigation (Asay et al., 2009; Hicks-Little et al., 2012; Whitchelo et al., 2014). These adaptations put further strain on muscle-joint and cognitive systems already working near maximal capacities, after which point the likelihood of sustaining an injury and related-complication significantly increases (Ambrose et al., 2013; Davis et al., 2009; Hadjistavropoulos et al., 2011; Jacobs, 2016). These findings are of particular concern, given research has found cautious gait to be indicative of functional decline at three years follow-up (Oh Park et al., 2011). Therefore, future research needs to further develop our understanding of how stereotype content can influence cautious gait compensatory strategies often adopted by both healthy older adults and those with osteoarthritis. The present study suggests that while positive priming for healthy older adults may work to mitigate declines in stair self-efficacy and performance measures, the same cannot be said about older adults with osteoarthritis who often experience psychosocial “double jeopardy” of age and disease stigma as well as “normal” age-related reductions in physical functioning required to accomplish stair navigation with age. Further research is thus warranted to examine whether the influences of stereotype priming are constantly suppressed in older adults with osteoarthritis regardless of stereotype content, or if these trends suggested by the present findings are specific to stereotype prime material in the physical domain of aging.

Conclusion

The present study examined a novel performance outcome, psychological outcome, and experimental group that have yet to be researched within stereotype literature. While the findings suggest a stereotype boost effect can occur for healthy older adults, the same cannot be assumed for older adults with a chronic physical condition, specifically, osteoarthritis. Given older adults represent the largest and fastest growing segment of the population, and osteoarthritis is the most common chronic condition diagnosed among this group, more research is necessary regarding the pervasiveness of negative stereotypes in society, and how positive stereotypes can be used to potentially mitigate biopsychosocial declines that are associated with negative stereotype embodiment. In addition, future research needs to examine explicit stereotype priming in more diverse health domains (e.g., cognitive vs. physical vs. social), as well as more diverse populations of healthy and non-healthy older adults, in order to develop a better understanding of how stereotype threat and boost can operate with maximum potency within these contexts. The implications of gaining such understanding could relay widespread health benefits to older adults during a time when facilitating “successful aging” continues to gain both mainstream and research popularity.

Table 11a. Correlations among primary outcomes and demographic and health variables (N=40)

	Age (1)	Sex (2)	Occ. status (3)	Education (4)	Income (5)	Height (6)	Weight (7)	Meds (8)	Falls (9)	PA level (10)	SA (11)	SESUp (12)	SESd (13)	Ascent time (14)	Descent time (15)
1	-	0.01	0.75*	0.05	0.02	-0.15	-0.25	0.29	0.29	-0.40*	0.12	0.77*	0.60*	0.46*	0.46*
2		-	0.10	0.09	0.29	-0.73*	-0.78*	-0.29	-0.01	0.17	0.05	-0.01	-0.10	0.20	0.17
3			-	-0.14	0.07	-0.10	-0.18	0.28	0.27	-0.28	0.16	-0.67*	-0.62*	0.42*	0.44*
4				-	-0.22	0.02	-0.21	-0.14	-0.40*	0.14	0.11	0.23	0.28	0.03	-0.05
5					-	-0.22	-0.25	-0.28	0.12	0.45*	0.51*	0.01	-0.09	-0.01	0.12
6						-	0.85*	0.23	0.01	0.12	0.08	0.17	0.23	-0.30	-0.33*
7							-	0.34*	0.09	-0.05	-0.09	0.13	0.14	-0.27	-0.28
8								-	0.51*	-0.53*	-0.05	-0.51*	-0.56*	0.13	0.07
9									-	-0.40*	0.16	-0.51*	-0.63*	-0.04	-0.11
10										-	0.34*	0.40*	0.37*	0.07	0.08
11											-	-0.03	-0.18	-0.15	-0.06
12												-	0.86*	-0.59*	-0.55*
13													-	-0.47*	-0.44*
14														-	0.93*
15															-

Notes: * significance at $p \leq 0.05$; Sex (0=male, 1 = female); Occ. status = occupational status; Meds = number of medications; Falls = falls in the past year; PA level = physical activity level; SA = sedentary activities; SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent

Table 11b. Correlations among outcome and osteoarthritis variables (N=40)

	Length of diagnosis (1)	Arthritis pain (2)	Arthritis symptoms score (3)	SESUp (4)	SESd (5)	Ascent time (6)	Descent time (7)
1	-	0.47*	0.41*	-0.45*	-0.47*	0.07	0.09
2		-	0.76*	-0.59*	-0.64*	0.04	0.08
3			-	-0.70*	-0.72*	0.24	0.16
4				-	0.86*	-0.59*	-0.55*
5					-	-0.47*	-0.44*
6						-	0.93*
7							-

Notes: * significance at $p \leq 0.05$; SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent

Table 11c. Correlations among outcome and psychological variables (N=40)

	ESCS (1)	RSES (2)	GSE (3)	ATOA (4)	SCQ (5)	FSE-I (6)	SESUp (7)	SESd (8)	Ascent time (9)	Descent time (10)
1	-	0.74*	0.77*	-0.34*	-0.57*	0.61*	0.70*	0.81*	-0.36*	-0.31*
2		-	0.75*	0.29	-0.51*	0.45*	0.25	0.47*	-0.12	-0.12
3			-	-0.40*	-0.21	0.59*	0.85*	0.88*	-0.52*	-0.52*
4				-	-0.20	0.22	-0.21	-0.24	0.06	0.14
5					-	-0.50*	-0.23	-0.47*	0.08	0.05
6						-	0.74*	0.79*	-0.40*	-0.31*
7							-	0.86*	-0.59*	-0.55*
8								-	-0.47*	-0.44*
9									-	0.93*
10										-

Notes: * significance at $p \leq 0.05$; ESCS = English self-confidence scale; RSES = Rosenberg self-esteem scale; GSE = General self-efficacy; ATOA = Attitudes towards own aging; SCQ = Stereotype consciousness questionnaire; FSE-I = Falls self-efficacy scale; SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent

Table 12a. Descriptive statistics for older adults with osteoarthritis by prime group (N=40)

Variables	**Prime Group Mean (SD) or n (%)** OA Negative (n=20)	OA Positive (n=20)	***p*-value**
Age (yrs)	68.0 (8.8)	68.2 (8.8)	0.94
Occupational status			
Working full-time	9.0 (47.4)	10.0 (52.6)	0.95
Retired	11.0 (52.4)	10.0 (47.6)	
Number of medications	2.2 (1.3)	2.2 (1.2)	0.78
Number of falls in past year	0.7 (0.7)	0.6 (0.8)	0.53
Physical activity levels			
Sedentary	8.0 (40.0)	7.0 (35.0)	
Inactive	6.0 (30.0)	9.0 (45.0)	0.59
Active	6.0 (30.0)	4.0 (20.0)	
Length of diagnosis (yrs)	6.5 (5.4)	8.4 (6.1)	0.18
Arthritis pain levels	29.1 (19.8)	32.9 (21.9)	0.56
Arthritis symptoms score	8.4 (6.2)	8.8 (5.9)	0.80
GSE	34.5 (3.9)	35.3 (3.6)	0.51
FSE-I	59.2 (5.3)	57.9 (7.1)	0.53
SESUp baseline	7.6 (2.8)	8.0 (2.0)	0.14
SESUp post-prime	6.7 (2.2)	6.3 (2.2)	0.62
SESd baseline	7.6 (2.0)	7.6 (2.1)	0.92
SESd post-prime	6.5 (2.0)	6.0 (2.3)	0.47
Article credibility	7.5 (1.9)	4.5 (2.5)	0.01*

Notes: * significance $p \leq 0.05$; *p*-values from t-test or Chi-squared; GSE = general self-efficacy; FSE-I = falls self-efficacy; SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent; OA=osteoarthritis

Table 12b. Descriptive statistics for older adults with and without osteoarthritis (N=130)

	Prime Group Mean (SD) or n (%)		
Variables	**OA (n=40)**	**Healthy (n=90)**	***p*-value**
Age (yrs)	68.1 (8.6)	66.0 (7.9)	0.18
Occupational status			
Working full-time	19.0 (47.5)	24.0 (26.7)	
Working part-time	0.0 (0.0)	17.0 (18.9)	0.004*
Retired	21.0 (52.5)	49.0 (54.4)	
Number of medications	2.2 (1.2)	1.0 (1.0)	0.001*
Number of falls in past year	0.6 (0.7)	0.2 (0.5)	0.001*
Physical activity levels			
Sedentary	15.0 (37.5)	13.0 (14.4)	
Inactive	15.0 (37.5)	36.0 (40.0)	0.007*
Active	10.0 (25.0)	41.0 (45.6)	
GSE	34.9 (3.7)	35.5 (3.7)	0.37
FSE-I	60.6 (6.2)	56.8 (6.8)	0.05*
SESUp baseline	7.8 (2.0)	8.5 (1.5)	0.03*
SESUp post-prime	6.5 (2.2)	8.4 (1.5)	0.001*
SESd baseline	7.6 (2.0)	8.4 (1.5)	0.003*
SESd post-prime	6.3 (2.2)	8.1 (1.8)	0.001*

Notes: *significance $p \leq 0.05$; *p*-values from t-test or Chi-squared; GSE = general self-efficacy; FSE-I = falls self-efficacy; SESUp = self-efficacy for stair ascent; SESd = self-efficacy for stair descent; OA=osteoarthritis

Table 12c. Stair navigation measures for older adults with and without osteoarthritis (N=130)

	Prime Group Mean (SD)			
Variables	**OA (n=40)**	**Healthy (n=90)**	***p*-value**	**η^2**
Duration up (sec)	4.8 (1.1)	4.4 (0.6)	0.03*	0.20
Roll angular deviation up (deg)	8.1 (2.0)	9.4 (3.0)	0.005*	0.24
Roll angular velocity up (deg/sec)	39.7 (8.0)	43.9 (12.9)	0.03*	0.20
Pitch angular deviation up (deg)	13.1 (2.9)	9.2 (3.2)	0.004*	0.25
Pitch angular velocity up (deg/sec)	77.6 (21.1)	80.6 (32.5)	0.09	0.08
Duration down (sec)	4.4 (1.3)	4.0 (0.7)	0.05*	0.16
Roll angular deviation down (deg)	7.3 (2.6)	6.7 (1.8)	0.04*	0.11
Roll angular velocity down (deg/sec)	43.5 (10.6)	50.4 (11.5)	0.001*	0.28
Pitch angular deviation down (deg)	11.8 (2.5)	9.4 (2.3)	0.001*	0.41
Pitch angular velocity down (deg/sec)	82.7 (29.5)	86.0 (25.5)	0.17	0.01

Notes: * significance $p \leq 0.05$; η^2 = effect size; OA=osteoarthritis

Table 13. Between groups ANCOVA for SESUp and SESd across time by prime group and osteoarthritis status (N=130)

	Prime Group & Bonferroni post-hoc					ANOVA Statistics		
Variables	**Control (C; n=30)**	**Negative (N; n=30)**	**Positive (P; n=30)**	**Negative OA (NOA; n=20)**	**Positive OA (POA; n=20)**	***F* (4, 125)**	***p*-value**	**Ƞ2**
Mean SESUp post-prime[a] (SD)	8.6[N,POA] (1.4)	7.0[C,P,NOA] (2.0)	8.6[N,POA] (0.8)	7.7[N,POA] (2.2)	7.1[C,P,NOA] (2.2)	7.1	0.001*	0.21
Mean SESd post-prime[b] (SD)	8.5[N,POA] (1.4)	7.0[C,P,NOA] (2.0)	8.4[N,POA] (0.8)	7.7[N,POA] (2.0)	6.8[C,P,NOA] (2.3)	9.0	0.001*	0.25

Notes: letters representative of each prime group indicate significant post-hoc differences at $p \leq 0.01$ level; Ƞ2 = effect size; SESUp = self-efficacy for stair ascent; [a]Model includes: prime group (Ƞ2=0.21*), age (Ƞ2=0.002), occupational status (Ƞ2=0.002), physical activity level (Ƞ2=0.0001), number of medications (Ƞ2=0.003), number of falls (Ƞ2=0.001), GSE (Ƞ2=0.007), FSE-I (Ƞ2=0.002), length of arthritis diagnosis (Ƞ2=0.03), arthritis pain level (Ƞ2=0.04), arthritis symptoms score (Ƞ2=0.003), SESUpbaseline*prime group (Ƞ2=0.68), Model R^2=0.89, p=0.001; [b]Model includes: prime group (Ƞ2=0.25*), age (Ƞ2=0.02), occupational status (Ƞ2=0.0001), physical activity levels (Ƞ2=0.0001), number of medications (Ƞ2=0.03), number of falls (Ƞ2=0.06), GSE (Ƞ2=0.002), FSE-I (Ƞ2=0.001), length of arthritis diagnosis (Ƞ2=0.02), arthritis pain level (Ƞ2=0.02), arthritis symptoms score (Ƞ2=0.0001), SESdbaseline*prime group (Ƞ2=0.61), Model R^2=0.85, p=0.001

Table 14a. ANCOVA for stair ascent navigation measures across prime group and osteoarthritis status (N=130)

	Prime Group Mean (SD) & Bonferroni post-hoc					ANOVA Statistics		
Variables	**Control (C; n=30)**	**Negative (N; n=30)**	**Positive (P; n=30)**	**Negative OA (NOA; n=20)**	**Positive OA (POA; n=20)**	***F*(4, 125)**	***p*-value**	**η²**
Duration Up (sec)	4.5^{P} (0.4)	4.7^{P} (0.7)	3.9^{C,N,NOA,POA} (0.4)	4.6^{P} (0.5)	4.8^{P} (0.3)	4.2	0.003*	0.18
Roll Deviation Up (deg)	8.5 (3.3)	10.3^{NOA} (2.3)	10.3^{NOA,POA} (2.8)	7.3^{N,P} (2.4)	8.0^{N,P} (2.1)	6.0	0.001*	0.14
Pitch Deviation Up (deg)	14.6^{NOA} (3.6)	12.8^{NOA} (1.8)	12.6^{NOA} (3.4)	10.9^{C,N,P} (2.2)	12.4^{P} (3.1)	6.2	0.01*	0.16
Roll Velocity Up (deg/sec)	37.6^{P} (11.4)	44.6^{P,NOA,POA} (8.5)	50.7^{C,N,NOA,POA} (15.5)	39.7^{N,P} (10.2)	37.3^{N,P} (13.6)	6.5	0.002*	0.14
Pitch Velocity Up (deg/sec)	70.8 (41.0)	65.6 (19.4)	73.0 (32.9)	70.3 (22.7)	64.3 (31.5)	1.3	0.29	0.04

Notes: letters representative of each prime group indicate significant post-hoc differences at $p \leq 0.01$ level; Model includes: prime group, age, occupational status, GSE, FSE-I, SESUp baseline, SESUp post-prime; Model $R^2=0.45$, $p=0.001$

Table 14b. ANCOVA for stair descent navigation measures across prime group and osteoarthritis status (N=130)

	Prime Group Mean (SD) & Bonferroni post-hoc					**ANOVA Statistics**		
Variables	**Control (C; n=30)**	**Negative (N; n=30)**	**Positive (P; n=30)**	**Negative OA (NOA; n=20)**	**Positive OA (POA; n=20)**	***F*(4, 125)**	***p*-value**	**η²**
Duration Down (sec)	4.1[P,NOA] (0.4)	4.2[P] (0.7)	3.7[C,N,NOA,POA] (0.4)	4.1[C,P] (0.4)	4.3[P] (0.5)	1.3	0.04	0.11
Roll Deviation Down (deg)	6.5 (3.3)	7.0[NOA,POA] (2.3)	7.2[NOA,POA] (2.8)	6.6[N,P] (2.4)	6.5[N,P] (2.2)	5.4	0.01*	0.13
Pitch Deviation Down (deg)	9.3[POA] (3.6)	9.2[NOA,POA] (1.8)	8.5[NOA,POA] (3.4)	10.9[N,P] (2.3)	12.4[C,N,P] (2.9)	7.3	0.01*	0.12
Roll Velocity Down (deg/sec)	48.9 (11.4)	45.3[P] (8.5)	51.3[N,NOA,POA] (15.5)	45.6[P] (12.4)	43.9[P] (14.7)	6.4	0.01*	0.13
Pitch Velocity Down (deg/sec)	71.8 (41.0)	70.1 (19.4)	74.0 (32.9)	73.2 (30.8)	69.4 (24.3)	1.4	0.35	0.04

Notes: letters representative of each prime group indicate significant post-hoc differences at $p \leq 0.01$ level; Model includes: prime group, age, occupational status, GSE, FSE-I, SESd baseline, SESd post-prime; Model $R^2=0.41$, $p=0.001$

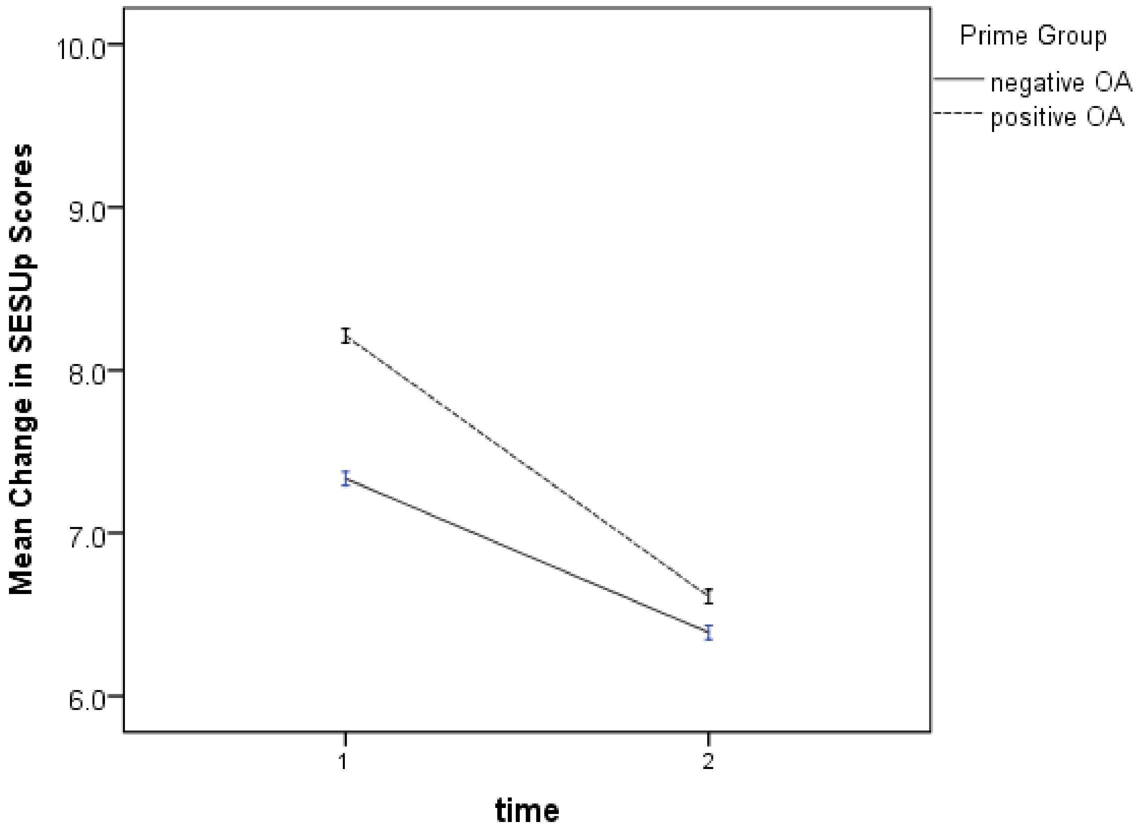


Figure 6a. Changes in mean SESUp scores among prime groups over time for older adults with osteoarthritis (N=40)

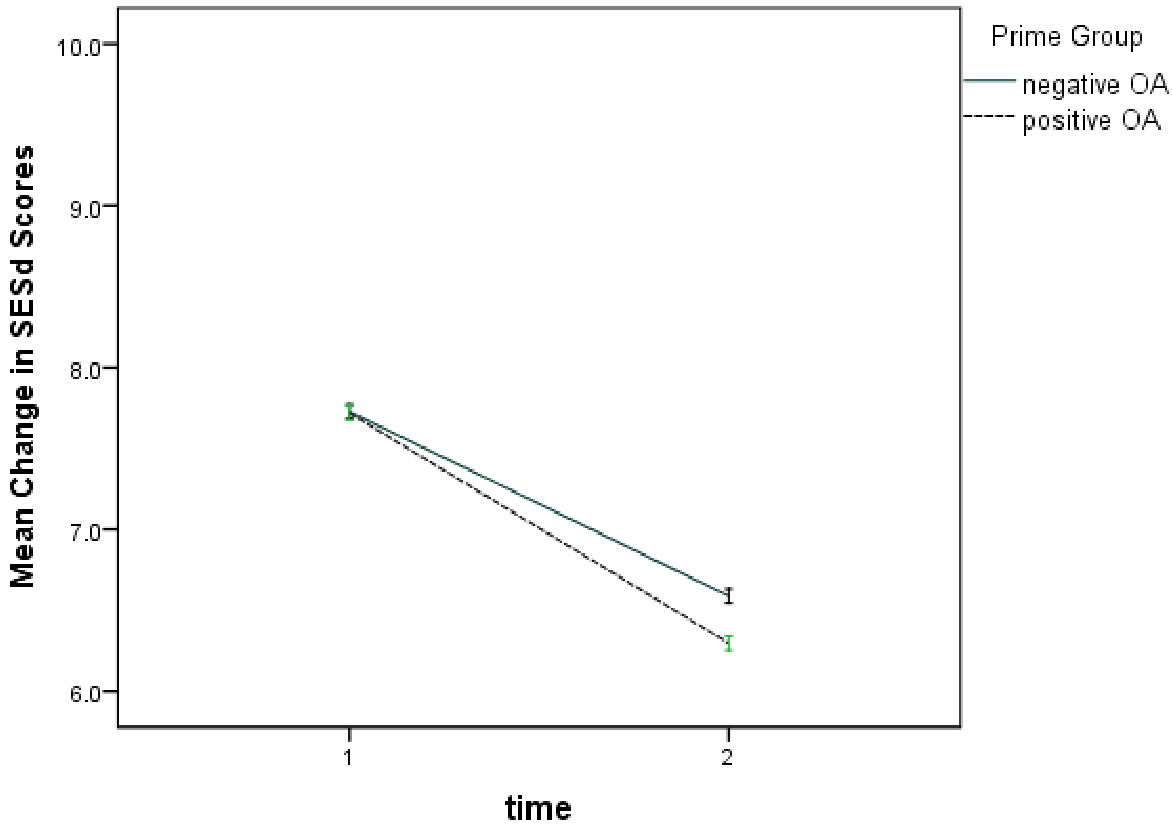


Figure 6b. Changes in mean SESd scores among prime groups over time for older adults with osteoarthritis (N=40)

General Discussion

The present studies considered the influence of task specific stereotype priming on stair-specific self-efficacy and stair navigation performance, a research domain that has yet to be explored in previous research. Overall, the manuscripts act as independent yet inherently connected segments towards the development and progression of analyzing this novel research objective.

Streamlining the research process

The results of manuscript one suggested an exploratory model for conducting stereotype research and analyses. Part of the development of this model was acknowledging the usefulness of task-specificity in terms of psychological outcomes and prime content. In optimizing research practice within this new domain, the model considered variables that were not necessarily statistically meaningful when assessing and predicting the influence of stereotype priming on a stair navigation and related self-efficacy. These considerations were three-fold: 1. Identifying multicollinearity among confounding variables to be removed prior to analyses in order to reduce potential wash-out effects, which can inflate type II error rates, 2. Identifying the value of using task-specific measures as opposed to general measures regarding self-efficacy, and 3. Testing for effectiveness of the constructed task-specific primes.

In congruence with considerations one and two, general psychological variables that are often used synonymously with self-efficacy (self-confidence and self-esteem; Rosenberg et al., 1995), were found to reach statistically unacceptable levels of multicollinearity with GSE

(Pearson r≥0.7 between ESCS, RSES, and GSE, $p \leq 0.05$). These results indicated that these scales were essentially measuring the same constructs and would likely statistically wash-out the potential of their individual effects regarding the primary outcomes. GSE was chosen as the representative scale within the analyses. However, none of the "general" scales (i.e., ESCS, RSES, GSE, FSE-I) were found to significantly change from baseline to post prime exposure, while manuscript two revealed that stair-specific self-efficacy was manipulated by the prime. These findings are in line with Bandura's research that has disregarded the notion of "general" or "global" self-efficacy having any predictive power related to performance outcomes, given that task-specificity is inherent to the definition of self-efficacy (Bandura, 2005). This may also explain why the SCQ and ATOA did not qualify for integration into the final model; while both are valid predictors of experiences with negative ageism and aging self-perceptions, neither of these measures are specific to the prime content and performance outcome regarding stair navigation. The results supported this method of variable elimination as the final models had acceptable goodness of fit indices and accounted for a significantly large amount of variance in the outcome measures (i.e., over 80% of the variance in SESUp and SESd). The same methods were employed in the development of the exploratory models of analyses for older adults with osteoarthritis, and similarly revealed significantly large amounts of variance were accounted for in each model.

In congruence with consideration three, manipulation checks were used in order examine whether the prime articles elicited a perceived concern from threat or boost regarding stair navigation, which has often been overlooked in previous research. The manipulation checks in the present studies revealed that older adults receiving either the positive prime article or negative prime article reported significantly higher personal concern regarding their age affecting their stair performance as well as significantly higher concern that the researcher would attribute a poor stair navigation performance to their age. The two levels of concern were significantly higher in all experimental groups (i.e., healthy positive, healthy negative, osteoarthritis positive, and osteoarthritis negative) compared to the control group. While these results are promising given the careful construction of the stereotype primes to elicit some kind of emotional reaction, the present work did not include a measure of perception of prime content (i.e., if the participants actually thought the positive prime had a positive tone/message; Horton et al., 2010). Previous research has found that this may be an important variable in determining the effectiveness of priming, and should be considered in future research.

Moreover, the prime was rated significantly more credible by older adults who were negatively primed in both the healthy and osteoarthritis groups compared to the positively primed groups. Additionally, prime credibility was significantly associated with the likelihood of recalling the prime information after a one-month follow-up for the healthy-primed older adults. Generally, previous research has highlighted that lower perceived-message credibility is associated with information that is counter to normalized thought and is therefore less persuasive and less thoroughly processed (Pronpitakpan, 2004). While previous research has also found that counter-stereotype information can potentially be used to mitigate sexism and racism (Finnigan et al., 2015), it appears that these trends may not be applicable to ageism. This warrants further research, especially within older adults who suffer from osteoarthritis or compromised health statuses, as suppressor effects may alter the positive influence of stereotype boost on task-specific self-efficacy that was observed for healthy positively primed older adults (Hubbard et al., 2012; Kemp & Mosqueda, 2007; Sheets & Liebig, 2005). These suppressor effects may have stemmed from a combination of stereotype embodiment that occurs over time as well as multiplicative stigma associated with having a chronic condition in older age. A suppression effect may also explain why negatively primed older adults with osteoarthritis reported significantly higher self-efficacy for stair scores post-prime exposure compared to the negatively primed older adults who have identified as “healthy”. Simultaneously experiencing disease- and age- “double jeopardy” has the potential to dull sensitivity to stereotype priming since these older adults may have reached a threshold at which positive stereotypes are actually perceived as negative if they are non-congruent with health status context (Sargeant-Cox et al., 2013; Ridgeway, 2001). Considering the complex and individualized nature of “double jeopardy”, further research is necessary regarding the intersection of disease and age, and the potential influence this has on task self-efficacy and accomplishing activities of daily living over time (Kemp & Mosqueda, 2004; Sheets & Liebig, 2005).

Stereotype priming and self-efficacy for stairs

The present studies have added to the body of stereotype research that has often found mixed results regarding the impact of positive compared to negative stereotype priming on performance outcomes. It is generally understood that while positive priming may have very small and subtle effects on performance, negative priming can produce effects almost three times as large (Meisner, 2012). However, much of what we currently know stems from stereotype research that has largely focused on cognitive performance outcomes and has not considered the significance of task-specific self-efficacy as a robust moderating variable (Lamont et al., 2015). The role of self-efficacy for stairs always remained significant in the analyses, producing small to medium sized effects whether being adjusted for in predictive models for stair navigation duration or being analyzed as an outcome variable across time and prime groups (as opposed to general psychological measures).

In healthy older adults, self-efficacy for stair descent and ascent was significantly reduced among those who were exposed to a negative prime, whereas self-efficacy for stairs did not significantly change across time for the positive or control group. This finding corroborated previous research claims that negative stereotype priming and stereotype threat is more evocative than positive priming (Meisner, 2012; Horton et al., 2008). The results that stair self-efficacy was significantly reduced is concerning considering research has shown reductions in task self-efficacy leads to activity-avoidance and health behavior disengagement over time (Jacobs, 2016; Levy & Myers, 2004; Reelick et al., 2009; Reid et al., 2011). Nevertheless, the same findings also revealed that negatively primed healthy older adults did not significantly differ from the control group on their stair navigation performance, indicative of the subtly of stereotype prime influences. In contrast, healthy older adults who were positively primed displayed significantly faster stair ascent and descent, and moved their centre of mass through roll angular deviations at faster velocities compared to the negatively and positively primed groups of older adults with osteoarthritis. This apparent boost in performance was accomplished, despite not reporting significantly different self-efficacy for stair scores from baseline to post-prime. While one may be quick to assume that positive priming thus did not work at boosting self-efficacy for stairs, these results may be more indicative of potential ceiling effects than prime ineffectiveness. SESUp and SESd were scored out of 10, with higher scores indicating more self-efficacy related to stair navigation. The baseline average SESUp and SESd scores in the healthy population were both 8.5, which is very close to the maximum score one can record for the scale. Given these results and the potential for a ceiling effect, it may be appropriate to say that self-efficacy for stairs did not change for positively primed healthy older adults (as opposed to reductions found for those who were negatively primed). Therefore, positive priming may have indeed fostered stereotype boost by mitigating declines in stair self-efficacy that occurred in older adults who were negatively primed and facilitating faster stair navigation measures despite the barriers of potential ceiling effects related to self-efficacy for stairs.

Stereotype priming and stair navigation among older adults with osteoarthritis

The potential stereotype boost in psychological and physical outcomes in healthy older adults who were positively primed became clearer when comparing their performances to primed older adults with osteoarthritis. After adjusting for confounding variables, the results indicated that both the negatively primed and positively primed group of older adults with osteoarthritis exhibited “cautious gait” patterns. Specifically, these two groups ascended and descended the stairs with less speed, restricted angular deviations in pitch and roll planes, and slower angular velocity in the roll plane consistently when compared to healthy older adults who were positively primed. However, given statistical assumptions of homogeneity of variances were violated within this study, the results should be interpreted as more exploratory than conclusive. Nevertheless, these trends regarding cautious gait are concerning for those with osteoarthritis considering the association between cautious gait and risk of falling, injury, and early mortality (Jacobs, 2016; Oh Park et al., 2011; Tiederman et al., 2006). Future research is warranted related to the type of primes that can “boost” by mitigating declines or facilitating enhancement of stair navigation performance and related self-efficacy measures in this at-risk population.

Limitations

While the present study is the first of its kind to connect task-stereotype priming, self-efficacy for stairs, and stair navigation outcomes, there are several limitations in study design and interpretation that emphasize the need for further research. The present work did not include a measure of self-relevance or investment in the stereotype domain, which has been noted as an important moderator of perception and behaviour change in older adults (Hess & Hinson, 2006; Horton et al., 2010). Considering stair navigation is an activity of daily living required for maintaining independence with age, it was assumed that stair navigation and related-perceptions would inherently be relevant and subject to personal investment in both healthy older adults and those with osteoarthritis. Nevertheless, this measure of investment should be included and investigated in future work. Moreover, there were no measures of visual patterns of the participants. Given the importance of vision in negotiating stair navigation before and during initiation, future research should aim to include a visual assessment of older adult gaze in congruence with motion analysis. This may be of particular importance given research has found visual field reductions during stair descent, which ultimately shifts one's core posture forward and downward in order to enhance depth perception of steps during descent (Kasahara, Okabe, Nakazato, & Ohno, 2007).

In addition, the e-mail follow-up assessing prime longevity in healthy older adults could not control for extraneous variables, such as further exposure to ageism, receiving information counter to the stereotype prime content, and changes in functional health that participants may have experienced in the month after the stair navigation task. Future work should assess prime longevity in congruence with re-completion of the baseline psychological surveys at regular intervals post-prime exposure in order to form a more complete picture of age-related experiences once removed from the confines of the experimental environment. Moreover, without a control group for comparison in the osteoarthritis sub-sample, it is more difficult to assert statistical inferences as to whether the prime manipulation actually facilitated any differences relative to the healthy sub-sample of older adults or whether the trends observed were strictly based on having osteoarthritis.

As well, aspects of the study design were cross-sectional in the sense that no baseline measures of stair navigation performances were collected prior to prime exposure. This was employed to maximize recruitment success and reduce the burden for older adult participants who have a tendency to withdraw from research when perceived as “inconvenient” or “rigorous”, and thus remain under-represented in most research domains (McHenry et al., 2012). While this strategy was seemingly successful at garnering enough recruitment to reach *apriori* statistical power, it raises an interesting interpretational question regarding the present findings for self-efficacy for stairs. Specifically, the predictive value revealed by the results does not fully allow for discerning whether higher self-efficacy for stairs leads to better stair navigation performance (or lower task self-efficacy leads to poorer performance), or whether better stair navigation leads to higher levels of self-efficacy. The present work begins to examine this complex relationship by analyzing self-efficacy for stair ascent and descent as respective moderating variables for stair ascent and descent navigation, and future research should continue to acknowledge and develop this relationship.

Lastly, the present study aimed to examine the influence of stereotype priming on diverse demographic subsets of older adults (i.e., varying age, sex, income, education, and ethnicity); however, the majority of the sample was found to be middle-high class, well-educated, White individuals. Previous research regarding these demographic variables has indicated that individuals of higher socio-economic status tend to be more immune to the effects of stereotype priming, especially in terms of perceived credibility when the prime is explicit (Andreoletti & Lachman, 2004). In addition, age-stereotype research remains mixed regarding the potential of ethnicity to influence the prime-performance association (Cuddy et al., 2005). While some research has indicated that Eastern social philosophies reduce the effects of ageism by placing more value on older adults in comparison to Westernized ideals, globalization seems to be diminishing these differences over time (Löckenhoff et al., 2009). Nevertheless, further research is warranted to tease out the potential moderating effect of ethnicity on stereotype prime effectiveness. Moreover, the present work further aimed to respond to the research call for conducting more stair-performance research “outside of laboratory settings” (Jacobs, 2016). However, participants were fitted with a foreign apparatus for recording their motion and remained aware of the presence of the researchers who were conducting the experiment with the goal of analyzing their motion. While this likely limited the ecological validity of the results, the present study took a step towards achieving analysis in “real-world” settings by using a stairwell for performance analysis that was located in a public space and could be interacted with outside of the experiment as opposed to exclusively within a formal and traditional laboratory setting.

Implications and future directions

Overall, these findings have implications for streamlining research methodologies related to stereotype priming in older adults. Importantly, they also acknowledge the gaps and limitations of this work and emphasize the need for future research in order to further our understanding of the influence age-based stereotypes have on healthy adults and those with a chronic condition. The implications of these methodological findings provide the foundation towards developing an exploratory model for analyses to be utilized by future researchers in order to produce more statistically meaningful results. This was found to be especially important regarding the use of general versus task-specific evaluations of self-efficacy. Furthermore, the present results add clarity to previous mixed findings related to the potential impact of explicit (as opposed to implicit) forms of stereotype priming, as well as the impact of stereotype boost (as opposed to stereotype threat) to elicit a response as a function of task-specific prime content. Future work should include both explicit and implicit stereotype priming measures in order to assess the specific impact on physical outcomes and self-efficacy as these two methods have largely been compared within cognitive stereotype domains (Lamont et al., 2015).

Furthermore, the present findings have implications for the use of positive task-specific stereotype priming to enhance physical performance measures of stair navigation while mitigating the potential self-efficacy declines that can occur when older adults are exposed to negative task-specific primes. Given the recent campaign launched by the World Health Organization to increase awareness and develop strategies to combat the effects of ageism, the present findings have direct implications regarding the promotion of stereotype boost in order to mitigate the effects of pervasive negative stereotypes within healthy older adults (World Health Organization, 2016). However, since prime longevity was compromised in positively primed older adults relative to those who were negatively primed, future longitudinal research is necessary to examine whether continued exposure to a stereotype boost can be used as a tool to promote retention of prime effects, and maintenance of the physical and psychological benefits of positive priming.

In addition, future research is necessary to corroborate the findings within the present study and further develop models for analyzing how stereotype priming influences stair navigation and self-efficacy for stairs. Future research should explore various stereotype-prime contexts (e.g., physiological, social, and psychological) within diverse subsets of the aging population, especially considering the notions of the present findings suggesting that stereotype priming may require unique tailoring to “healthy” versus “non-healthy” older adults. Thus, future research is also warranted in older adult with mobility-related chronic conditions, who may be experiencing suppression effects towards prime effectiveness and “double jeopardy” effects related to physical and psychological declines greater than those of healthy older adults. Moreover, the present findings have implications for examining “cautious gait” patterns in older adults with osteoarthritis after exposure to both positive and negative stereotype primes. Future work is required to further develop the relationship between stereotype priming and potentially exacerbating cautious gait compensation strategies often adopted by both healthy older adults and those with osteoarthritis. This work could include the use of force plates and sensors in order to develop our understanding of muscle and joint moments during stair navigation after exposure to a stereotype prime; however, the use of these apparatuses may restrict ecological validity and move towards a formal laboratory setting as opposed to a realistic setting of stair navigation within public spaces. Rather, it may of particular interest to examine variables that can influence self-efficacy for stairs and stair ascent and descent in real world settings after prime-exposure, such as perceptions of stair height and dimensions, frequency of attempted hand-rail use, and various light intensities. These manipulations are encountered on a daily basis and could heighten the visual, proprioception, cognitive, and physical resources available towards accomplishing stair navigation.

Overall, the present work has implications for using stereotype priming to optimize stair navigation performance and self-efficacy, both of which tend to decline with advancing age and increased exposure to negative stereotypes. The present findings lay a foundation for conducting and assessing stereotype priming within diverse subpopulations of older adults. The findings add some clarity to the mixed results previously found in the age-based stereotype literature, and add a novel outcome to this body of evidence. In addition, the findings suggest a complex interaction between health status and the effectiveness of stereotype priming, with implications for developing nuanced methodologies for older adults with compromised health statuses in order to promote potential performance enhancements.

Conclusion

In examining the influence of stereotype priming on stair navigation performances and related self-efficacy in older adults, the present work answered multiple calls recently put forth by several fields of research. Specifically, the calls highlight the need for more stereotype research focusing on physical performance outcomes and the role of self-efficacy (Lamont et al., 2015), as well as the need for more research exploring cognitive interventions that can influence stair navigation (Jacobs, 2016). Considering the present “stereotypes, self-efficacy, and stairs” study is the first of its kind, the findings have implications for streamlining future research processes in order to corroborate evidence, and develop and progress this novel subject of study. The present work also has implications for using stereotype boost as a tool to negotiate risky stair navigation and optimize the physical and psychological well-being of healthy and non-healthy older adult populations. With vast implications for current and future research, the present work aligns with recent campaigns urging the development of strategies to combat the negative effects of ageism; a goal that is both timely and critical given worldwide age-demographic shifts and the ubiquitous nature of negative age-stereotypes within Westernized societies.

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Appendix A: Baseline Questionnaire Package

Rapid Assessment of Physical Activity (RAPA; Topolski et al., 2006)

Physical Activities are activities where you move and increase your heart rate above its resting rate, whether you do them for pleasure, work, or transportation.

The following questions ask about the amount and intensity of physical activity you usually do. The intensity of the activity is related to the amount of energy you use to do these activities.

Examples of physical activity intensity levels:

Light activities • your heart beats slightly faster than normal • you can talk and sing	 Walking Leisurely · Stretching · Vacuuming or Light Yard Work
Moderate activities • your heart beats faster than normal • you can talk but not sing	 Fast Walking · Aerobics Class · Strength Training · Swimming Gently
Vigorous activities • your heart rate increases a lot • you can't talk or your talking is broken up by large breaths	 Stair Machine · Jogging or Running · Tennis, Racquetball, Pickleball or Badminton

How physically active are you? (Please consult the examples above and choose an answer for each item)

	Yes	No
I rarely or never do any physical activities.	○	○
I do some **light** or **moderate** physical activities, but not every week.	○	○
I do some **light** physical activity every week.	○	○
I do **moderate** physical activities every week, but less than 30 minutes a day or 5 days a week.	○	○
I do **vigorous** physical activities every week, but less than 20 minutes a day or 3 days a week.	○	○
I do 30 minutes or more a day of **moderate** physical activities, 5 or more days a week.	○	○
I do 20 minutes or more a day of **vigorous** physical activities, 3 or more days a week.	○	○
I do activities to increase **muscle strength**, such as lifting weights, once a week or more.	○	○
I do activities to improve **flexibility**, such as stretching or yoga, once a week or more.	○	○

Western Ontario and McMaster Universities Arthritis Index – Short Form (WOMAC-SF; Baron et al., 2007)

Please **rate the difficulties** you experience in each of the following activities **as caused by your osteoarthritis:**

	None	Slight	Moderate	Severe	Extreme
Descending the stairs	○	○	○	○	○
Acsending the stairs	○	○	○	○	○
Getting into/out of a car	○	○	○	○	○
Rising from sitting	○	○	○	○	○
Walking on a flat surface	○	○	○	○	○
Going shopping	○	○	○	○	○
Putting on socks	○	○	○	○	○
Getting on/off the toilet	○	○	○	○	○

The Geriatric Depression Scale Short Form (GDS-15; Sheikh & Yesavage, 1986)

Choose the best answer for how you have felt over the past week:

1. Are you basically satisfied with your life? YES / NO
2. Have you dropped many of your activities and interests? YES / NO
3. Do you feel that your life is empty? YES / NO
4. Do you often get bored? YES / NO
5. Are you in good spirits most of the time? YES / NO
6. Are you afraid that something bad is going to happen to you? YES / NO
7. Do you feel happy most of the time? YES / NO
8. Do you often feel helpless? YES / NO
9. Do you prefer to stay at home, rather than going out and doing new things? YES / NO
10. Do you feel you have more problems with memory than most? YES / NO
11. Do you think it is wonderful to be alive now? YES / NO
12. Do you feel pretty worthless the way you are now? YES / NO
13. Do you feel full of energy? YES / NO
14. Do you feel that your situation is hopeless? YES / NO
15. Do you think that most people are better off than you are? YES / NO

English Self-Confidence Scale (ESCS; Johnson & McCoy, 2000)

Indicate how much you agree with each of the following statements by circling the appropriate number on the scale.

1. I have come to have doubts about my ability to succeed in life.
2. I have sometimes given up on doing something because I thought I didn't have the ability to succeed.
3. I do not share my ideas with others very often because I question their values and I am afraid the others might make fun of me.
4. I don't worry when I meet new people. I am interesting and there is no reason for them not to like me.
5. I trust myself when I have to anticipate and solve a future problem.
6. I feel that something bad may happen if I do not make some changes in my behaviors or life.
7. Nobody can make me change my beliefs when I hold them strongly.
8. I have a tendency to give up easily when I face difficult problems.
9. I am confident of performing well when I try a new sport or physical activity.
10. I am afraid of making a mistake when I have to make quick decisions.
11. I am sure of success when I pursue important goals.
12. I feel I can make a good impression when I have to.
13. I am not sure I can face emergency situations.
14. I lack confidence when I am in a new and unknown situation.
15. I feel comfortable when I have to take the initiative and act independently of others.
16. I prefer to consult with other people when I have to make important decisions.
17. When I am done with a task, I often wonder if I have done it right.
18. I can do anything I want to do because I have confidence in myself.

Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965)

Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle **SA**. If you agree with the statement, circle **A**. If you disagree, circle **D**. If you strongly disagree, circle **SD**.

1. On the whole, I am satisfied with myself. SA A D SD
2. At times, I think I am no good at all. SA A D SD
3. I feel that I have a number of good qualities. SA A D SD
4. I am able to do things as well as most other people. SA A D SD
5. I feel I do not have much to be proud of. SA A D SD
6. I certainly feel useless at times. SA A D SD
7. I feel that I'm a person of worth, at least on an equal plane with others. SA A D SD
8. I wish I could have more respect for myself. SA A D SD
9. All in all, I am inclined to feel that I am a failure. SA A D SD
10. I take a positive attitude toward myself. SA A D SD

General Self-Efficacy Scale (GSE; Schwarzer & Jerusalem, 1995)

1. I can always manage to solve difficult problems if I try hard enough.
2. If someone opposes me, I can find the means and ways to get what I want.
3. It is easy for me to stick to my aims and accomplish my goals.
4. I am confident that I could deal efficiently with unexpected events.
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.
6. I can solve most problems if I invest the necessary effort.
7. I can remain calm when facing difficulties because I can rely on my coping abilities.
8. When I am confronted with a problem, I can usually find several solutions.
9. If I am in trouble, I can usually think of a solution.
10. I can usually handle whatever comes my way.

For each item: 1=Not at all true, 2=Hardly true, 3=Moderately true, 4=Exactly true

Attitude Toward Own Aging Sub-Scale (ATOA; PGC Morale Scale; Lawton, 2001)

1. Do things keep getting worse as you get older?	Yes ______	No _______
2. Do you have as much pep as you had last year?	Yes ______	No _______
3. Do you feel that as you get older you are less useful?	Yes ______	No _______
4. As you get older, are things (better/worse) than you thought they would be?	Better ____	Worse ____
5. Are you as happy now as you were when you were younger?	Yes ______	No _______

Stigma Consciousness Questionnaire (SCQ; Hess, Hinson, & Hodges, 2009; Pinel, 1999)

For the statements below, indicate the extent to which you agree or disagree with each statement.
Please circle the number of your response:

1. Stereotypes about aging have affected me personally
   1-----------2-----------3-----------4-----------5-----------6-----------7
   1 - Strongly Agree
   7 - Strongly Disagree

2. I worry that my behaviours will be viewed as stereotypically old
3. When interacting with younger people, I feel like they interpret all my behaviours in terms of the fact that I am older
4. Most younger people judge older people on the basis of their age
5. Being older does not influence how younger people act with me
6. I almost always think about the fact that I am older when I interact with younger people
7. My being older does not influence how older people act with me
8. Most younger people have a lot more ageist (negative judgments about older age) thoughts than they actually express
9. I often think that younger people are unfairly accused of being ageist (negatively judgmental about older age)
10. Most younger people have a problem viewing older people as equals

Self-Efficacy for Falls – International (FSE-I; Yardley et al., 2005)

Each item is scored on a 4-point scale with 1=Not at all concerned and 4=Very concerned. Please indicate for each scenario, how concerned you are doing each of the actions without falling?

1. Cleaning the house
2. Getting dressed/undressed
3. Preparing simple meals
4. Taking a bath or shower
5. Going to the shop
6. Getting in or out of a chair
7. Going up or down stairs
8. Walking around outside
9. Reaching up or bending down
10. Answering the telephone
11. Walking on a slippery surface
12. Visiting a friend/relative
13. Going to a place with crowds
14. Walking on an uneven surface
15. Walking up or down a slope
16. Going out to a social event

Self-Efficacy for Stairs (SESUp; SESd; Hamel & Cavanaugh, 2007)

A scale of 0-10 is used for each item, with 0=no confidence and 10=complete confidence.

1. How confident are you that you can negotiate the stairs in your home without losing your balance?
Going down the stairs
Going up the stairs

2. How confident are you that you can negotiate a flight of stairs rapidly, without losing your balance?
Going down the stairs
Going up the stairs

3. How confident are you that you can negotiate the stairs not using the handrail without losing your balance?
Going down the stairs
Going up the stairs

4. How confident are you that you can negotiate stairs that are poorly lit without losing your balance?
Going down the stairs
Going up the stairs

5. How confident are you that you can negotiate stairs in a crowd of people without losing your balance?
Going down the stairs
Going up the stairs

6. How confident are you that you can negotiate stairs that are not in your home without losing your balance?
Going down the stairs
Going up the stairs

7. How confident are you that you can negotiate outdoor stairs or steps without losing your balance?
Going down the stairs
Going up the stairs

8. How confident are you that you can recover from a loss of balance on stairs to prevent yourself from falling?
Going down the stairs
Going up the stairs

Appendix B: Stereotype Primes

Negative Prime

HEALTH & WELLNESS

WARNING Stairs Ahead: Are the Stairs a Younger Persons' Domain?

The Activities of Daily Living (ADLs) are a specific set of activities often accomplished throughout the course of a day. These activities include: movement from bed, transferability, locomotion, dressing, personal hygiene, and feeding one's self. The most important ADL is locomotion, which involves going up and down the stairs. Although one would expect going up and down the stairs to be completed in a similar manner regardless of age, recent experiments at Sinai Hospital have found that older persons are less successful at accomplishing this task than younger persons – both less efficiently and with more injuries. In a recent interview with Dr. Sam Page (of Orthopedics at Sinai Hospital), the orthopedic surgeon explained, "These declines in stair performance observed in older adult populations could be attributed to age-related amplifications of frailty, shakiness, and general inability". Dr. Page went on to clarify, "It is the development of these attributes that largely accounts for the abundance of non-successfully aging older adults within the population". Thus, it would appear that younger persons have more adaptability and fitness for accomplishing stair-related tasks compared to their older counterparts.

Stairs lab located within Sinai Hospital

Positive Prime

HEALTH & WELLNESS
Stepping It Up: Are the Stairs an Older Persons' Domain?

The Activities of Daily Living (ADLs) are a specific set of activities often accomplished throughout the course of a day. These activities include: movement from bed, transferability, locomotion, dressing, personal hygiene, and feeding one's self. The most important ADL is locomotion, which involves going up and down the stairs. Although one would expect going up and down the stairs to be completed in a similar manner regardless of age, recent experiments at Sinai Hospital have found that older persons are more successful at accomplishing this task than younger persons – both more efficiently and with less injuries. In a recent interview with Dr. Sam Page (of Orthopedics at Sinai Hospital), the orthopedic surgeon explained, "These improvements in stair performance observed in older adult populations could be attributed to age-related accumulations of experience, resiliency, and fitness". Dr. Page went on to clarify, "It is the development of these attributes that largely account for the abundance of successfully aging older adults within the population". Thus, it would appear that older persons have more adaptability and mastery for accomplishing stair-related tasks compared to their younger counterparts.

Stairs lab located within Sinai Hospital