The effects of stereotype threat on older adults' walking performance as a function of task difficulty and resource evaluations

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Abstract

Stereotype threat occurs when people are concerned about confirming a negative stereotype about their social group, and this often leads people to underperform within the threatened domain. Although this is well-documented, the majority of prior studies examining stereotype threat in older adults have focused on cognitive outcomes and comparatively less research has focused on how stereotype threat affects physical outcomes. In this study we examined whether negative age-based evaluations invoke stereotype threat and adversely affect older adults' gait, and whether this depends upon the difficulty of the gait task and upon participants' evaluations of their own resources to cope with the demands of the gait task. To test this, we recruited 163 healthy, community-dwelling older adults and asked them to complete either an "easy" gait task (i.e., walking at their own comfortable pace) or a "difficult" gait task (i.e., walking within a 15 cm narrow base of support) along a 24' temporospatial-measuring walkway. This was done in either the presence or absence of a negative age-based evaluation. Results showed that the adverse effects of stereotype threat (i.e., walking slower, with relatively more variability in speed, and with more step errors) were generally limited to participants completing the difficult gait task who were not confident that they had sufficient resources to cope with the demands of the task. Thus, stereotype threat can impair older adults' physical performance, but the magnitude of this effect depends upon the task's objective difficulty and on participants' subjective evaluations of their own resources.

Key words: gait speed, stereotype threat, ageism, individual differences, resource evaluations

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Walking may seem like a simple activity, but it is actually a physiologically complex task that involves the interplay of multiple motor and cognitive systems. When any one of these systems is not working properly, markers of walking ability such as gait speed, decline (Studenski et al., 2011). Because of this, gait speed is a powerful predictor of many health outcomes in older adults (e.g., Cesari et al., 2005; Van Kan et al., 2009). It predicts fall status (e.g., Callisaya et al., 2011; Verghese, Holtzer, Lipton, & Wang, 2009), disability (e.g., Perera et al., 2016), cognitive impairment (e.g., Buracchio, Dodge, Howieson, Wasserman, & Kaye, 2010; Ojagbemi, D'Este, Verdes, Chatterji, & Gureje, 2015), quality of life (e.g., Hirvensalo, Rantanen, & Heikkinen, 2000), and even mortality (e.g., Hardy, Perera, Roumani, Chandler, & Studenski, 2007; Studenski et al., 2011). In fact, its predictive value is so strong, that many have called for gait speed to be considered an additional vital sign that is routinely assessed for older adults (e.g., Fritz & Lusardi, 2009; Lusardi, 2012; Middleton, Fritz, & Lusardi, 2015; Studenski, 2009).

Although gait is primarily a physical measure, it can also be affected by psychological factors, such as aging expectations and stereotypes. Not only is physical activity less common for older adults who have negative expectations about aging or negative beliefs about aging (e.g., Beyer, Wolff, Warner, Schüz, & Wurm, 2015; Meisner, Weir, & Baker, 2013; O'Brien Cousins, 2000; Sarkisian, Prohaska, Wong), but longitudinal research also shows that older adults who endorse negative aging stereotypes show greater declines in gait speed over time (Robertson, Savva, King-Kallimanis, & Kenny, 2015), which in turn predicts reductions in cognitive performance (Robertson & Kenny, 2016). Experimental lab studies have also demonstrated the power of age stereotypes in affecting performance (for a review, see Meisner, 2012). For example, subliminally priming older adults with positive aging stereotypes (e.g., ‘wise’, ‘astute’, and ‘accomplished’) can increase their gait speed (Hausdorff, Levy, & Wei, 1999), in part because this priming manipulation decreases older adults’ negative age stereotypes and negative self-perceptions of aging (Levy, Pilver, Chung, & Slade, 2014).

These findings are often explained by drawing upon Levy’s (2003; 2009) *stereotype embodiment theory*. According to this view, beginning as children, people acquire both negative and positive stereotypes about older adults and the aging process (see Montepare & Zebrowitz, 2002). These are then reinforced over time, as aging stereotypes are frequently encountered (e.g., Kroon, Van Selm, ter Hoeven, & Vliegenthart, 2018; Mason, Kuntz, & McGill, 2015), and this is particularly true for those that are negative in valence (e.g., Levy, Chung, Bedford, & Navrazhina, 2014). Because these stereotypes are not self-relevant, younger people have no psychological need to scrutinize them and this allows them to become strongly internalized. As a result, when these age stereotypes become self-relevant in old age, they are often assimilated into people’s self-representations (e.g., Kornadt & Rothermund, 2012; Rodin & Langer, 1980; Rothermund, 2005; Rothermund & Brandstädter, 2003; Rothermund, 2005; Weiss & Kornadt, 2018).

Internalized negative age stereotypes can in turn have adverse behavioral and health consequences for older adults. They can lead older adults to have higher stress responses (e.g., Levy, Ryall, Pilver, Sheridan, Wei, & Hausdorff, 2008), particularly when there is an age-based evaluation (Weiss, 2018). They can also lead to self-fulfilling prophecies, such as older adults blaming health-related declines on their age (e.g., Stewart, Chipperfield, Perry, & Weiner, 2012), and can also reduce engagement in health-promoting behaviors (e.g., Meisner & Baker, 2013).

For example, when people internalize the stereotype that old age inevitably brings health problems, they are less likely to engage in health behaviors themselves, such as taking medications or engaging in regular exercise (Levy & Myers, 2004). Conversely, interventions that reduce older adults' negative age stereotypes can also improve their physical function (Levy et al., 2014).

Stereotype Threat and Older Adults' Physical Performance

A related way that negative aging stereotypes can affect older adults' performance is through the process of *stereotype threat*[1]. Stereotype threat occurs in situations where people are consciously concerned that poor performance on their part will confirm that a negative self-relevant stereotype is true. For a variety of reasons, this concern can then lead to underperformance within the threatened domain (Steele, 1997; Steele & Aronson, 1995). For example, a prevalent stereotype about older adults is that they are senile and that their cognitive abilities have steeply declined (e.g., Hummert, 1990). This in turn can negatively affect older adults' cognitive performance. When older adults encounter negative age-based evaluations about their memory abilities they often underperform on cognitive tests (Hess, Auman, Colcombe, & Rahhal, 2003; for reviews, see Barber, 2017; Barber & Lui, in press) and are sometimes more likely to meet the diagnostic screening criteria for cognitive impairment (Haslam, Morton, Haslam, Varnes, Graham, & Gamaz, 2012; Mazerolle et al., 2016; but see Barber, Mather, & Gatz, 2015).

Although a well-documented phenomenon, prior studies examining stereotype threat in older adults have almost exclusively focused on memory or cognitive performance (79% of the

[1] For comparisons of stereotype embodiment and stereotype threat theories, see Fawsitt and Setti (2017) and Wurm, Diehl, Kornadt, Westerhof, and Wahl (2017). For a comparison of how implicit priming differs from explicit stereotype threat, see Barber and Mather (2014).

effects coded in a meta-analysis by Lamont, Swift, and Abrams (2015) fell within these domains) and less research has examined the impact of stereotype threat on older adults' physical performance. To our knowledge, only three studies have examined the effect of these stereotypes on older adults' physical performance, and their results have been inconsistent. In one study using older adults with low functional ability levels, Swift, Lamont, and Abrams (2012) found that negative age-based evaluations reduced older adults' hand grip strength and persistence. However, two subsequent studies using older adults with higher functional ability levels reported no impact of negative age-based evaluations on these same measures (Horton, Baker, Pearce, & Deakin, 2010; Marquet et al., 2018). These two studies also assessed older adults' performance in additional physical domains (e.g., flexibility, walking speed, balance). On almost all of these outcome measures there were no significant effects of the stereotype threat manipulation. However, the one exception is that Marquet et al. (2018) found stereotype-threat related performance deficits during a tandem walking test in which participants were required to walk heel-to-toe along a pathway.

Thus, whereas negative age-based evaluations impaired older adults' physical performance in one study (Swift et al., 2012), this effect was not observed in two other studies (Horton et al., 2010; Marquet et al., 2018). One possible explanation for these different results is that participants in these studies also varied in their physical abilities to perform the tasks. For example, when looking at hand grip strength (which was an outcome measure in all three studies), normative data show that men in their 60s have an average right-hand grip strength of 40 kg and women have a right-hand grip strength of 24 kg. This decreases with age such that men aged 70 or older have an average right-hand grip strength of 33 kg and women have a right-hand grip strength of 20 kg (Massy-Westropp, Gill, Taylor, Bohannon, & Hill, 2011). In comparison, the participants tested by Swift et al. (2012) were considerably weaker with an average grip strength of only 11.02 kg whereas the participants tested by Horton et al. (2010) were considerably stronger with an average grip strength of 64.5 kg. Those tested by Marquet et al. (2018) most closely resembled the normative data, with an average grip strength of approximately 34 kg.

These baseline ability differences are important and likely affected how people responded to the age-based evaluation. Stereotype threat effects are often most pronounced on difficult tasks (e.g., Ben-Zeev, Fein, & Inzlicht, 2005; Hess, Emery, & Queen, 2009; Neuville & Croizet, 2007; O'Brien & Crandall, 2003), including during performance on physical tasks (Hively & El-Alayli, 2014). This is perhaps because perceived difficulty completing the task leads to doubts about ones' own abilities or about the veracity of the stereotype (see Steele, Spencer, & Aronson, 2002). As noted above, the participants tested by Swift et al. (2012) had low functional ability levels. Because of this, they may have been more likely to perceive the handgrip task as difficult and exhibit a stereotype-threat-related performance impairment. In contrast, the participants tested by Marquet et al. (2018) and by Horton et al. (2010) had average or above-average functional ability levels and likely perceived the task to be relatively easier. This in turn may have protected them from showing performance declines as a result of the stereotype threat manipulation.

Cognitive evaluations moderate stereotype threat effects

Within the broader stereotype threat literature, there is also growing evidence that participant factors can moderate the magnitude of stereotype threat effects (for a review, see Barber & Lui, in press). For instance, within the domain of cognition, stereotype threat effects are greater for older adults with low memory self-efficacy (Desrichard & Kopetz, 2005;

Schlemmer & Desrichard, 2018), with poorer self-perceptions of aging (Fernández-Ballesteros, Bustillos, & Huici, 2015), who believe that age inevitably brings declines (Plaks & Chasteen, 2013; Weiss, 2018), and who do not see themselves as having control over their life outcomes (Hehman & Bugental, 2013). When considered together, the common feature of these findings is that stereotype threat effects are more likely to occur for individuals who evaluate their current resources as being insufficient to meet the demands of the task. This is also the key tenant of the biopsychosocial model of challenge and threat (Blascovich, 2008; Blascovich & Mendes, 2000; Blascovich, Mendes, Salomon, & Hunter, 1999).

The biopsychosocial model of threat and challenge has its origins in research on stress and coping (Lazarus & Folkman, 1987) and was developed to explain how people respond during motivated performance situations. These are tasks that are goal-relevant, self-relevant, and perceived as relatively important; prototypical examples include taking tests, giving speeches, playing competitive sports, negotiating conflicts, or trying to make a good impression (see Blacovich, 2008). Completing a task under the evaluation of others (as is often the case in stereotype-threat inducing situations) can also increase a tasks' self-relevance and cause it to become a motivated performance situation (Blascovich & Mendes, 2000).

The biopsychosocial model further specifies that during motivated performance situations, people respond differently based upon how they evaluate their personal resources (e.g., perceived abilities, self-efficacy, skills, knowledge, coping abilities, external support) as well as the task demands (e.g., difficulty, required effort, uncertainty). When people evaluate their personal resources to be sufficient to meet or exceed the demands of the situation then they experience a “challenge” motivational state – they see the situation as having the potential for gains and growth and they approach the situation with eagerness or excitement. In contrast, when they evaluate the demands of the situation to exceed their personal resources then they experience a “threat” motivational state – they see the situation as having the potential for losses or harm and they approach the situation with anxiety or worry. Although this specification seems to connote that challenge and threat are distinct states, these evaluations represent a relative continuum. The same stressor can lead to individual differences in the extent to which people feel challenged versus threatened.

Going beyond these psychological evaluations, the biopsychosocial model also assumes that threat and challenge motivational states are associated with differential physiological responses (e.g., Seery, 2013; Tomaka, Blascovich, Kelsey, & Leitten, 1993) and performance outcomes. In particular, threat motivational states are typically associated with poorer task performance as compared to challenge motivational states (e.g., Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004; Gildea, Schneider, & Shebilske, 2007; Moore, Vine, Wilson, & Freeman, 2012). Although this has previously been used to explain stereotype-threat related performance deficits in younger adult participants (Berjot, Roland-Levy, Girault-Lidvan, 2011; Derks, Scheepers, van Laar, & Ellemers, 2011; Flores, Chavez, Bolger, & Casad, 2019; Vick, Seery, Blascovich, & Weisbuch, 2008; see also Mendes & Jamieson, 2011) to our knowledge no prior study has extended this to stereotype threat studies using older adult participants.

Overview

The primary aim of this study was to examine whether the effects of negative age-based evaluations on older adult’s physical performance depends upon the difficulty of the physical task and on participants’ evaluations of their resources to cope with the demands of the task. In doing so, we focused on performance during two different gait tasks, which varied in terms of task demands and skill requirements. The “easy” gait task involved normal walking back-and-forth over level ground whereas the "difficult" gait task involved walking back-and-forth over level ground within a narrow base of support (i.e., these participants were required to keep their feet within the confines of two lines that were separated by 15 cm). Although there are age-related declines in gait speed during normal base walking tasks, this is particularly pronounced during narrow base gait tasks (e.g., Schranger, Kelly, Price, Ferrucci, & Shumway-Cook, 2008), as this task requires additional postural control (Arvin et al., 2016). Although more difficult, it is also worth noting that walking along a narrow base of support is an important everyday skill. People negotiate walking along narrow pathways when they navigate through crowds, through narrow doorways, or between pieces of furniture.

Within each of these gait tasks, we assessed gait speed, which is a clinically diagnostic measure of physical capability that strongly predicts disability, morbidity, and mortality (Hardy et al., 2007; Perera et al., 2016; Studenski et al., 2011). Gait speed is also a stronger predictor of functional decline in both vigorous and basic activities of daily living than handgrip strength (Sarkisian, Gutierrez, Seely, Cummings, & Mangione, 2000). As an additional gait parameter, we also examined gait speed variability. Although gait speed is an important predictor of many health outcomes (e.g., Cesari et al., 2005; Van Kan et al., 2009), gait variability measures are even better predictors of falls and declines in mobility (e.g., Brach, Studenski, Perera, VanSwearingen, & Newman, 2007; Hausdorff, Rios, & Edelberg, 2001). Finally, within the difficult narrow-base gait task, we also assessed step errors (i.e., steps in which at least part of the foot fell outside the lines demarking the narrow base of support).

In addition to varying the difficulty of the critical gait task, we also varied whether walking was done in the presence or absence of a negative age-based evaluation (i.e., a stereotype threat or stereotype alleviation instruction). We hypothesized that the stereotype threat instruction would lead to poorer gait performance (i.e., slower and more variable walking that has more step errors), and that this would be particularly pronounced during the difficult, narrow base of support, gait task. We also predicted that the magnitude of these stereotype-threat related performance impairments would be most pronounced for participants who felt that their resources are insufficient to cope with the demands of the task (e.g., Blascovich, 2008).

Finally, as an exploratory aim, we also planned to test whether stereotype threat effects would vary between the male and female participants. In a prior meta-analysis, the effects of age-based stereotype threat on performance increased as the number of women in the study increased (Lamont et al., 2015). This is consistent with other research suggesting that due to a double-standard of aging such that stereotypes about aging are more self-relevant for women (Levy, Ng, Myers, & Marottoli, 2013). However, to our knowledge no prior experimental study has directly compared how older men and women respond to age-based stereotype threat.

Method

Design & Participants

The experiment had a 2 (Gait task: Normal vs. Narrow base) X 2 (Task instruction: Stereotype threat vs. Stereotype alleviation) between-subject design. Stratified randomization was used to separately assign men and women to the four between-subject conditions. We initially recruited a total of 168 community-dwelling older adults, but subsequently excluded five from all analyses. Of these, four did not follow instructions during the difficult, narrow base of support gait task (i.e., they did not keep their feet within the lines demarking the narrow base of support) and one failed to disclose during the telephone screening interview that she met one of our exclusion criteria (described below). This left a final sample of 163 participants (M_{age} =

73.34; range = 66.90 to 86.27 years). Within this sample there were 50 men and 113 women. For additional participant characteristics as a function of gait task and task instruction, see Table 1.

Participants were recruited via flyers distributed at local senior centers and community groups and also from a database of individuals who had previously expressed interest in volunteering for research studies related to aging issues. Interested individuals were screened for eligibility over the telephone. To ensure that participants were free from neurological, respiratory, cardiovascular, pharmacological and musculoskeletal impairments that might affect their gait, our exclusionary criteria included the following: regular use of assistive devices for walking, painful arthritis in the lower limbs that limited walking or standing, surgeries on the legs or feet in the past five years, frequent ankle sprains, chronic dizziness, neurological diseases that affect gait, vestibular diseases, an injurious fall in the previous year, significant visual impairments and medications that might affect gait and balance.

Procedure

All procedures were approved by the Institutional Review Board (IRB) at San Francisco State University (protocol X17-63R1a) and analyses of this data were also approved by the IRB at Georgia State University (protocol H19150). Prior to the experimental session, participants completed an online survey, or upon request were mailed a paper version of the online survey. This included a variety of questionnaires including a demographics form and a health and activity inventory (Rose, 2010) in which participants noted whether or not they had ever been diagnosed with a variety of health conditions (e.g., osteoporosis, high blood pressure, cancer, cognitive impairment). This questionnaire also assessed medication usage, recent hospitalization, fall history, fear of falling, gait self-efficacy, as well as general quality of life and physical activity questions. This pre-experiment assessment took approximately 35 minutes to complete.

It was completed after the telephone screening but prior to the laboratory session, at a time and location convenient to the participant.

The experimental laboratory session took place at San Francisco State University. Each participant was tested individually by two younger adult experimenters (one of whom administered the study protocol and one of whom served as a technician and monitored acquisition of the gait data). At the outset of the experimental session, participants completed the Positive and Negative Affective Schedule (PANAS; Watson, Clark, & Tellegen, 1988) as a baseline measure of mood. We also assessed participants' height, weight, and resting blood pressure. Following this, we assessed baseline gait. To standardize instructions, participants read and listened to a pre-recorded set of instructions stating that their task was to walk back and forth along the carpeted walkway at their own comfortable pace, that they would be videotaped while they walked, and that they should refrain from talking during this task. Participants then walked back and forth five times along a Zeno Walkway (ProtoKinetics, LLC). This is a 0.61 m x 7.92 m long carpeted walkway with a 16-level pressure sensing pad filled with 1 cm square pressure sensors, which measures data at 120 Hz to assess foot placement (Protokinetics, 2014).

We then introduced a brief delay phase of approximately ten minutes in order to prepare the Zeno Walkway for the critical gait task. During this time all participants (regardless of their condition in the current study) completed filler questionnaires (i.e., an additional demographics form and the BFI-10 personality inventory; Rammstedt & John, 2007). This was followed by the critical gait task, which was meant to be perceived as "easy" or "difficult". The easy gait task was identical to that completed during the baseline assessment (i.e., normal walking, back and forth five times over level ground at their own comfortable pace). However, the difficult gait task entailed walking back and forth five times within two tape-marked lines on the Zeno Walkway (i.e., within a narrow base of support). These lines were separated by 15 cm and were placed on the walkway during the delay period; they were not present during the baseline gait assessment.

Instructions for the critical gait task varied across participants. Participants randomly assigned to the stereotype threat condition received instructions that included a negative age-based evaluation. More specifically, they read and listened to a pre-recorded set of instructions (see Appendix A) stating that older adults like themselves have declines in gait and balance and this increases their risk of falling. They were further told that their performance would be compared to younger adults and that the purpose of the study was to understand why older adults, like themselves, exhibit steep declines in gait and balance. In contrast, other participants were randomly assigned to receive stereotype alleviation instructions. They read and listened to a pre-recorded set of instructions (see Appendix A) stating that healthy community-dwelling older adults like themselves have minimal changes in mobility and as a result have a much lower risk of falling than their frailer peers. They were further told that their performance would be compared to that of frailer adults who were in their 90s and that the purpose of the study was to understand why healthy community-dwelling older adults, like themselves, maintain their gait and balance while their frailer peers show steep declines. All participants then completed the critical gait assessment (i.e., walking back and forth five times on level ground with either a normal or narrow base of support). Participants next completed a questionnaire adapted from Feldman, Cohen, Hamrick, and Lepore (2007), which assessed their evaluations of the critical gait task (see Appendix B). Within this questionnaire, four items assessed task evaluations (i.e., the extent to which this task was perceived as a danger to self-esteem), and four items assessed resource evaluations (i.e., the extent to which participants perceived themselves to have the resources needed to complete the task). Questions were answered on a 1 (*strongly disagree*) to 5 (*strongly agree*) scale.[2] Using the same scale, participants also responded to one item assessing the perceived importance of the critical gait task (‘*Doing well on this task was important to me’*).

After completing all procedures for this study, participants subsequently completed two additional unrelated studies. These involved assessments of cognitive capabilities and the preliminary validation of a consumer-level gait-analysis system. Cognitive capabilities as a function of gait task condition and task instruction condition are presented in Table 1. However, these additional assessments will not be discussed further here. In total, the lab session lasted approximately 1.5 hours. As compensation, participants received $50 at the end of these assessments.

Measures

Temporospatial gait parameters were assessed using the PKMAS software from ProtoKinetics. During the baseline and critical gait tasks, we calculated average stride velocity (i.e., gait speed) and within participant coefficient of variation of stride velocity (i.e., gait speed variability) using steps 4-7 in the central 4 m of the 8.5m walkway. This is similar to the standardized protocol for the measurement of gait speed found in the NIH Toolbox (www.nihtoolbox.org), and ensured that analyses were limited to steady state gait. Previous research has also documented high test-retest reliability of self-selected gait speed (e.g., Peters, Fritz, & Krotish, 2013; Steffen, Hacker, & Mollinger, 2002; van Ulden & Besser, 2004). The change scores between the baseline and critical tasks for these two gait variables were used for the statistical analyses reported below. In addition, for participants who completed the more

[2] Proponents of the biopsychosocial model of challenge and threat often rely upon cardiovascular markers to index these states (e.g., Blascovich & Mendes, 2000; Seery, 2013). Although this approach has the advantage of avoiding social desirability biases and assessing automatic processes, it is unclear whether the cardiovascular signatures of threat and challenge would emerge for older adults who were physically moving. Because these physiological changes are simply a correlate of threat and challenge states, which result from task and resource evaluations, in the current study we opted to use self-reports of task and resource evaluations.

difficult, narrow base gait task we also calculated the number of step errors in which at least part of the foot fell outside the two tape-defined lines during this critical task. Due to a video recording failure, we were unable to calculate this for one participant in the stereotype alleviation, narrow-base gait condition. We also note that steps in which an error occurred were included when calculating average stride velocity and within participant coefficient of variation of stride velocity.

Task evaluations and resource evaluations were assessed via self-report, and had adequate internal consistency. The observed Cronbach's alpha was .91 for the task evaluations and .74 for the resource evaluations.

Analytic Strategy

Analyses were conducted in Minitab 18 (Minitab, Inc.). One-way ANOVAs were used to test for differences in demographics and baseline measures between the four groups (using an $\alpha = 0.05$). We then conducted a series of 2 (Gait task: Normal vs. Narrow base) X 2 (Task instruction: Stereotype threat vs. Stereotype alleviation) General Linear Models (GLMs) with task evaluations and resource evaluations as covariates (mean-centered). The GLM is an ANOVA procedure in which calculations are conducted using least-squares regression approach. It allows for the characterization of the statistical relationship(s) between one or more predictors and a continuous outcome, and allows for continuous covariates to interact with other predictors. In our analyses, we used this approach to examine the relationships between gait task, gait task instruction, task evaluations, and resource evaluations for the change scores (critical gait task – baseline gait task) in average stride velocity and coefficient of variation of stride velocity. Within these analyses, the initial statistical model started with a hierarchical model that included the three-way interaction between task evaluations, gait task, and task instruction as well as the three-way interaction between resource evaluations, gait task, and task instruction. A stepwise procedure with backward elimination was then used to reduce the model to its significant terms, with an alpha to remove set at 0.1. The alpha level for significant terms in the final model was set at 0.05.

For participants assigned to complete the narrow base gait task we also examined whether the number of step errors during the critical task varied as a function of gait task instruction, task evaluations, and resource evaluations. Within this analysis, the initial statistical model included the two-way interaction between task evaluations and task instruction and also the two-way interaction between resource evaluations and task instruction. As described above, a stepwise procedure with backward elimination was then used to reduce the model to its significant terms.

Finally, we also planned to test whether the magnitude of the effect was greater for women than for men. Given that this was an exploratory aim, and given that our power to detect such effects was low (especially for detecting higher-order interactions), this was not included in our primary models and we limited these supplemental analyses to only those outcomes where stereotype threat effects had previously emerged. In these cases, we repeated the analyses above and included sex in the statistical model.

Results

Baseline Measures

There were no significant differences between the four groups in the majority of the demographic or self-rated health variables (Table 1). However, Tukey post-hoc comparisons showed that participants in the stereotype alleviation/normal gait task group had slightly lower gait self-efficacy ($p = 0.02$) and slightly higher fear of falling ($p = 0.03$) than participants in the stereotype threat/narrow base gait task group. However, there were no significant differences in these measures between the other groups.

At baseline, the average stride velocity of participants (collapsed across all four conditions) was 1.18 m/s, which is similar to the normative gait speed from a comprehensive study of community-dwelling older adults in good health status (~1.17 m/s for the 70-79 year olds in the study; Hollman et al., 2011). A one-way ANOVA confirmed that during the baseline task, there was no significant difference in mean stride velocity, $F(3,159) = 0.08$, $p = 0.97$, or coefficient of variation of stride velocity, $F(3,159) = 0.69$, $p = 0.56$, between the four groups. Baseline gait parameters as a function of critical gait task (easy/ normal vs. difficult /narrow base) and task instructions (stereotype threat vs. stereotype alleviation) are presented in Table 2.

Task and Resource Evaluations

Because task engagement is a prerequisite for experiencing threat and challenge motivational states (Blascovich & Mendes, 2010), we next tested whether participants in each group perceived the critical gait task as important. This was done using a series of one-sample t-tests against the critical value of 3 (i.e., the scale midpoint which indicated neither agreement or disagreement with the statement '*Doing well on this task was important to me*'). As can be seen in Table 3, results showed that all participants perceived the critical gait tasks as important (all *p*s $< .001$).

In the current study, the critical gait task was designed to vary in difficulty. We tested whether this was reflected in participants' task evaluations (i.e., was this task threatening and a negative experience?) and resource evaluations (i.e., did I have the resources needed to cope with the demands of this task?) using separate 2 (Gait task) X 2 (Task instruction) ANOVAs. Within these analyses, there was a significant main effect of gait task on both task evaluations, $F(1,159)$

= 44.7 $p < .001$, and also on resource evaluations, $F(1,159) = 55.0$, $p < .001$. As shown in Table 3, participants who completed the difficult, narrow base of support gait task perceived the task as more threatening (i.e., gave higher task evaluations) and perceived themselves as less able to cope with the demands of the task (i.e., gave lower resource evaluations). However, there were no significant main effects of task instruction condition on task evaluations, $F(1,159) = 0.13$, $p = .72$, or resource evaluations, $F(1,159) = .33$, $p = .57$. There were also no significant interactions between gait task and task instruction on task evaluations, $F(1,159) < 0.01$, $p = .95$, or resource evaluations, $F(1,159) = 0.07$, $p = .79$.

Critical Gait Task Parameters

Stride velocity. We first examined whether changes in mean stride velocity depended upon the relationships between gait task condition, task instruction condition, participants' task evaluations, and participants' resource evaluations. Within this analysis there were three significant effects. There was a significant main effect of gait task condition, $F(1, 155) =82.80$, $p < .001$, a significant interaction between resource evaluations and task instruction condition, $F(1, 155) = 6.35$, $p = .013$, and also a significant interaction between resource evaluations, task instruction condition, and gait task condition, $F(1, 155) = 7.79$, $p = .006$ (see Figure 1).

To better understand this three-way interaction, we next analyzed the two different gait tasks separately. For participants in the normal gait task, there were no significant effects (all *p*s > .10). In contrast, for participants in the narrow base gait task there was a significant interaction between task instruction condition and resource evaluations, $F(1, 77) = 9.63$, $p = .003$. As can be seen in Figure 1, during the narrow base gait task we observed a stereotype threat effect (i.e., slower walking after receiving the stereotype threat instruction), but only for participants who did feel that they had sufficient resources to cope with the demands of the task. In contrast, this adverse effect was not present (and was numerically reversed) amongst people who were confident in their abilities to perform well on the task.

Coefficient of variation of stride velocity. We repeated the above analyses using the coefficient of variation of stride velocity as our outcome of interest, which provides a measure of variation relative to the mean. Within our initial model we again observed only three significant effects. There was a main effect of gait task condition, $F(1, 155) = 19.80$, $p < .001$, a significant interaction between task instruction condition and resource evaluations, $F(1, 155) = 5.55$, $p = .020$, and a significant interaction between task instruction condition, gait task condition, and resource evaluations, $F(1, 155) = 4.32$, $p = .039$.

When broken down by gait task condition, in the normal gait task, there was only a significant effect of task instruction condition on the change in coefficient of variation of stride velocity, $F(1, 80) = 4.54$, $p = .036$. As shown in Figure 2, participants in the stereotype alleviation group reduced their coefficient of variation by .44% whereas participants in the negative age-based evaluation group increasing their coefficient of variation by .12%. In contrast, during the narrow base gait task, the only significant effect that emerged was an interaction between task instruction condition and participants' resource evaluations, $F(1, 77) = 6.48$, $p = .013$. Relative to the mean performance, stride velocity was significantly more variable during the narrow base gait task in the negative age-based evaluation group compared to the threat alleviation group, but this effect was limited to participants with low perceptions of their resources to complete the task and was reversed amongst participants with high perceptions of their resources to complete the task.

Step errors. During the narrow base of support gait task, we also calculated the number of step errors. We next examined whether the number of step errors during the narrow base gait task varied based upon task instruction condition, task evaluations, and resource evaluations. Results showed two significant effects. There was a significant main effect of resource evaluations, $F(1,76) = 4.18$, $p = .044$, which was qualified by a significant interaction between task instruction condition and resource evaluations, $F(1,76) = 6.16$, $p = .015$. For participants who completed the narrow base of support gait task, step errors were more common for participants in the stereotype threat condition, but this effect was again limited to participants who felt that their resources were too low to cope with the demands of the task (see Figure 3).

Exploratory Analyses of Sex Differences

As an exploratory aim, we next tested whether stereotype threat effects observed in the prior analyses differed between the male and female participants. In the normal gait tasks, the only outcome affected by stereotype threat was the coefficient of variation of stride velocity. When sex was included in this model, none of the conclusions about stereotype threat changed and there were no significant effects involving sex (all *p*s > .10). Likewise, in the narrow base gait task, for change in the coefficient of variation of stride velocity and for step errors, there were also no significant effects involving sex (all *p*s > .10) and none of the conclusions reported above changed. However, for change in stride velocity during the narrow base task, there were differences between the men and women. More specifically, when including sex in the model the interaction between task instruction condition and resource evaluations, $F(1, 75) = 9.99$, $p = .002$, remained statistically significant. There was also an interaction between task instruction condition and sex for the change in mean stride velocity, $F(1, 75) = 4.08$, $p = 0.047$, such that the effects of our stereotype threat manipulation were larger for the women than for the men. The three-way interaction between task instruction condition, sex, and resource evaluations was not statistically significant ($p > .10$). However, as can be seen in Figure 4, in the stereotype alleviation conditions, the relationship between resource evaluations and change in mean stride velocity was similar for men and women. In contrast, in the negative age-based evaluation conditions, there was no relationship between resource evaluations and change in mean stride velocity for the men (R^2 = 0.8%) but there was a relatively strong relationship between the two for the women (R^2 = 22.6%).

Discussion

Older adults are often stereotyped as being frail, slow, and weak (Minichiello, Browne, & Kendig, 2000; Hummert, 1990). The purpose of the present study was to examine whether explicit activation of these ageist stereotypes can lead older adults to experience stereotype threat and underperform on physical performance tasks. In testing this, we focused on gait parameters, as these are powerful predictors of functional declines, disability, and the risk of mortality in older adults (e.g., Cesari et al., 2005; Van Kan et al., 2009). This study had three key findings. First, aligning with a large body of research showing that age-based stereotypes can affect older adults' cognitive performance (see Barber, 2017; Barber & Mather, 2014; Lamont et al., 2015), we found that age-based stereotypes can also adversely affect older adults' gait performance. However, these adverse effects (i.e., walking slower, with relatively more variability in speed, and with more step errors) were generally limited to participants completing the difficult gait task who were not confident that they had sufficient resources to cope with the demands of the task. These findings are consistent with previous proposals that stereotype threat effects should be most pronounced on difficult tasks (for a review, see Steele et al., 2002) and are also consistent with the notion that subjective evaluations of resources to cope with task demands affect whether people have a threat versus challenge motivational response (Blascovich, 2008; Blascovich & Mendes, 2000).

Our finding that resource evaluations modulate the magnitude of stereotype threat effects in a physical domain can also help explain previous inconsistencies in the literature. As previously noted, the three prior studies examining the effects of age-based stereotype threat on older adults' physical performance have yielded inconsistent findings. However, the participants in these studies varied in their baseline functional abilities. This likely affected participants' subjective perceptions that the task was difficult and that they had the necessary resources to cope with the demands of the task. Our results suggest that these subjective perceptions should in turn should affect whether or not stereotype-threat related performance deficits emerge. Consistent with this, stereotype-threat performance impairments were documented in the study using participants with below-average functional abilities (Swift et al., 2012), were inconsistent (emerging on one task but not others) in the study using participants with average functional abilities (Marquet et al., 2018), and were absent in the study using participants with above-average functional abilities (Horton et al., 2010).

This finding also aligns with other research in the cognitive domain suggesting that not all aspects of cognition are equally affected by stereotype threat (for a review, see Barber & Lui, in press). For example, previous research has shown that stereotype threat has a larger impact on working memory tasks than on episodic memory tasks (for a meta-analysis, see Armstrong, Gallant, Li, Patel, & Wong, 2017), on source memory tasks than on item memory tasks (Brubaker & Naveh-Benjamin, 2018), on recollection than on familiarity (Hess, Emery, & Queen, 2009; Mazerolle, Régner, Rigalleau, & Huguet, 2015), and for prospective memory tasks that use non-focal rather than focal cues (Zuber, Ihle, Blum, Desrichard, & Kliegel, 2019). One commonality of these findings is that the stereotype-threat related performance declines are typically larger in domains where there are greater age-related changes. This may be because these tasks are perceived as more difficult. Consistent with this, stereotype threat effects are not always observed on recognition memory tests (e.g., Barber & Mather, 2013; Kang & Chasteen, 2009), but emerge when the task is made more difficult by imposing a response deadline (Hess et al., 2009). Future research is needed to further examine how participants perceive the difficulty of various cognitive and physical tasks, and test whether this in turn predicts the magnitude of stereotype threat effects observed on those tasks.

Our findings also add to a growing body of evidence suggesting that there are individual differences in older adults' susceptibility to age-based stereotype threat effects (for a review, see Barber & Lui, in press). In the current study we found that effects were largely limited to older adults completing the difficult narrow base task who did not perceive themselves as having adequate resources to cope with the demands of the task. This is similar to prior results that stereotype threat effects in cognition are larger for older adults with lower domain-relevant self-efficacy (Desrichard & Köpetz, 2005; Schlemmer & Desrichard, 2018), for older adults with negative self-perceptions of aging (Fernández-Ballesteros, Bustillos, & Huici, 2015), and for older adults who believe age-related declines are inevitable and non-modifiable (Plaks & Chasteen, 2013; Weiss, 2018). Together, these findings suggest that changing self-perceptions of efficacy, mastery, and beliefs about aging may be effective interventions to inoculate against stereotype threat effects. Although these are all components of resource evaluations, future research is needed to compare their individual contributions to moderating stereotype threat effects, in order to determine the most appropriate intervention targets.

Our results also suggest that these interventions may be particularly effective for older women. In the current study we found preliminary evidence that stereotype threat effects were larger for women than men, and the link between resource evaluations and performance was larger for women than men. However, future research is needed to further examine this sex difference. As previously noted, our exploratory analysis was underpowered to fully examine this issue.

The current findings also fit with two different theories of stereotype threat. The first is a framework that draws upon regulatory focus theory (Higgins, 1998; for a comparison of regulatory focus theory and the biopsychosocial model of challenge and threat, see Sassenberg & Scholl, 2019). In brief, regulatory focus theory differentiates between concerns about the presence or absence of positive outcomes (promotion focus) and about the presence or absence of negative outcomes (prevention focus). It has been argued that in situations that elicit stereotype threat, people are less eager to achieve the gains that will lead to their aspirations (promotion focused) and instead vigilantly avoid the losses that will lead to negative outcomes (prevention focused; see Seibt & Förster, 2004). If true, then stereotype threat should be associated with a risk averse and cautious responding style. In cognition, this has been evidenced by slower responding (Abrams, Eller, & Bryant., 2006; Popham & Hess, 2013; Zhang, Lin, Gao, Zawisza, Kang, & Chen, 2017). Likewise, in the current study we found that our stereotype threat instruction was associated with slower walking speeds during the difficult narrow base gait task, although this effect was limited to people who felt their resources were insufficient to cope with the demands of the task.

If stereotype threat induces a prevention focus, we would also expect to see people adopt a more cautious responding strategy that attempts to avoid mistakes and errors. For example, in cognition, stereotype threat is sometimes associated with reductions in memory errors (Barber & Mather, 2013; Thomas, Smith, & Mazerolle, 2018), although this effect reverses during false memory paradigms (Smith, Gallo, Barber, Maddox, & Thomas, 2017; Thomas & Dubois, 2011).

However, in the current study we found that stereotype threat was associated with increased (rather than decreased) step errors during the difficult narrow base gait task. At first glance, this seems at odds with the regulatory focus account of stereotype threat. However, it is important to note that step errors can occur for multiple reasons. Step errors can reflect an inability to tightly control balance in the mediolateral direction, but they can also reflect a lateral protective step that helps people avoid falling or losing balance. In this second case, the step errors would be consistent with the adoption of a more cautious approach to the task and an increased concern with avoiding the negative outcome of falling, and the finding that these increase under stereotype threat is therefore consistent with the regulatory focus account.

Although these findings are consistent with the regulatory focus account of stereotype threat, they are also consistent with the integrated process model of stereotype threat. Proposed by Schmader, Johns, and Forbes (2008) this model suggests that stereotype threat is associated with increased task monitoring, with increased vigilance towards situational cues in the environment, and also with negative thoughts and affective responses that people try to regulate. Together, these responses consume working memory resources and this in turn leads to performance decrements on tasks that require controlled processes. Of relevance to the current study, cognition plays a role in the postural control of gait (for a review, see Woollacott & Shumway-Cook, 2002) and prior research has shown that performing a concurrent cognitive task leads to performance decrements amongst older adults during narrow base walking: Older adults walk slower (Kelly, Schrager, Price, Ferrucci, & Shumway-Cook, 2008) and sometimes have more step errors (Gimmon et al., 2016; but see Kelly et al., 2008 for a failure to observe this). Thus, the current results are also consistent with the proposal that stereotype threat consumes cognitive resources, which in turn leads to performance decrements.

Regardless of the mechanisms underlying these stereotype threat effects, the current results also have implications for fall risks. Falls affect about one-third of people over the age of 65 annually (Campbell, Borrie, Spears, Jackson, Brown, & Fitzgerald, 1990; Hausdorff, Rios, & Edelberg, 2001). They are the leading cause of injury and death amongst older adults (Tinetti, 2003), and also account for 40% of nursing home placements (Masud & Morris, 2001). This constitutes a major public health problem with substantial economic costs: In 2000, it is estimated that the direct medical costs of falls in the United States totaled over 19 billion dollars (Stevens, Corso, Finkelstein, & Miller, 2006). Numerous studies have examined risk factors for falls amongst older adults (e.g., Prevention, O.F., & Panel, O. S., 2001). Although results have been mixed, in reviewing the literature Abrose, Paul, and Hausdorff (2013) suggest that the primary risk factors include older age, functional abilities (e.g., lower extremity strength), and chronic conditions (e.g., vestibular dysfunction, cognitive deficits, neurodegenerative disease, cardiovascular disease, depression). However, of relevance to the current study, pathologies in gait parameters are also a risk factor for falls. Falls are more common in people with slower gait speed (Verghese et al., 2009) and with more variability in their gait (Hausdorff et al., 2001). Given that the current study found that stereotype threat was associated with both reductions in gait speed (in the narrow base task) and with increases in the variability of gait speed (in both the normal and narrow base task), it follows that stereotype-threat related concerns may also increase fall risks. Future research is needed to test this.

There are also limitations of this study that will need to be addressed in future research. First, in this study, participants provided retrospective judgments of their resource evaluations. This allowed us to administer the critical gait task immediately after the stereotype threat instructions, which is important given that stereotype threat effects dissipate over time and/or across multiple tasks (Lamont et al., 2015). However, it is unclear whether or not these hindsight evaluations are representative of how the participants perceived the critical gait task.

An additional limitation of the current study is that it did not include a control condition. Rather, we designed our two instruction conditions to either increase or alleviate concerns about being evaluated negatively due to age-related physical changes. However, this raises the question of whether our stereotype threat instruction impaired performance, whether our stereotype alleviation instruction improved performance, or whether some combination of these effects occurred. Within the domain of memory, one prior study reported similar effects between a control condition and a stereotype alleviation condition (Hess et al., 2003). However, future research is needed to also test this within the context of physical performance.

In doing so, it will also be important to test participants with a wider variety of functional abilities. Participants in this study were all in good health and had average functional ability levels. As noted earlier, the average gait speed of our participants at baseline (1.18 m/s) was comparable to the normative gait speed from a comprehensive study of community-dwelling older adults in good health status (~1.17 m/s for the 70-79 year olds; Hollman et al., 2011). As shown in Table 1, our participants also had relatively high gait self-efficacy and regularly engaged in physical activity. This in turn likely affected how participants responded to our task instruction manipulation. We expect that the adverse effects of the stereotype threat instruction reported here would have been larger amongst participants with lower functional ability levels, who have lower levels of gait self-efficacy, and are more sedentary. Furthermore, amongst frailer older adults with poorer functional abilities it is possible that we would have also observed a stereotype-threat related decline in gait speed during the “easy” normal gait task. Future research is needed to test this. Finally, the fact that resource evaluations did not modulate gait parameters during the “easy” normal gait task should be interpreted cautiously. The participants who completed this task generally saw themselves as able to cope with the demands of the task.

Future research should also examine whether the effects of stereotype threat on older adults’ physical performance varies with age. Prior studies using cognitive outcomes have shown that age-based stereotype threat effects tend to be greater in younger-old adults than in older-old adults (Eich, Murayama, Castel, & Knowlton, 2014; Hess & Hinson, 2006; Hess, Hinson, & Hodges, 2009). Although it is currently unclear whether age-differences in susceptibility to stereotype threat effects would also emerge in a physical domain, the current study was not able to answer this question. Even though participants in this study ranged in age from 66 to 86, the vast majority were in their early 70s. Future stereotype threat research is needed that focuses on physical outcomes and includes a larger number of older-old adults. In doing so, it will also be important to consider how younger-old and older-old adults differ in functional ability levels, physical activity, self-efficacy, task evaluations, and resource evaluations in order to better understand potential age differences in stereotype threat effects.

In summary, negative age-based evaluations typically impair older adults’ performance by invoking stereotype threat (Lamont et al., 2015). In the current study we replicated this in a physical task domain. When older adults with lower resource evaluations were concerned that they were being negatively evaluated because of their age, they walked slower, with more variability in their speed, and with more step errors during a difficult narrow base task. This in turn has important implications for the clinical utility of assessing gait parameters. Clinicians have been encouraged to routinely assess older adults’ gait speed (Fritz & Lusardi, 2009; Middleton et al., 2015), and assessing performance during a narrow base walking task may provide a better estimate of older adults’ fall risk (Gimmon et al., 2016; Simonsick et al., 2001).

However, protocols for evaluating gait parameters vary widely, and this influences interpretations of physical performance (Graham, Ostir, Fisher, & Ottenbacher, 2008). Given that older adults report experiencing overt ageism from medical providers (Eymard & Douglas, 2012; Greene, Hoffman, Charon, & Adelman, 1987; Robb, Chen, & Haley, 2002) as well as negative age-based evaluations and stereotype threat in healthcare settings (Abdou, Fingerhut, Jackson, & Wheaton, 2016; Phibbs & Hooker, 2017), the current results suggest that these experiences can in turn alter older adults' gait performance. Because of this, clinicians should ensure that the instructions used during gait assessments do not inadvertently remind older patients of negative ageist stereotypes.

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Table 1

Mean Scores (and Standard Deviations) for Demographic factors, Self-Reported Health Status, and Cognitive Capabilities for Participants as a Function of Gait Task Condition and Task Instruction Condition

	Normal Gait		Narrow Base Gait	
	Stereotype Alleviation	**Stereotype Threat**	**Stereotype Alleviation**	**Stereotype Threat**
Sample size (n)	41	41	39	42
Age (years)	73.0 (4.7)	73.8 (4.7)	72.6 (4.0)	73.9 (4.5)
Sex				
Male	13	13	12	12
Female	28	28	27	30
Race				
Asian	4	7	9	2
Caucasian/White	34	31	29	37
African American/Black	1	0	0	0
American Indian/Alaskan Native	0	1	0	0
Other	2	1	1	3
Declined to state	0	1	0	0
Education (years)	17.1 (1.6)	17.3 (2.0)	17.6 (2.2)	17.5 (2.3)
Body mass index[a]	25.7 (4.3)	25.6 (4.7)	25.2 (4.6)	24.0 (4.1)
Total number of diagnosed medical conditions [b]	1.8 (1.3)	1.9 (1.4)	1.8 (1.6)	2.0 (1.6)
Fallen in the last year	10/41 (24%)	11/41 (27%)	7/39 (18%)	6/42 (14%)
Fear of falling [c]	3.1 (1.6)*	2.4 (1.4)	2.7 (1.4)	2.1 (1.5)
Self-rated health [d]	3.9 (0.7)	4.2 (0.7)	3.8 (0.8)	4.1 (0.9)
Self-reported number of days per week currently spent participating in exercise [e]	5.1 (1.8)	5.3 (1.9)	4.9 (1.7)	5.3 (1.7)
Gait self-efficacy [f]	9.2 (0.8)*	9.5 (0.7)	9.3 (0.7)	9.7 (0.4)
Positive mood [g]	3.7 (0.7)	3.6 (0.9)	3.6 (0.6)	3.4 (0.7)
Negative mood [g]	1.1 (0.2)	1.1 (0.1)	1.1 (0.2)	1.1 (0.1)
Trail Making Test A [h]	32.8 (10.1)	32.2 (10.3)	32.4 (8.9)	31.2 (8.6)
Trail Making Test B [h]	91.8 (64.2)	89.8 (66.9)	89.5 (33.4)	89.1 (52.7)
NIH Cognition Toolbox				
Fluid cognition composite [i]	90.2 (8.1)	92.5 (10.7)	90.7 (9.9)	91.5 (9.6)
Crystallized cognition composite [i]	117.8 (5.8)	117.7 (5.5)	116.0 (5.7)	117.5 (6.0)

* Tukey posthoc comparisons showed that Fear of falling was significantly higher and Gait Self Efficacy was significantly lower in the Stereotype Alleviation/Normal Gait Task group compared to the Stereotype

Threat/Narrow Base Task group (*p*s < 0.05). There were no significant differences between groups in any of the other demographic or health-related measures (all *p*s > 0.1).

[a] Body mass index was calculated using measured height and weight. Data is missing for one participant.
[b] Diagnosed medical conditions included arthritis, depression, diabetes, heart attack, high blood pressure, chest pain (angina), neuropathies, osteoporosis, other neurological diseases, respiratory disease, chemical dependency, cancer, visual problems and other health diagnoses not related to gait.
[c] Fear of falling was assessed on a 1 to 5 scale (1 = not at all, 5 = extremely)
[d]Self-rated health was assessed on a 1 to 5 scale (1 = excellent, 5 = poor)
[e]Self-rated days spent exercising was assessed using the question "*How many days do you currently participate in regular physical exercise (such as walking, sports, exercise classes, housework, yard work) that is strenuous enough to cause a noticeable increase in breathing, heart rate, or perspiration?*".
[f]Gait Self Efficacy was assessed using the mGES (modified Gait Efficacy Scale; Newell, VanSwearingen, Hile, & Brach. 2012) with a score of 10 = complete confidence
[g]Positive and negative mood in the present moment were assessed using the PANAS (Watson et al., 1988). The average response to each subscale is reported here on a 1 to 5 scale (1 = very slightly or not at all, 5 = extremely).
[h]Executive function, visual search and speed of processing abilities were assessed using the Trail Making Test Part A and B (Reitan Neuropsychology Laboratories, Inc.). Data for Part A is missing for one participant.
[i]Fluid and crystallized cognitive capabilities were assessed using the NIH Toolbox Cognition Battery (see www.nihtoolbox.org). Based upon scores from seven instruments, uncorrected standardized composite scores reflecting fluid and crystallized abilities are calculated. Scores on these measures are normed to have a mean of 100 and a standard deviation of 15 within the general U.S. population. Data from four participants is missing for the fluid cognition composite score and data from one participant is missing for the crystallized cognition composite score.

Table 2

Mean Gait Parameters (± SDs) as a Function of Gait Task (baseline vs. critical), Critical Gait Task Condition (normal vs. narrow base) and Task Instruction Condition (stereotype threat vs. stereotype alleviation)

		Normal Gait		Narrow Base Gait	
		Stereotype Alleviation	Stereotype Threat	Stereotype Alleviation	Stereotype Threat
Mean Stride Velocity (m/s)	Baseline Gait	1.19 (.14)	1.18 (.15)	1.20 (.14)	1.18 (.19)
	Critical Gait	1.22 (.14)	1.21 (.15)	0.98 (.23)	0.93 (.28)
Coefficient of Variation (CV) of Stride Velocity (%)	Baseline Gait	4.5 (2.0)	4.2 (1.5)	4.1 (1.1)	4.4 (1.2)
	Critical Gait	4.1 (1.8)	4.3 (1.8)	8.3 (6.8)	10.8 (9.3)

Note: There were no significant differences between groups at Baseline for either the Mean Stride Velocity (p = 0.97) or the Coefficient of Variation of Stride Velocity (p = 0.56).

Table 3

Mean Scores (and Standard Deviations) for Perceived Task Importance, Primary Evaluations, and Secondary Evaluations as a function of Gait Task Condition and Task Instruction Condition

	Normal Gait		**Narrow Base Gait**	
	Stereotype Alleviation	**Stereotype Threat**	**Stereotype Alleviation**	**Stereotype Threat**
Task Importance	3.8 (1.4)	4.0 (1.1)	3.8 (1.2)	3.7 (1.0)
Task Evaluations	1.1 (0.2)	1.1 (0.3)	1.7 (0.8)*	1.8 (0.9)*
Resource Evaluations	4.5 (0.6)	4.5 (0.6)	3.8 (0.7)*	3.7 (0.8)*

* Those in the narrow base gait condition were significantly different from those in the normal gait condition ($p < 0.001$).

Figure 1

Best Fit Regression Lines for Change in Mean Stride Velocity (cm/s) as a function of Gait Task Condition, Task Instruction Condition, and Resource Evaluations

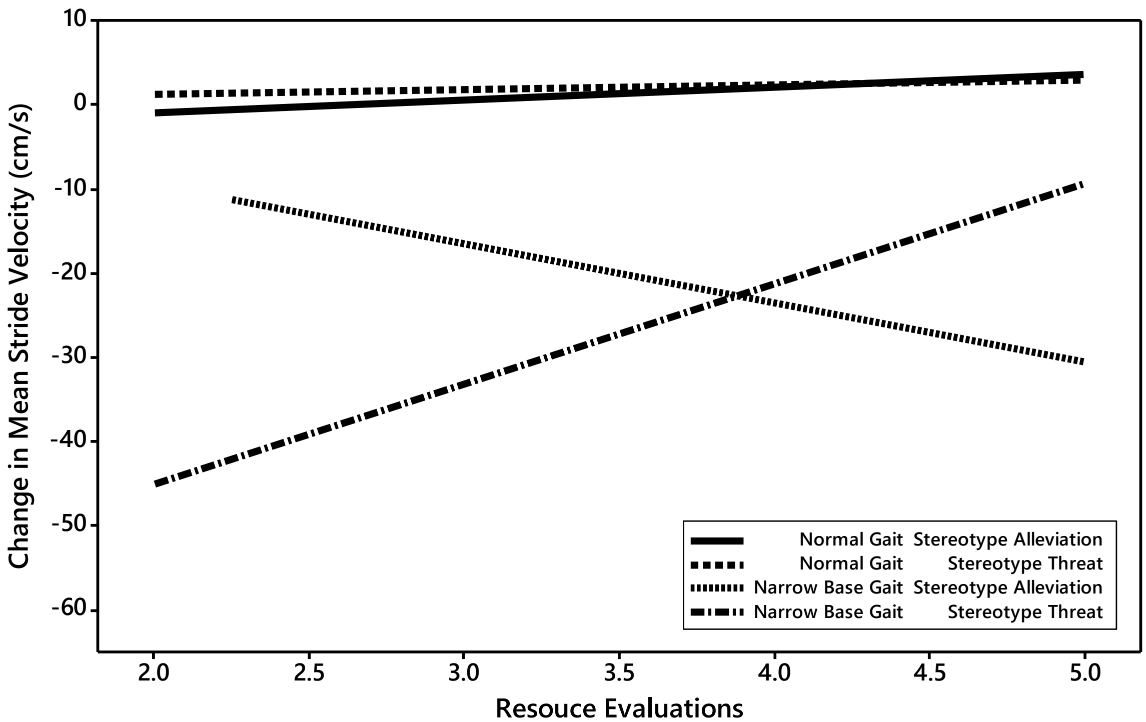


Figure 2

Best Fit Regression Lines for Change in Coefficient of Variation of Stride Velocity (%) as a function of Gait Task Condition, Task Instruction Condition, and Resource Evaluations

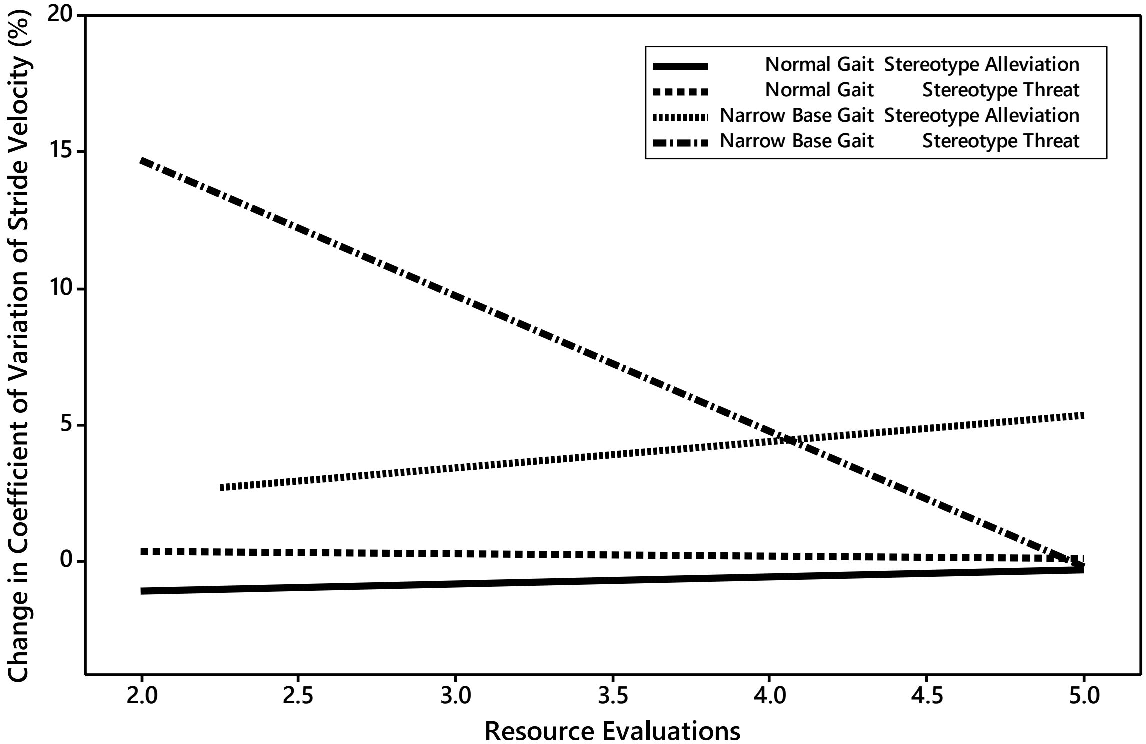


Figure 3

Best Fit Regression Lines for Step Errors during the Narrow Base Gait Task as a function of Task Instruction Condition and Resource Evaluations

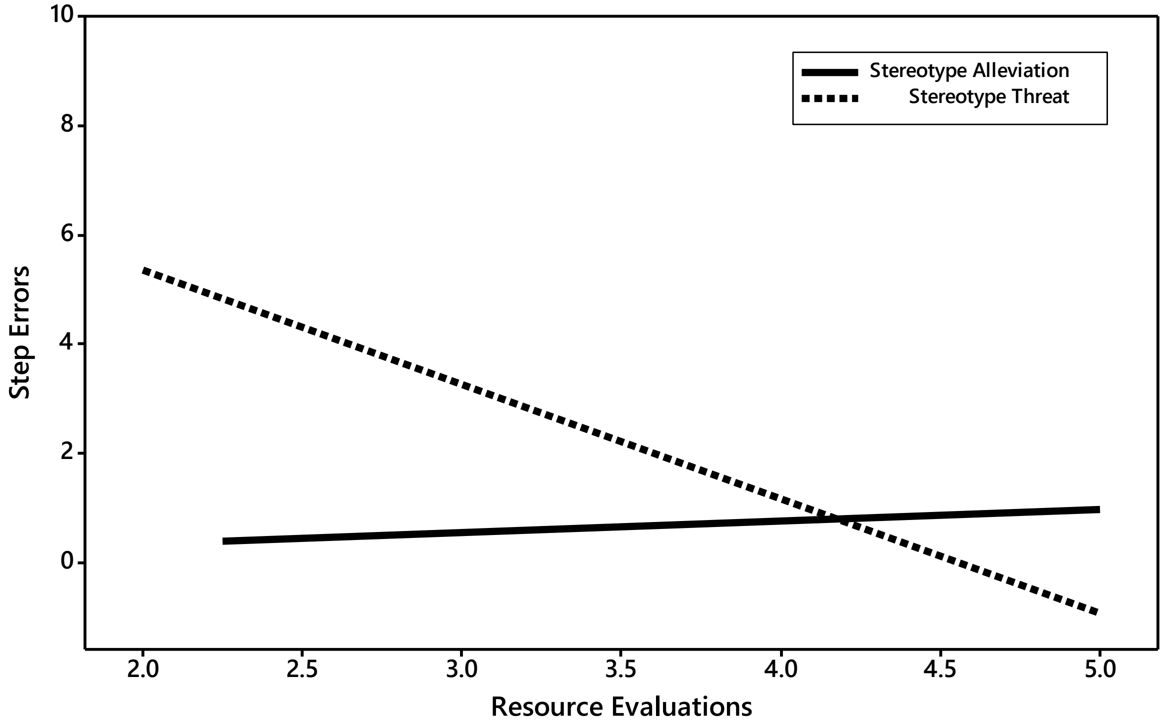
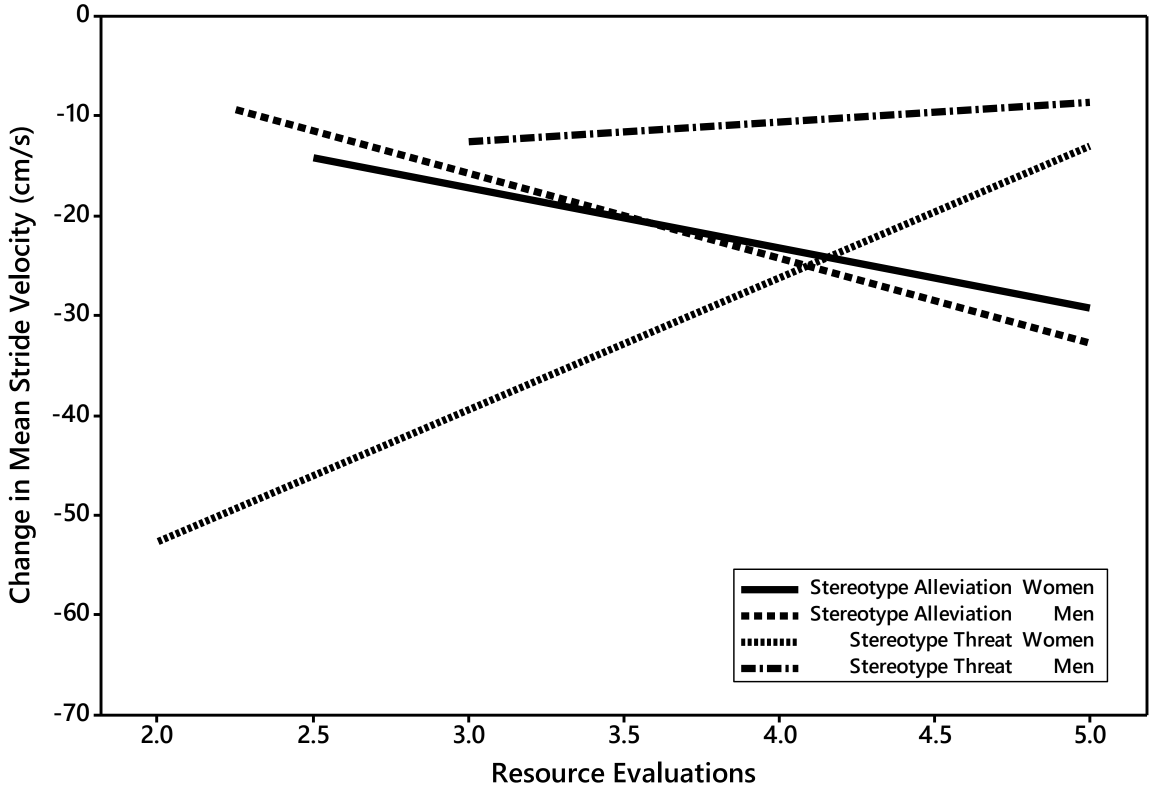


Figure 4

Best Fit Regression Lines for Change in Mean Stride Velocity (cm/s) during the Narrow Base Gait Task as a function of Task Instruction Condition, Participants Sex, and Resource Evaluations



Appendix A

Task instructions used in the current study

<u>Stereotype threat condition:</u>

The purpose of the current study is to investigate how age affects gait and balance. Previous scientific research has suggested that as people get older, they inevitably show declines in their gait and balance. As a result, older adults have a much greater risk of falls compared to younger adults. Because of this relationship, clinicians are now starting to evaluate the way older adults' walk as a vital sign of health.

In this study we will further evaluate the relationship between age, gait, and health. To do so, we are recruiting both younger and older adults. Based upon your age, you are part of our older adult group. Your performance will be compared to that of younger adults, who are physically active and in their 20s. This will help us better understand why older adults -- like yourself -- exhibit steep declines in gait and balance as compared to younger adults.

<u>Stereotype alleviation condition</u>

The purpose of the current study is to investigate how age affects gait and balance. Previous scientific research has suggested that healthy-community dwelling older adults have minimal or no change in their gait and balance. As a result, they have a much lower risk of falling compared to their frailer peers. Because of this relationship, clinicians are now starting to evaluate the way older adults' walk as a vital sign of health.

In this study we will further evaluate the relationship between age, gait, and health. To do so, we are recruiting adults who range in age from 65 to 100. Based upon the health screenings you have completed and your age, you are part of our younger group of healthy, community-dwelling older adults. Your performance will be compared to that of a much older group of older adults, who are frailer and in their 90's. This will help us better understand why healthy, community-dwelling older adults -- like yourself -- are able to maintain their gait and balance while your frailer peers show steep declines.

Appendix B

Questions used in the current study to assess task and resource evaluations

Task Evaluation Questions

1. This task was threatening.
2. Completing this task was a negative experience for me.
3. This task resulted in negative emotions for me.
4. This task had a negative impact on me.

Resource Evaluation Questions

1. I was able to cope with the demands of this task.
2. I had a sense of control over this task.
3. I expect that other people would have a sense of control over this task.
4. I was not confident in my ability to perform well during this task. (*reverse coded*)