Does the effect of stereotypes in older people depend upon task intensity?

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Title: Does the effect of stereotypes in older people depend upon task intensity?
Abstract

This study examined whether aging stereotypes impact physical performance. 50 physically active women aged between 67 to 95 years participated in this study. They were randomly assigned to a positive stereotype, a negative stereotype, or a control condition. They were asked to perform a voluntary contraction at a level of muscular effort that corresponded to different perceived effort intensities (at a score of 3, 5, 7, and 9 on a 0-10 point scale). Results showed that participants developed more strength at levels 3 and 7 after the induction of both negative and positive stereotypes. At levels 5 and 9, stereotype induction did not significantly change the strength from the baseline performance. During submaximal perceived intensities, both negative and positive stereotypes can positively influence strength production. Consequently, such manipulation may be used to increase active women’s strength and more generally work intensity during adapted physical program.

Key-words: positive stereotype, negative stereotype, perception of effort, strength, ageism
Introduction

“Ageism” refers to the negative stereotypes or behavior toward older people (Butler, 1969). For example, they are perceived as frail and weak (Hummert, 1990). Even if negative stereotypes are prevalent, positive stereotypes also exist (e.g., more experienced) (Hummert, 1990). At the physiological level, the aging process tends to reduce physical functions (e.g., strength; Tuna, Edeer, Malkoc, & Aksakoglu, 2009) and results in difficulties in daily life activities. Some studies showed that positive stereotypes as well as negative stereotypes may influence physical performance (e.g., Levy & Leifheit-Limson, 2009). As grip strength is a good index of the degree of individual capability in daily life (Bohannon, Peolsson, Massy-Westropp, Desrosiers, & Bear-Lehman, 2006), the present research investigated the effect of aging stereotypes on older people physical performance on a strength grip task.

According to the literature, positive and negative aging stereotypes may significantly impact older adults’ cognitive performance (e.g., Hess, Auman, Colcombe, & Rahhal, 2003). Fewer studies investigated the effect of stereotypes on physical performance. Concerning positive stereotypes, Hausdorff, Levy, and Wei (1999) found that the induction of positive stereotypes significantly improved walking speed and spatiotemporal parameter of gait (i.e., percentage swing time). In the same way, Levy and Leifheit-Limson (2009) showed that positive stereotypes may increase older individuals’ balance performance. Finally, an implicit-age-stereotype-intervention during 4 weeks has been shown to increase physical functions (Levy, Pilver, Chung, & Slade, 2014). In contrast, Moriello, Cotter, Shook, Dodd-McCue, and Welleford (2010) observed that older adults’ gait speed, standing balance and lower extremity performance were not influenced by positive stereotypes. Similarly, Horton, Baker, Pearce, and Deakin (2010) found that maximal
strength, maximal performance during a “Sit and reach test”, and gait speed were not affected by a positive stereotype. A recent research also showed that balance performance (i.e., 10 30-sec trials on a horizontal platform) was unaffected after the induction of a positive stereotype (Chiviacowki, Cardozo, & Chalabaev, 2018).

One possible explanation of these disparate findings could be the difference of stereotype activation. While Hausdorff et al. (1999) and Levy and Leifheit-Limson (2009) exposed their participants to subliminal stereotypic words (e.g., “fit”), Moriello et al. (2013) exposed their participants to stereotype-related objects (e.g., book), Horton et al. (2010) and Chiviacowski et al. (2018) used explicit manipulations. For example, Chiviacowski et al. (2018) informed their participants that “[they] were interested in examining differences in balance ability between different age groups, and that their performance would be compared with performance of participants 20 years older”. It could therefore be hypothesised that the level of consciousness of the stereotype presentation could influence its effect. For example, in the context of race and gender based, the results of a meta-analysis suggested that subtle threat-activating cues produced the largest effect, followed by blatant and moderately explicit cues (see also Nguyen & Ryan, 2008).

In the present research, we focused on the effect of a conscious and explicitly provided positive stereotype suggesting an advantage of older adults on motor performance (i.e., as compared to younger adults). To induce a positive stereotype, Horton et al. (2010) informed their participants that their performance, on certain tasks, may be identical to the scores of people half their age. Chiviacowski et al. (2018) only told that their performance will be compared with performance of participants 20 years older. But, these two studies did not provide to participants a positive stereotype suggesting an advantage of older adults on younger ones (e.g., more experienced). Because there is no positive stereotype concerning physical capacities of older people (e.g., Hummert, 1990), a positive stereotype based on older people experience was adapted to the task.
A second explanation of the disparate findings concerning the effects of positive stereotypes on physical performance could be the intensity of the task. Indeed, tasks used in the literature varied in intensity from low (e.g., walking task at preferred speed, Hausdorff et al., 1999) to high (e.g., maximal handgrip strength, Horton et al., 2010) (i.e., submaximal to maximal). We noted that when tasks were submaximal, an increase of motor performance was generally observed (e.g., Hausdorff et al., 1999) whereas the induction of a positive stereotype during a maximal task, do not modify the performance (e.g., Horton et al., 2010). Hence, the intensity of the task may moderate the effect of aging stereotypes on physical performance. In the present research, we tested this hypothesis by evaluating the effect of a positive stereotype on the same task but at different intensities (from low to maximal effort). To that end, we have used a perceived exertion scale to set the intensity of the exercise (e.g., Borg, 1998). This method allows to set the intensity of an effort from 0 (i.e., no effort) to 10 (i.e., maximal effort) and participants must develop an intensity matching to their perception of the selected level of effort. This kind of effort scale is more and more used in older adults to set intensity during adapted physical activities (e.g., Row Lazarini, Dropp, & Lloyd, 2017).

The effects of negative stereotypes in older adults are also debated. Studies using subtle manipulation (i.e., no reference about the purpose of the study or the superiority of one group as compared to another one) (e.g., subliminal stereotypic words flashed on a screen, Levy & Leifheit-Limson, 2009) generally observed no modification of performance after the induction of the negative stereotype (e.g., Hausdorff et al., 1999; Moriello et al., 2013). Conversely, two of the three studies evaluating the effect of an explicit verbal manipulation (e.g., “[Participants] were informed that we were interested in examining differences in balance ability between different age groups, and that their performance would be compared with performance of young adults, Chiviacowski et al., 2018) highlighted an alteration of the performance. For example, Swift, Lamont, and Abrams
(2012) showed that a social comparison (to younger counterparts) may decrease grip test performance of older adults. In the same way, Chiviacowski et al. (2018) showed that older adults performed worse on a balance task during a retention test the day after the induction of a negative stereotype toward older adults. Hence, we may suggest that the effect of negative stereotypes on physical performance could depend on the stereotype manipulation (i.e., subtle vs. explicit).

All these previous studies, evaluating the effect of a negative stereotype on older physical’s performance, did not distinguish active and inactive participants. For example, Moriello et al. (2013) recruited participants from various senior centers and senior housing units. However, the literature shows that only participants who considered the stereotyped domain as important can be affected by a negative stereotype (e.g., Roberson & Kulik, 2007). Individuals who consider the stereotyped domain as important are more likely to experience the negative stereotype than individuals who do not value this domain of activity. Thus, the lack of results in some studies, could be due to this problematic (i.e., heterogeneous sample). Consequently, in the present research, we recruited only participants register to senior sports club to rule out this possibility.

The explanatory mechanisms of the effects of stereotypes on physical performance are still poorly understood. It has been shown that positive and negative stereotypes may impact psychological constructs such as subjective age, subjective health and age group identification. Weiss and Lang (2012) observed that negative stereotypes induced a greater age bias, as expressed as a difference between chronological age and subjective age. Coudin and Alexopoulos (2010) showed that inducing a negative stereotype led to a decrease of subjective health. Finally, Weiss and Lang (2012) noted that a negative stereotypical information lead to an age group dissociation, as participants who were exposed to the negative stereotype tend to dissociate themselves from their age group. Moreover, these variables can also be associated to cognitive and physical performance. For example, Stephan, Sutin, and Terracciano (2015) showed that a lower subjective
age was associated with faster walking speed. Also, inducing a social comparison that reduce the subjective age can improve maximal strength (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013). As these variables are related to stereotypes and physical performance, stereotypes could influence them, which in turn impact performance. To this end, we analysed, in the present research, the effect of both positive and negative stereotypes on these variables during physical tasks.

The aim of the present study was to examine the influence of positive and negative stereotypes on submaximal grip strength in older adults. Concerning positive stereotypes, based on previous studies (e.g., Levy & Leifheit-Limson, 2009) we suggested that the effect of the stereotype should be more visible at lower intensities as compared to higher intensities of effort. Concerning negative stereotypes, based on previous works evaluating the effects of explicit negative stereotypes on older performance (e.g., Chiviacowski et al., 2018; Swift et al., 2012), we suggested a performance decrease after the induction of the negative stereotype.

Methods

Participants and design.

Based on the last studies using explicit stereotypes in the motor domain (e.g., Chiviacowski et al., 2018; Swift et al., 2012) a large effect size could be expected. With a fixed $\alpha$-level (.05) and a high statistical power of .80, the required sample size was at least 45 participants. Previous stereotypes studies in sport psychology have usually been conducted with similar samples (e.g., Chalabaev, Brisswalter, et al., 2013; Hermann & Vollmeyer, 2016), especially for aging stereotypes studies (e.g., Chiviacowski et al., 2018; Swift et al., 2012). Fifty old women members of a senior sports club ranged in age from 67 to 95 years old ($M_{age} = 73.6$, $SD_{age} = 6.8$) were recruited. They were directly contacted during their sports class. Individuals were eligible to
participate if they met the following criteria: 60 years or older and physically active. The exclusion
criteria included: any bone, muscle or tendon trauma of the upper limbs (e.g., osteoarthritis). All
participants provided informed consent. They were randomly assigned to a positive stereotype
(N=17), a negative stereotype (N=17) or a control condition (N=16) for a single session (using a
block randomization). This study lasted approximately 60 minutes. Institutional approval of the
study protocol was obtained.

Materials and measures

Handgrip Strength. Strength was measured with a MicroFET 4 dynamometer (Hoggan
Health Industries, West Jordan, UT). This dynamometer was configured for wireless operation with
a USB receiver connected to a computer. Participants’ position was standardized. They were seated
on a chair, with their dominant shoulder adducted and neutrally rotated. Elbow’s angle was fixed
at 90° and the forearm and the wrist in a neutral position. Each contraction lasted 5 seconds; during
the first two seconds, participants had to reach gradually the level of strength expected and during
the last three, they had to maintain this level. Consequently, only the last three seconds of the
contraction were analysed.

RPE Scale. The intensity of the contraction was based on the perceived effort measured
with the Borg’s CR10 scale (Borg, 1998). This scale was composed on 11 points from 0
corresponding to “no effort” to 10 corresponding to “maximal effort”. During the session,
participants had to perform contractions at four different levels of this scale (3, 5, 7 and 9). Before
the beginning of the task, the scale and its graduation were explained in details to participants. The
protocol began only when the familiarization was successful so that participants were able to
differentiate each level of the scale.

Psychological variables.
**Subjective age.** Based on Weiss and Lang (2012), a pre-induction phase of the condition was introduced by asking the participants to indicate “As a whole, how old [you] feel”. Post-induction, they responded to the following question: “At this moment, how old you feel”. The subjective-age score was obtained by computing the discrepancy expressed in years between chronological age and felt age. The subjective age bias specifies the tendency to feel either younger or older than one’s chronological age. Positive values indicate the tendency to feel younger and conversely.

**Subjective health.** In line with existing research (e.g., Stephan et al., 2013), self-rated health was assessed with a single item pre- and post-induction. At the pre-induction time, participants responded to: “As a whole, how do you rate your current health?”. At post-induction, this item was partially transformed into “At this moment, how do you rate your health?”. Each time, a Likert-type scale ranging from 1 (poor) to 6 (excellent) was used to answer.

**Age group identification.** Based on Weiss and Lang (2012), participants rated the items “I identify with people of my age” and “I have a lot in common with people of my age” in order to assess the affiliation with one’s age group. They responded using a 7-point scale that was anchored with 1 (do not agree) and 7 (absolutely agree). The mean of the two items was calculated to represent age group identification. Participants responded to these items twice, at pre- and post-induction of the stereotype conditions

**Procedure**

The session was split in two periods separated by a recovery time. Participants were randomly assigned to one of the three groups: (1) a positive stereotype condition (N=17), (2) a negative stereotype condition (N=17), and (3) a control condition (N=16).

After the familiarization trials, the first experimental time (T1) began. First, maximal strength was determined by performing two maximal voluntary contractions (MVC) with one
minute of rest between each trial. Participants were required to “squeeze as hard as possible” for 5 seconds. After a 1 minute-break, participants were required to perform isometric contractions at the four different submaximal effort levels. They were asked to perform two voluntary isometric contractions that produced a level of muscular effort that corresponded to a rating of 3 (i.e., light effort), 5 (i.e., moderate effort), 7 (i.e., strong effort) and 9 (i.e., very strong effort) with a 1-min rest in-between the trials. These different efforts were tested in a random order with 1 minute of rest between each trial to avoid any fatigue. Once the participants indicated that they were ready, the experimenter indicated the effort level required and, after a “three, two, one, go”, participants produced the required effort and held it for 5 seconds (the last 3 seconds were used for analyses). At the end of the first experimental period, participants responded to the questionnaire (baseline measurement). After the completion, participants had a 5-min break while they stayed seated on the chair with no contact with the experimenter.

After this break, the second experimental time (T2) began. First, participants performed two more MVC. Then, participants were assigned to one of the three conditions: (1) a positive stereotype, (2) a negative stereotype, and (3) a control condition with no stereotype induction. The induction was made in a private and quiet room, and the experimenter ensure that participants were attentive during the induction. After the induction of the conditions, participants performed the same protocol as in T1 (see Figure 1). Finally, they responded a second time to the questionnaire to evaluate the effects of the different conditions on all variables evaluated.

Stereotype manipulation.

As indicated earlier, the different conditions were induced after the two MVC at T2. During explicit stereotype manipulation, different methods can be used to induce the expected stereotype. For example, saying that the present research investigated differences between two groups and that one group perform better than the other is usually used and efficient to induce stereotypes (e.g.,
Chalabaev, Brisswalter, et al., 2013). Next, in a meta-analysis, Lamont, Swift, and Abrams (2015) showed that stereotype-based manipulation (e.g., “It is widely assumed that intellectual performance declines with age”, Abrams, Eller, & Bryant, 2006) is more efficient than fact-based manipulation (e.g., “Previous studies showed that males have problems keeping their balance compared to females”, Chalabaev, Stone, Sarrazin, & Croizet, 2008). Consequently, to ensure a good stereotype manipulation, we coupled these two methods. Specifically, a stereotype-based manipulation was used as well as information about groups and the superiority of one as compared to the other (according to the conditions). In the negative stereotype condition, they were told: “Now, we are going to investigate differences between young adults and old people. As age increases, people become weaker and frail. This weakness typically leads to a worse regulation of effort. Consequently, older adults generally perform worse than young adults on this kind of task”.

In the positive stereotype condition, all participants were told: “Now, we are going to investigate differences between young adults and old adults. As age increases, people gain more experience. This better experience typically leads to a better regulation of effort. Consequently, older adults generally perform better than young adult on this kind of task”. This speech was based on Hummert’s (1990) study which referenced weakness and frailty as negative stereotypes and experience as positive stereotype towards old people. Finally, for the control condition, nothing was said to the participants.

Data Analysis

Strength. Rather than averaging each contraction for each intensity, which results in a loss of information (Speelman & McGann, 2013), all timepoints of each contraction were analysed using a mixed model approach. For each intensity (RPE 3, 5, 7, and 9), distribution of strength was positively skewed. To accommodate this skewed distribution of strength, a general linear mixed model (GLMM) was used by modelling strength data with a gamma function and a log link that is
typically adapted for positive data that have an asymmetry in the largest values (Myers & Montgomery, 1997). A random intercept effect structured by participants was included to control for the non-independence of the data. The fixed factors of the GLMM were the time of measurement (pre-induction vs. post-induction), the order of the contraction (1 vs. 2) (representation the two contractions performed for each perceived intensity), the condition (negative stereotype vs. positive stereotype vs. control), and all interactions between these factors. To include for the nested structure of the data (each measurement sample nested within a measure and each measure nested within a same individual), we included a random effect structured by participant and a random effect structured by measure by participants.

**Psychological variables.** For subjective age, subjective health, and age group identification, distribution was also positively skewed. To accommodate the skewed distribution of these variables, a GLMM was used. A random intercept effect structured by participants was included to control for the non-independence of the data. The fixed factors in these models were the time of measurement (pre-induction vs. post-induction), the condition (negative stereotype vs. positive stereotype vs. control), and the interaction between these factors. To calculate an effect size for each dependent variable, Cohen’s $d$s were calculated to represent the effect size of the time of measurement using the difference of the exact means and standard-deviations in the pre-induction and in the post-induction conditions.

**Results**

Means and standard deviations for the study variables are presented in Table 1.

**Strength.**

For RPE 3, The GLMM indicated a significant effect of the time of measurement with higher strength produced during post-induction ($M= 1.8; SD= 0.9$) than during pre-induction
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(1) ($M$ = 1.4; $SD$ = 0.7), $F(1, 58821)$ = 32.68, $p$ < .001, $d$ = 0.71). While no significant main effect of condition was found, $F(2, 58821)$ = 0.16, $p$ = .849, this factor interacted with the time of measurement, $F(2, 58821)$ = 5.54, $p$ = .004. Specifically, a significant increase of strength was visible in the positive stereotype condition (from $M$ = 1.3; $SD$ = 0.9 at T1 to $M$ = 1.9; $SD$ = 1.1 at T2, $d$ = 0.93). In the same way, the strength was higher at T2 ($M$ = 1.9; $SD$ = 0.8) than at T1 ($M$ = 1.5; $SD$ = 0.6) ($d$ = 0.64) in the negative stereotype condition. For the control condition, no significant difference emerged between pre-to-post induction (See figure 2).

Concerning RPE 5, the GLMM revealed no significant main or interaction effect of the condition, $F(2, 59671)$ = 1.03, $p$ = .36 and $F(2, 59671)$ = 0.88, $p$ = .41, respectively. A significant difference of the time of measurement was found, $F(1, 59671)$ = 34.57, $p$ < .001, $d$ = 0.66, suggesting that participants developed more strength at T2 ($M$ = 2.3; $SD$ = 1.1) than at T1 ($M$ = 2.0; $SD$ = 1.0) (See Figure 2).

For RPE 7, results showed a significant effect of time of measurement, $F(1, 59373)$ = 22.68, $p$ < .001, $d$ = 0.69, revealing that participants developed more strength at T2 ($M$ = 3.2; $SD$ = 1.4) than at T1 ($M$ = 2.9; $SD$ = 1.1). There was no significant main effect of condition, $F(2, 59373)$ = 0.31, $p$ = .73. However, an interaction between time of measurement and condition was found, $F(2, 59373)$ = 4.99, $p$ = .007. In the positive stereotype condition, the strength was higher at T2 ($M$ = 3.4; $SD$ = 1.4) than at T1 ($M$ = 2.7; $SD$ = 1.1) ($d$ = 0.55). In the negative stereotype condition, the strength was higher at T2 ($M$ = 3.3; $SD$ = 1.4) than at T1 ($M$ = 3.1; $SD$ = 1.1) ($d$ = 0.35). For the control condition, no significant difference emerged between pre-to-post induction (See figure 2).

Concerning RPE 9, main analyses indicated no significant main or interaction effects of the condition, $F(2, 59551)$ = 1.04, $p$ = .36, and $F(2, 59551)$ = 0.59, $p$ = .56, respectively. A significant effect of time of measurement was found, $F(1, 59551)$ = 16.82, $p$ < .001, $d$ = 0.62. Post-induction,
participants developed more strength ($M= 4.0; SD= 1.4$) than at T1 ($M= 3.7; SD= 1.3$) (see Figure 2).

### Psychological variables.

For subjective health, there was a non-significant main effect of the condition ($F(2, 94)= 0.59, p=0.56$), a non-significant main effect of the time of measurement ($F(1, 94)= 1.79, p=.18$) and a non-significant condition × time of measurement interaction effect ($F(2, 94)= 1.33, p=.27$).

For subjective age, analyses showed no main effect of the condition ($F(2, 80)= 2.42, p=0.10$) but a time of measurement effect ($F(1, 80)= 5.21, p=.03, d= 0.52$) revealing that post-induction, the discrepancy between chronological age and felt age was smaller ($M= 9.7; SD= 8.9$) than at pre-induction ($M= 11.0; SD= 10.3$). Finally, there was no significant condition × time of measurement interaction effect, ($F(2, 80)= 0.03, p=.97$).

Considering age group identification, the GLMM revealed only a time of measurement main effect ($F(1, 94)= 8.83, p=.004, d= 0.68$), revealing that post-induction, participants were more identified with their group ($M= 4.6; SD= 1.6$) than at T1 ($M= 4.2; SD= 1.7$). No significant main or interaction effect of the condition emerged ($F(2, 94)= 0.87, p=.42$) and ($F(2, 94)= 1.73 , p=0.18$), respectively.

### Discussion

The aim of this study was to examine the effect of positive and negative stereotypes on submaximal grip strength in older adults (i.e., RPE 3, 5, 7, and 9). Based on previous works (e.g., Levy & Leifheit-Limson, 2009, Horton et al., 2010), we hypothesised that the effect of a positive stereotype should be more visible at lower intensities as compared to higher intensities of effort. Concerning the negative stereotype, we expected a performance decrease after the induction of an explicit stereotype toward older adults.
Results of the present study are partially in line in with our hypothesis about the effects of positive stereotype. Hence, after the induction of the positive stereotype (T2), participants developed more strength at RPE 3 and 7 than during pre-induction (T1). These results seem in line with previous studies showing that during submaximal exercises, inducing a positive stereotype is likely to elicit a performance increase (e.g., Hausdorff et al., 1999). Concerning RPE 9, no significant difference emerged after the induction of the positive stereotype. This result is also in line with past studies showing that when the intensity of the task is high (i.e., maximal exercise or near to the maximal), inducing a positive stereotype did not influence performance (e.g., Horton et al., 2010). Concerning RPE 5, even if no significant difference emerged, we observed the same effect with those obtained at RPE 3 and RPE 7, as suggested by the effect size (i.e., $d=0.71$). The major explanation of this “non-significant” result could be the lack of power. Also, a relatively high variability was observed between and within participants’ performance which decreases the statistical power. It could be interesting to replicate this effect with more participants and on another task, with less variability. By the present study, we found that the intensity of the task can moderate the effect of the induction a positive stereotype, with a positive impact on performance during submaximal intensities but with no effect during maximal (or near to the maximal) intensities.

The present research strengthens previous studies especially by the stereotype induction and the design used. Very few studies investigated the effects of aging stereotypes on motor performance. Among these studies, the induction of the stereotypes was very different. Some authors used implicit activation with subliminally flashed words on a computer (Hausdorff et al., 1999; Levy & Leifheit-Limson, 2009), or exposed their participants to objects representing aging stereotypes (Moriello et al., 2013), or used explicit activation by making participants read a newspaper’s article reporting a stereotypical information (e.g., Horton et al., 2010). Moreover, in these studies, positive stereotypes are sometimes not related to physical activity. In other words,
the domain of the stereotypes used was sometimes not matched to the outcomes. For example, in Moriello et al.’s (2013) study, positive stereotypes are induced using objects (e.g., a book) but the task used was a leg strength task. Also, previous studies did not use a real positive stereotype but rather a positive report of aging (e.g., Horton et al., 2010). The present study is, to our knowledge, the first evaluating the effect of an explicit positive stereotype suggesting a better performance, as compared to younger adults, with a match between the stereotype and the outcome.

Concerning the negative stereotypes, as for the positive stereotype condition, at T2, participants developed more strength at RPE 3 and 7 than during pre-induction (T1). For RPE 5 and 9, no significant difference emerged between T1 and T2. Results are consequently contrary to our hypothesis (i.e., performance decrease) and to the literature (e.g., Horton et al., 2010). Indeed, two of the three previous studies using an explicit stereotype manipulation showed a performance decrease after the induction of a negative stereotype (Chiviacowski et al., 2018; Swift et al., 2012). Swift et al. (2012) observed that, after the induction of a negative stereotype (by a social comparison with younger people), participants developed less strength and persisted less in a handgrip task, as compared to a control group. In the same way, Chiviacowski et al. (2018) observed that a negative stereotype altered performance of older women on a balance task, not immediately but the day after the induction. Finally, Horton et al. (2010) observed no effect of a negative condition on performance during a maximal handgrip strength task. These three studies used maximal tasks and observed a performance decrease or no modification of performance. In the present research, at the highest perceived intensity (i.e., RPE 9), no modification of performance emerged after the induction of the negative stereotype. Consequently, we could suggest that the intensity of the task could moderate the effect of negative stereotypes on performance.

The results of the present study may also be explained by the sample we used. Majority of previous studies did not distinguish active and inactive people. For example, Swift et al. (2012)
recruited participants from senior centres and senior’s lunches. Literature clearly show that only participants who considered the stereotyped domain as important for them, can be affected by the stereotype (e.g., Roberson & Kulik, 2007). As a consequence, in the present study, participants were only recruited from a physical activity group. Recent studies showed that when a negative stereotype was induced, participants are motivated to perform well, to disprove the negative stereotype (e.g., Jamieson & Harkins, 2007). Moreover, it has been shown that physical activity enhanced older people self-efficacy (e.g., Langan & Marotta, 2000). In other word, practicing regularly a physical activity can lead to an improvement of older people self-efficacy. It is well established that a high self-efficacy leads to an improvement in motor performance (e.g., Hutchinson, Sherman, & Martinovic, 2008). We may suggest that a high level of self-efficacy could counter the effect of the induction of a negative stereotype during submaximal exercises. Hence, physically older people could perceive the negative stereotypes more as a challenge than a threat (e.g., “I am not worse than younger adults, I can perform better than them!”). Further research is needed to test the level of physical activity hypothesis.

A last explanation of the present results could be the instruction used by the experimenter. In previous studies, experimenters asked participants to give their best on the task (e.g., “squeeze the handgrip as hard as possible”, Horton et al., 2010; “squeeze this handle as hard as you can, for as long as you can”; Swift et al., 2012). This instruction can induce a stress to participants due to a high performance expectation. Indeed, it is well established that negative stereotypes conduct to a physiological stress response (e.g., increase of systolic/diastolic blood pressure; Levy, Hausdorff, Hencke, & Wei, 2000) and negative thought (Schmader, Johns, & Forbes, 2008), leading to a performance decrease. In the present research, the instruction was different. The experimenter did not ask participants to perform the best performance that they could but asked them to “develop a strength corresponding to [3], [5], [7] or [9] on the effort scale”. This kind of instruction may have
induced less physiological stress, this can explain why we did not observe a performance decrease, as reported in previous studies (e.g., Chiviacowski et al., 2018).

No significant difference was observed for subjective age, subjective health and age group identification between pre-to-post induction of the conditions. These results may be surprising because in the literature, these three constructs are closely related to stereotypes (e.g., Coudin & Alexopoulos, 2010; Weiss & Lang, 2012). One possible explanation of these results could be the nature of the stereotype. Previous studies used stereotypes of daily life that were not related to physical activity, unlike our study. The second explanation of these surprising findings is related to data collection. Participants responded to the questionnaires two times during the visit, one time during T1 (i.e., baseline measures) and the other time after the induction of the condition during T2. There was only 10 minutes between these two measurements time. Because this questionnaire is short, participants could have easily remembered their answers from one time to another and consequently responded the same way to the questionnaire at T1 and T2.

Despite these new interesting results, this work has also limitations. First, only women were involved in the present study and consequently, we can not generalize these results to men. Indeed, in addition to inducing aging stereotypes, it is possible that a gender stereotype was implicitly activated. Some studies showed that gender stereotypes influence motor performance (Chalabaev, Sarrazin, Fontayne, Boiché, & Clément-Guillotin, 2013). Consequently, it could be interesting to replicate this study with men or a more sex-balanced sample to better control the confounding effect of the age and the gender stereotypes. Secondly, we decided not to use a manipulation checks. Even though manipulation checks are informative and used to control the effectiveness of the treatment, these measures are mostly verbal or written (e.g., Chalabaev, Brisswalter, et al., 2013); thus they can act as interventions which initiate new processes that would otherwise not occur and consequently, they may amplify or interact with the effects of the manipulation (Hauser, Ellsworth,
& Gonzalez, 2018). To evaluate the effectiveness of the stereotype manipulation, it would be necessary to investigate a new kind of manipulation checks based on behaviour for example to limit bias from previous ones.

From a practical point of view, RPE is generally considered as a reliable method to regulate the intensity of an exercise during an adapted program, and especially for older adults (e.g., Row Lazzarini et al., 2017). For example, it is generally recommended to work between 70 to 90% of MVC or at a RPE between 14 and 16 (based on an effort scale ranging from 6 “no exertion” to 20 “maximal exertion”) to increase voluntary strength (Row Lazzarini et al., 2017). However, older adults have difficulty to correctly set up their effort according to a scale of effort and that they developed less strength as expected by the scale of effort (e.g., John, Liu, & Gregory, 2009). By the present research, we found that inducing a positive stereotype may lead to an increase of the strength developed during submaximal perceived intensities. Consequently, during an adapted program, creating a positive context can be beneficial to increase the strength developed and consequently reduce the gap between the strength developed and the expected strength. Concerning negative stereotypes, even if an increase of strength developed was also observed, this result may probably be only applicable to active older adults and not to sedentary people. Indeed, sedentary older adults would probably not be identified with the physical activity domain and consequently would be non-affected by the stereotypes (Steele, 1997).

In summary, we observed that positive and negative stereotypes lead to an increase of the strength produced during submaximal exercises. The effect of aging stereotypes on performance may be consequently moderate by the intensity of the exercise. In a general way, inducing a positive context, through positive stereotypes, seems a good way to increase women’s strength and more generally work intensity during adapted physical program. Finally, two issues deserve more
attention, the effect of positive and negative stereotypes on men’s performance and on individuals less identified with the physical activity domain.

References


Table 1. Means (± standard deviations) of all the dependent variables of the study

<table>
<thead>
<tr>
<th>Variables</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive stereotype</td>
</tr>
<tr>
<td></td>
<td>T1</td>
</tr>
<tr>
<td>MVC (kg)</td>
<td>5.8 ± 1.3</td>
</tr>
<tr>
<td>RPE 3 (kg)</td>
<td>1.3 ± 0.9</td>
</tr>
<tr>
<td>RPE 5 (kg)</td>
<td>2.0 ± 0.9</td>
</tr>
<tr>
<td>RPE 7 (kg)</td>
<td>2.7 ± 1.1</td>
</tr>
<tr>
<td>RPE 9 (kg)</td>
<td>3.8 ± 1.3</td>
</tr>
<tr>
<td>Subjective age</td>
<td>8.2 ± 10.1</td>
</tr>
<tr>
<td>Subjective health</td>
<td>4.4 ± 1.0</td>
</tr>
<tr>
<td>Age group</td>
<td>4.6 ± 1.7</td>
</tr>
</tbody>
</table>

Notes. MVC = maximal voluntary contraction; RPE = rate of perceived exertion

# p<.05 for test of difference between T1 and T2
Figure captions

Figure 1. Schematic illustration of the protocol

Figure 2. Difference of strength developed at RPE 3, RPE 5, RPE 7 and RPE 9 between T1 and T2 according to the three conditions.

Data are expressed in kilogram. *Significant difference between T1 and T2 (p<.05)
Figure 1. Schematic illustration of the protocol

297x67mm (150 x 150 DPI)
Figure 2. Difference of strength developed at RPE 3, RPE 5, RPE 7 and RPE 9 between T1 and T2 according to the three conditions. Data are expressed in kilogram. *Significant difference between T1 and T2 (p<.05)
Acknowledgments

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