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An ego depletion account of aging stereotypes' effects on health-related variables

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Abstract

Objectives. This study examined whether stereotypes may predict health outcomes independently from their internalization into the self. Specifically, we tested whether endorsement of negative age stereotypes in the physical activity (PA) domain is related to decreased subjective vitality among active older adults, illustrating ego depletion.

Method. This longitudinal study included 192 retired individuals aged 60 to 92 years who regularly participated in organized PA, and who completed the measures on three occasions (9-month period).

Results. Multilevel growth models tested whether within-person variation in age stereotypes endorsement across waves predicted subjective vitality, after controlling for self-perceptions of aging and relevant covariates. Results showed that (a) within-person increases in endorsement of age stereotypes of self-efficacy ($b = 0.17$, $p < .01$) were associated with increases in subjective vitality, (b) between-person mean difference in endorsement of age stereotypes of PA benefits ($b = 0.21$, $p < .05$) positively predicted subjective vitality, and (c) subjective vitality mediated the relationship between endorsement of self-efficacy stereotype and self-rated health.

Discussion. This study confirmed that endorsement of age stereotypes of PA predicted subjective vitality among active older adults. These results suggest that stereotypes may be related to health-related outcomes notably through ego depletion effects.

Keywords: Age stereotypes, subjective vitality, ego depletion, physical activity, multilevel growth modeling

An ego depletion account of aging stereotypes' effects on health-related variables

A growing body of research has started to question the assumption that the aging process can be explained exclusively as a physiological process of inevitable decline (Levy, 2009; Rothermund, 2005). This psychosocial approach to aging considers that age stereotypes (i.e., beliefs about older people in general) may also substantially affect health. For example, there is evidence that older individuals who hold positive age stereotypes recover more rapidly from a disability (Levy, Slade, Murphy, & Gill, 2012), and have better memory (Levy, Zonderman, Slade, & Ferrucci, 2012) abilities than those who hold negative age stereotypes (Levy, 2009).

Aging Stereotypes and Health Outcomes: The Stereotype Internalization Approach

To explain these relationships, the stereotype internalization hypothesis proposes that age stereotypes are internalized into *self-perceptions of aging* (SPA) (older adults' beliefs about their own aging), which act as a lens through which aging experiences are interpreted (Levy, 2009). In line with this idea, SPA have been shown to predict health outcomes, with positive SPA being related to better physical functioning (balance and gait speed) (Sargent-Cox, Anstey, & Luszcz, 2012), and increased survival (Sargent-Cox, Anstey, & Luszcz, 2013). According to the internalization hypothesis, SPA predict health outcomes through their influence on adoption of health behaviors (Levy & Myers, 2004): because people with negative SPA consider their functional decline as an inevitable part of the aging process, they are more likely to consider health-related behaviors as useless than people with positive SPA. Therefore, the latter engage in healthy behaviors (e.g., being physically active) more than the former. In line with this hypothesis, there is evidence that positive SPA are associated with healthy behaviors such as regular engagement in PA (Emile, Chalabaev, Stephan, Corrion, & d'Arripe-Longueville, 2013; Wurm, Tomasik, & Tesch-Römer, 2010). Moreover, SPA have been shown to mediate the relationship between stereotype endorsement and adoption of an

active lifestyle (Emile et al., 2013), providing further support to the stereotype internalization hypothesis.

Interestingly, the study of Emile et al. (2013) also revealed a direct relationship between stereotype endorsement and adoption of an active lifestyle, even after controlling for SPA. This study focused on stereotypes in the domain of PA, which is usually associated with beliefs that older adults are too weak to be physically active (Roters, Logan, Meisner, & Baker, 2010). Results indicated that the more older adults endorsed positive age stereotypes in the domain of PA, the more they adopted an active lifestyle, independently of how they perceived their own aging. This suggests that SPA are not the only pathway through which stereotype endorsement may affect older adults' health. The present study explored a complementary pathway, by testing the novel hypothesis that endorsement of age stereotypes may be related to *ego depletion*, a concept issued from the strength model of self-control (Muraven & Baumeister, 2000). The theoretical rationale underlying this hypothesis is described below.

Aging Stereotypes and Health Outcomes: An Ego Depletion Approach

The strength model defines self-control as the mental energy individuals use to effortfully regulate their emotions, thoughts, impulses, or other automatic behavioral responses that interfere with goal-directed behaviors. A major tenet of the model is that engaging in acts of self-control draws from a limited 'reservoir', which, when depleted, results in reduced capacity for further self-regulation, a phenomenon known as ego depletion (Muraven & Baumeister, 2000). In other words, ego depletion refers to the depletion of energy necessary to regulate one's behaviors. For example, depleted individuals have been found to regulate physical demands more poorly, and to exercise less regularly (Hagger, Wood, Stiff, & Chatzisarantis, 2010).

Relevant here, a few studies suggest that endorsement of stereotypes may affect ego depletion. Drawing on stereotype threat hypothesis that negative self-stereotypes may be stressful, Inzlicht and Kang (2010) showed that females who faced negative gender stereotypes during a math task had difficulties to exert self-control afterwards: they responded more aggressively, ate more unhealthy food, and made more risky decisions. To explain these results, the authors proposed that coping with stereotype threat when performing a math task consumed the mental energy necessary for self-regulation, leaving females with fewer resources to overcome environmental temptations and override impulses. In the same vein, Levy, Hausdorff, Hencke, and Wei (2000) observed that older adults who were exposed to negative age stereotypes demonstrated a heightened cardiovascular response to stress compared with those exposed to positive age stereotypes, suggesting that stereotypes may act as direct stressors. Given that people who endorse negative self-stereotypes are more susceptible to experience stereotype threat than people who do not (Schmader, Johns, & Barquissau, 2004), these results suggest that stereotype endorsement may affect ego depletion.

The Present Research

Based on these results, we examined whether endorsement of age stereotypes in the domain of PA may be related to ego depletion among older adults who are physically active. It was hypothesized that the more individuals would endorse negative age stereotypes, the lower their energy for self-regulation. More particularly, we reasoned that if individuals believe that older adults in general are too old to exercise, this belief would be in conflict with their goal to stay physically active. In this case, engaging in regular PA would need self-control resources to override their negative stereotype-based beliefs, leading to increased ego depletion. We examined age stereotypes in the PA domain, because stereotypes that are specific to a life domain may affect individuals' functioning in this domain (Kornadt &

Rothermund, 2011) more than other-domain stereotypes. Therefore, we reasoned that negative age stereotypes of PA would likely affect the self-control resources used to participate in PA on a regular basis.

Ego depletion was indexed by subjective vitality, defined as the energy that one can harness or regulate for purposive actions (Ryan & Deci, 2008). In line with theoretical assumptions, the meta-analysis of Hagger et al. (2010) showed that subjective fatigue (i.e., fatigue that is consciously felt) may be one explanation for the self-control deficits observed in ego depletion experiments, reflecting the effortful nature of self-control tasks. Past research indicates that subjective vitality, which may be situation-specific, is a valid marker of ego depletion (Muraven, Gagné, & Rosman, 2008; Rouse, Ntoumanis, & Duda, 2013). For example, Muraven et al. (2008) showed that declines in self-control performance after a depleting task were mediated by decreased subjective vitality. These findings suggest that subjective vitality and behavioral assessments of ego depletion tap into the same phenomenon, with subjective vitality having the advantage of being a highly accessible, phenomenologically-based variable (Ryan & Deci, 2008).

In addition, subjective vitality is an important predictor of health outcomes. It has notably been associated with more resilience to stressors and less susceptibility to illness (Benyamini, Idler, Leventhal, & Leventhal, 2000), better regulation of negative emotions (Rozanski, Blumenthal, Davidson, Saab, & Kubzansky, 2005), and higher mental health (Ryan & Frederick, 1997). Therefore, if endorsement of negative age stereotypes predicts subjective vitality, this would suggest that ego depletion is a pathway through which age stereotypes may affect older adults' health that complements the internalization pathway.

To provide further support to this hypothesis, an additional objective was to examine whether age stereotypes in the PA domain were related to self-rated health, through the mediating role of subjective vitality. We hypothesized that the more individuals would

endorse negative age stereotypes, the lower their subjective vitality, which would in turn result in lower perceived health.

Overview of the study

Multilevel models

The hypothesis that endorsement of age stereotypes predicts lower subjective vitality was examined in a longitudinal design. Measures were assessed on three occasions over a 9-month period, among older adults who participated in PA in leisure clubs on a regular basis. This allowed us to examine whether within-person variability in stereotype endorsement across waves predicted subjective vitality. This hypothesis was tested using multilevel models (Raudenbush & Bryk, 2002).

Covariates

Several covariates were included in this study. First, SPA were taken into account, as the study aimed at examining a pathway of stereotype influence that complements the stereotype internalization approach. As such, we investigated whether stereotype endorsement may be ego depleting independently of how older adults have internalized stereotypes into perceptions of their own aging. SPA were indexed by participants' attitude toward their own aging (e.g., "Things keep getting worse as I get older"). Self-perceptions related to the physical domain were also measured, in order to rule out the possibility that the stereotype measure would not tap into a domain not being assessed by the SPA measure. These self-perceptions were assessed by physical self-worth (i.e., general feelings of happiness, satisfaction, pride, respect, and confidence in the physical self).

In addition, we controlled for individual differences in motivation for PA. We reasoned that although engaging in health-related behaviors on a regular basis may require self-control resources, this is not systematically the case. Based on self-determination theory (Deci & Ryan, 2000), past research indicates that engaging in self-control behaviors for

autonomous reasons (free choice) is less depleting than exerting self-control for controlled reasons (external or internal pressure) (Muraven et al., 2008). Therefore, we measured older adults' motivations for PA (autonomous *vs.* controlled motivations) and examined whether stereotype endorsement affects subjective vitality independently of these motivations.

Other covariates included self-reported level of PA (leisure and daily activities), self-rated health, and perceived loneliness. These variables were chosen because past research has shown that they are related to PA stereotype endorsement (Chalabaev et al., 2013), and health-related variables (Levy, 2009) in older adults.

Method

Participants

192 retired individuals (24 men and 168 women) aged from 60 to 92 years (M_{years} = 73.22*;* SD = 7.53*),* and residing in the south of France, participated in this study on a voluntary basis. Participants met the following criteria: (a) participating in at least one session of organized PA per week (based on the timesheets completed by PA instructors at each session), and (b) living independently in the community. Among the initial 362 contacted participants, 72 were not included because they did not meet these criteria. Moreover, we excluded from the analyses 98 participants who participated in the study on one occasion only. Indeed, as our main goal was to examine the relationship between stereotype endorsement and ego depletion among active older adults, we wanted to ascertain that participants were regular PA participants. Concerning education level, 71.1% of participants had completed high school. The study complied with APA ethical standards.

Procedure

Participants were contacted through a leisure club for older adults, comprising roughly 1400 members. The membership fee costs ten euros per year, making this club accessible to individuals with various income levels. Eligibility requirements include: (a) living in the

southeast region of France, (b) being retired, (c) being aged 49 years and older, and (d) presenting a medical certificate attesting that the individual was free from severe functional, mental or cognitive impairment. They were informed about the study on site, during their PA lessons. Written informed consent was obtained from all participants. After their PA lesson at the leisure club, participants were asked to fill out individually a questionnaire that included the variables of interest. The average time of completion was 15 minutes. Measures were assessed on three occasions over a 9-month period, with an interval of 4 to 5 months between each occasion.

Measures

Subjective vitality. Subjective vitality was measured by the *Subjective Vitality Scale* (Ryan & Frederick, 1997), which includes five items (e.g., "I feel alive and vital"). Participants responded on a 7-item Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*). The scale presented good reliability ($\alpha = .90$).

Age stereotypes in the PA domain. Endorsement of age stereotypes was assessed using the *Aging Stereotypes and Exercise Scale* (Chalabaev et al., 2013). This questionnaire consists of 12 items divided into three subscales: (a) four items measure stereotypes about older adults' self-efficacy to participate in PA on a regular basis (e.g., "older adults are convinced that they are capable of being physically active"), (b) four items measure stereotypes about positive outcomes (i.e., benefits) of PA for older adults (e.g., "PA raises older adults' spirits"), and (c) four items measure stereotypes about negative outcomes (i.e., risks) of PA for older adults (e.g., "the physical capacities of older adults are too diminished for being physically active"). Participants responded on a 7-point Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*), such that lower scores indicate lower beliefs in older adults' self-efficacy, positive outcomes of PA, and negative outcomes of PA. Each subscale presented good reliability ($\alpha_{\text{self-efficacy}} = .78$, $\alpha_{\text{benefits}} = .80$, $\alpha_{\text{risks}} = .83$).

Covariates.

Self-perceptions of aging. SPA were measured by a French version (Allard, Allaire, Leclerc, & Langlois, 1991) of the *Attitude Toward Own Aging* scale (Liang & Bollen, 1983), which consists of five items (e.g., " Things keep getting worse as I get older "). Participants responded on a 7-point Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*). This scale has been used to assess self-perceptions of aging (Levy et al., 2002; Sargent-Cox et al., 2012). This scale presented good reliability ($\alpha = .78$).

Self-determined motivation. Motivation for PA was measured with the French version (Gourlan, Sarrazin, & Trouilloud, 2013) of the *Behavioural Regulation in Exercise Questionnaire* (BREQ-2) of Markland and Tobin (2004). This questionnaire consists of 15 items assessing four types of regulations: (a) external (4 items, e.g., "I exercise because other people say I should"), (b) introjected (3 items, e.g., "I feel guilty when I don't exercise"), (c) identified (3 items, e.g., "I value the benefits of exercise"), and (d) intrinsic (4 items, e.g., "I exercise because it's fun"). Participants responded on a 7-point Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*). Finally, in agreement with previous studies on self-determination (e.g., Silva et al., 2011), the intrinsic motivation and identified regulation subscales were averaged to form a score of autonomous motivation, whereas a score of controlled motivation was created by averaging the responses provided to the introjected regulation and external regulation subscales. Each subscale presented good reliability ($\alpha_{autonomous} = .82$, $\alpha_{controlled} = .79$).

Physical self-worth. Physical self-worth was measured using the corresponding subscale of the *Physical Self Inventory* (PSI-25), the French version of the *Physical Self-Perception Profile* (PSPP) of Fox and Corbin (1989) (Ninot, Delignières, & Fortes, 2000). It consists of five items (e.g., "Overall, I am satisfied with my physical capacities"). Participants

answered on a 7-point Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*). This subscale presented good reliability (α = .87).

Level of general PA. Level of PA was measured with the *Dijon Physical Activity Score* of Robert et al. (2004). This 9-item questionnaire was specifically developed to assess PA in a population of healthy, elderly subjects. The scale includes: (a) an overall appraisal of one's PA ("Do you consider yourself to be physically: from (1) very active and athletic, to (4) completely sedentary?"); (b) two items on everyday activities (e.g., "On a weekly basis, your everyday activities take you: from (1) more than 10 hours, to (5) no time spent"); (c) five items on sport and leisure activities (e.g., "For how many months of the year do you engage in these activities (sport or leisure)?"); and (d) one item on rest (e.g., "On a daily basis, you rest (sleep, nap or wakeful rest): from (1) less than 12 hours, to (4) more than 20 hours"). Then the scores on each item are summed up, and this total score indicates participant's level of physical activity (individuals who score below 18 (out of 30 points) being considered as sedentary). This measure has been shown to be reproducible and to be a valid measure of PA. The score notably correlates with maximal oxygen consumption and maximal power attained during a stress test in older adults (Robert et al., 2004), and with energy expenditure measured using an accelerometer in coronary artery disease patients (Guiraud, Granger, Bousquet, & Gremeaux, 2012).

Perceived loneliness. Perceived loneliness was measured by the following item "I feel lonely" (*Philadelphia Geriatric Center Morale Scale*; Lawton, 1975). Participants answered on a 7-point Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*).

Self-rated health. Self-rated health was measured by the following item "In general, how would you rate your current health status". Participants answered on a 6-point Likert scale ranging from 1 (*very bad*) to 6 (*very good*) (Benyamini, Leventhal, & Leventhal, 2003).

Data Analysis

Multilevel models tested whether within-person variation in age stereotypes endorsement across waves predicted subjective vitality, after controlling for relevant covariates. Multilevel models extend multiple regressions to data that are hierarchically structured (Singer & Willett, 2003). Given that we had several observations for each individual, repeated measurements (level 1 units of analysis) were nested within individuals (level 2 units of analysis). This method has several advantages over ordinary least squares regression. Multilevel models are a flexible approach that can be applied to evaluate inter-individual differences in intra-individual changes over time. That is, these models separate inter-individual variance from intra-individual variance, so that each participant has his or her own curve (Raudenbush & Bryk, 2002). Indeed, traditional regression models are based on the assumption that all observations are independent, which may not be the case with nested data. In addition, multilevel models do not require equal numbers of responses from each participant, which is usually the case in longitudinal designs (for use in aging research, see Birditt, Antonucci, & Tighe, 2012). By taking into account the hierarchical structure of the data, multilevel models provide unbiased estimates of the parameters (Singer & Willett, 2003).

The hypothesis that endorsement of age stereotypes predicts subjective vitality was thus tested in several steps. First, unconditional models (i.e., with no predictor) were estimated for each variable. Intraclass correlations were calculated from these models to estimate the amount of variance at the between and within-individual levels, which allowed us to determine whether conducting multilevel models was relevant or not. Next, all explanatory variables were added in the conditional growth model, along with time (the baseline time point, wave 1, was given a value of 0 on the timescale). This model explored whether within-person variation in age stereotypes endorsement predicted subjective vitality, after controlling

for covariates (i.e., SPA, self-determined motivation for PA, physical self-worth, perceived loneliness, self-rated health, level of general PA).

Preliminary models included time × predictor interaction terms to test whether the relationships changed significantly over the course of the study. However, as these interactions were not significant, they were not included in the final model. Similarly, inclusion of the random effects of the linear slope and of the covariance slope-intercept did not improve fit of the model, and were therefore not included in the final model.

We therefore tested a two-level random intercept model that led to the following Level 1 model:

$\text{Vitality}_{it} = \beta_{0i} + \beta_1 \text{ time}_{it} + \beta_2 \text{ self-efficacy stereotype}_{it} + \beta_3 \text{ PA benefits stereotype}_{it} + \beta_4 \text{ PA risks stereotype}_{it} + \beta_5 \text{ SPA}_{it} + \beta_6 \text{ autonomous motivation}_{it} + \beta_7 \text{ controlled motivation}_{it} + \beta_8 \text{ physical self-worth}_{it} + \beta_9 \text{ perceived loneliness}_{it} + \beta_{10} \text{ self-rated health}_{it} + \beta_{11} \text{ level of general PA}_{it} + e_{it.}$

In this equation, person *i*'s score of vitality at time *t* is a sum of his/her rating intercept (β_{0i}), linear change over time (β_1), the regression coefficients associated with explanatory variables and covariates (β_2 to β_{11}), and a residual term e_{it}.

The present study included time-varying (Level 1) and time-invariant (Level 2) predictors. Time-varying predictors were centered on each individual's unique mean over time (i.e., group mean centering), which enabled for a pure estimation of the intra-individual effects (Enders & Tofighi, 2007). Time-invariant predictors were centered on the sample mean (i.e., grand mean centering). We added these mean scores to ensure that our estimates of within-person change at level 1 were not confounded with between-person differences (Raudenbush & Bryk, 2002). This led to the following Level 2 model:

$\beta_{0i} = \gamma_0 + \gamma_1 \text{ mean self-efficacy stereotype}_i + \gamma_2 \text{ mean PA benefits stereotype}_i + \gamma_3 \text{ mean PA risks stereotype}_i + \gamma_4 \text{ mean SPA}_i + \gamma_5 \text{ mean autonomous motivation}_i + \gamma_6 \text{ mean controlled}$

motivation$_i$ + γ_7 mean physical self-worth$_i$ + γ_8 mean perceived loneliness$_i$ + γ_9 mean self-rated health$_i$ + γ_{10} mean level of general PA$_i$ + u_{0i}.

This equation indicates that β_{0i} is equal to a constant (γ_0), the regression coefficients associated with time-invariant explanatory variables and covariates (γ_1 to γ_{10}), and a residual term u_{0i}. We did not include predictors of the slopes because the time x predictor interaction was not significant.

The fit of the model was tested using a chi-square test of the differences in -2 log likelihood values (LLV) between this model and the unconditional growth model (with time as the only predictor), with degrees of freedom equal to the difference between each model's total number of estimated parameters. The difference in -2 LLV may be useful to assess whether adding fixed effects to a model increases its overall fit to the data (Singer & Willett, 2003; see for example Trouilloud, Sarrazin, Bressoux, & Bois, 2006). Finally, we calculated pseudo $R1^2$ (within-person level) and $R2^2$ (between-person level) values to estimate the proportion of variance accounted for by the predictors from the unconditional growth model to the conditional model (Singer & Willett, 2003). These values are an estimate of effect size, similar to the R^2 value in traditional ordinary least squares regression analyses (Hox, 2002).

Results

Means, standard deviations, Cronbach's alpha coefficients for all variables at each wave are presented in Table 1 along with their intraclass correlation (ICC). Correlations are reported in Table 2.

On average, at time 1, participants reported high endorsement of self-efficacy stereotype (*M* = 5.66), benefits of PA stereotype (*M* = 6.31), and low endorsement of risks of PA stereotype (*M* = 2.49). Moreover, they reported high autonomous motivation (*M* = 6.48) and low controlled motivation (*M* = 2.74). Finally, they presented high SPA (*M* = 5.03),

physical self-worth (*M* = 4.85), self-rated health (*M* = 4.65), subjective vitality (*M* = 4.96), and perceived loneliness (*M* = 5.32).

Intraclass correlations showed that a significant amount of variance was located at the between-individual level for all variables, including subjective vitality (57%), stereotype endorsement (57% to 65%), SPA (61%), motivations for physical activity (59% to 69%), physical self-worth (75%), perceived loneliness (80%), self-rated health (68%), and level of general PA (57%). This indicates several sources of variation (between and within-individuals) in our variables, justifying our rationale for using multilevel modeling (Hox, 2002).

We next tested whether stereotype endorsement predicted subjective vitality, after controlling for covariates. First, this model provided a better fit to the data, the reduction of the deviance of this model, compared with the unconditional growth model, being significant ($\mathbf{\Delta} = 161.1$; $df = 20$; $p < .001$). At level 1, increases in endorsement of age stereotypes of self-efficacy (b = 0.17, $p < .01$) were associated with increases in subjective vitality ($ß_2$). Some covariates were also significant predictors of subjective vitality, and notably SPA (b = 0.17, $p < .01$) ($ß_5$), autonomous motivation (b = 0.17, $p < .05$) ($ß_6$), physical self-worth (b = 0.44, $p < .001$) ($ß_8$), perceived loneliness (b = -0.08, $p < .05$) ($ß_9$), and self-rated health (b = 0.22, $p < .01$) ($ß_{10}$). All of these predictors accounted for 38.2% of the within-person variance in subjective vitality. At level 2, results revealed that between-person mean differences in endorsement of age stereotypes of PA benefits (b = 0.21, $p < .05$) positively predicted subjective vitality (γ_2), along with SPA (b = 0.39, $p < .001$) (γ_4), physical self-worth (b = 0.45, $p < .001$) (γ_7), perceived loneliness (b = -0.07, $p < .05$) (γ_8), and self-rated health (b = 0.44, $p < .001$) (γ_9). This model accounted for 38.2% of the within-person and 37.5% of the between-person variance in subjective vitality.

In order to examine whether stereotypes predicted health beyond subjective vitality, we tested whether age stereotypes affected self-rated health through the mediating role of subjective vitality. To do so, we added subjective vitality to the multilevel model (at both Level 1 and Level 2), with self-rated health as the outcome. This allowed testing whether the mediator (vitality) predicted self-rated health, after controlling for the predictor (stereotypes) and relevant covariates. Results showed that subjective vitality positively predicted self-rated health at the within-individual level (b = .21, $p < .001$), along with stereotypes of self-efficacy (b = .10, $p < .05$). We then tested the significance of the indirect effect of age stereotypes on self-rated health using the distribution of products test (MacKinnon, Lockwood, Hoffman, & Sheets, 2002). Results showed that the indirect effect was significant (P = 11.22, $p < .001$). In other words, within-individual endorsement of self-efficacy stereotypes predicted self-rated health through its indirect effect on vitality.

Discussion

In line with a psychosocial approach to aging, the study examined whether stereotypes may predict health outcomes independently from their internalization into the self (Levy, 2009). Based on the strength model of self-control (Muraven & Baumeister, 2000), we hypothesized that endorsement of negative age stereotypes may be related to depletion of resources for self-regulation as indexed by subjective vitality. Results corroborated this hypothesis, showing that the less participants believed in the benefits of PA and in older adults' self-efficacy to stay physically active, the less they experienced vitality, over a 9-month period. Importantly, these results were observed after controlling for SPA and a number of potential correlates of subjective vitality (i.e., self-rated health, level of PA, self-determined motivation for PA, physical self-worth, and perceived loneliness). Results also revealed that subjective vitality acted as a mediating variable between endorsement of self-efficacy stereotype and self-rated health.

These findings open new avenues of research by suggesting that age stereotypes may affect health through multiple pathways, and not only through their internalization into the self. Although the internalization hypothesis is important in predicting the aging process, our results suggest that other mechanisms may be involved. This idea is reinforced by the fact that the findings were observed among active older adults, in other words, among individuals who are the least likely to have internalized negative aging stereotypes in the PA domain.

If age stereotypes may affect subjective vitality and health independently from their internalization into SPA, what are the mechanisms involved? Stereotype threat research could help explain the results. There is indeed evidence that coping with threatening negative stereotypes may consume the mental energy necessary for self-regulation (Inzlicht & Kang, 2010). Moreover, people who endorse stereotypes may be more susceptible to experience stereotype threat (Schmader et al., 2004). Based on these results, it is possible that endorsement of negative age stereotypes conflicted with older adults' goal to stay physically active, which required self-control resources to override stereotype-based beliefs, leading in turn to decreased subjective vitality. As we used a correlational design, it is difficult to establish causality links from the observed relationships: stereotype endorsement may have impacted vitality, but vitality may have also affected stereotype endorsement by generating a general "optimistic outlook". A recent study tested the direction of the SPA-functional health relationship over a 16-year period, and found that the best fitting model was that which allowed SPA to predict change in functional health (Sargent-Cox et al., 2012). Given that SPA index stereotype internalization, one may wonder whether the same results could be observed with regard to the stereotype endorsement-vitality relationship. However, given that we did not measure the same constructs as in Sargent-Cox et al.'s (2012) study, it is not possible to draw conclusions. The next step consists in conducting experiments to better ascertain the direction of this relationship, as well as the mechanisms underlying it, and we

hope that other researchers will join us to start investigating this stereotype-related ego depletion hypothesis. Although we cannot infer causality relationships, one strength of this correlational study was to use a rigorous methodology for validity purposes, by using a longitudinal design including relevant covariates, and multilevel modeling.

In addition, the predominance of women is specific to our sample. Given that women may have to face negative sex stereotypes (e.g., women have lower physical and motor abilities than men) in the domain of PA (Chalabaev, Sarrazin, Fontayne, Boiché, & Clément-Guillotin, 2013), it would be interesting to examine whether stereotype endorsement affects subjective vitality similarly among men. Another potential moderator refers to older adults' goal to stay physically active. Although fulfilling such goal may require self-control resources, this may depend on the reasons of engagement. Engaging in self-control behaviors for autonomous reasons may be less depleting than engaging for controlled reasons (Muraven et al., 2008). As our sample was characterized by a high degree of autonomous reasons to engage in PA, it would be interesting to compare it with a sample of older adults who engage in PA for controlled reasons. We may expect the latter to exhibit higher levels of ego depletion.

Beyond the question of the mechanisms that underlie stereotype effects, the present study has implications with regard to health more generally. Indeed, subjective vitality is an important predictor of health outcomes, as it is associated with more resilience, less susceptibility to illness (Benyamini et al., 2000), and higher mental health (Ryan & Frederick, 1997). Our results were in line with this literature, as they showed significant correlations between vitality and self-rated health. It is therefore crucial to better understand the health consequences of aging stereotypes endorsement through subjective vitality on the long term. Moreover, future research should examine whether decreased vitality is associated with self-control failures, which may be reflected in decreased adherence to an exercise program.

Finally, results indicated that aging stereotypes differentially affected subjective vitality depending on their specific content. For example, time-varying endorsement of self-efficacy stereotypes positively predicted subjective vitality, but not time-varying endorsement of outcomes stereotypes. These results may be due to different relations between these stereotypes and intention to be physically active. Indeed, it seems that self-efficacy is a better correlate of older adults' PA intention than outcomes expectancies (Caudroit, Stephan, & Le Scanff, 2011). It is therefore possible that the less participants believed in older adults' self-efficacy to be physically active, the less they intended to continue being physically active, increasing in turn ego depletion. Future research should be conducted to better understand the different implications of specific stereotypes.

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