Subliminal Strengthening: Improving Older Individuals' Physical Function Over Time With an Implicit-Age-Stereotype Intervention

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Abstract

Negative age stereotypes that older individuals assimilate from their culture predict detrimental outcomes, including worse physical function. We examined, for the first time, whether positive age stereotypes, presented subliminally across multiple sessions in the community, would lead to improved outcomes. Each of 100 older individuals (age = 61–99 years, $M = 81$) was randomly assigned to an implicit-positive-age-stereotype-intervention group, an explicit-positive-age-stereotype-intervention group, a combined implicit- and explicit-positive-age-stereotype-intervention group, or a control group. Interventions occurred at four 1-week intervals. The implicit intervention strengthened positive age stereotypes, which strengthened positive self-perceptions of aging, which, in turn, improved physical function. The improvement in these outcomes continued for 3 weeks after the last intervention session. Further, negative age stereotypes and negative self-perceptions of aging were weakened. For all outcomes, the implicit intervention's impact was greater than the explicit intervention's impact. The physical-function effect of the implicit intervention surpassed a previous study's 6-month-exercise-intervention's effect with participants of similar ages. The current study's findings demonstrate the potential of directing implicit processes toward physical-function enhancement over time.

Older individuals tend to assimilate from their culture a variety of negative age stereotypes (i.e., deprecating beliefs about old people as a category), which are associated with detrimental outcomes, including worse physical function (e.g., Levy, Slade, & Kasl, 2002; Levy, Slade, Murphy, & Gill, 2012; Sargent-Cox, Anstey, & Luszcz, 2012). It has not been previously shown whether an implicit intervention could mitigate negative age stereotypes and their effects over time. The current community-based study with older individuals utilized a novel approach: presentation of implicit positive age stereotypes in multiple sessions. The goal was to create an intervention that could strengthen positive age stereotypes, which could strengthen positive self-perceptions

of aging (i.e., beliefs about oneself as an old person), which, in turn, could improve physical function.

The rationale for the implicit intervention was based on single-session laboratory studies showing that (a) subliminally presented positive age stereotypes improved older individuals' physical function (e.g., Levy & Leifheit-Limson, 2009), and (b) increased exposure to subliminal symbols correspondingly increased preference for them

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(Murphy, Monahan, & Zajonc, 1995). Building on these findings, we examined whether an implicit-positive-age-stereotype intervention presented four times, each 1 week apart, could benefit older individuals' physical function 3 weeks after the last intervention session.

An additional goal of the current study was to explore the process by which an implicit-positive-age-stereotype intervention could potentially improve age stereotypes, self-perceptions of aging, and physical function over time. In order to accomplish this goal, we considered three questions. The first was whether an implicit-stereotype intervention would influence these outcomes more strongly than an explicit-stereotype intervention. We expected that it would because the implicit approach may be able to circumvent the internalized negative age stereotypes that tend to predominate over the positive ones (Levy, 2009), whereas the explicit approach may be thwarted by cognitive strategies that preserve existing beliefs (e.g., Dasgupta & Greenwald, 2001). These premises were supported by a single-session study in which an implicit-positive-age-stereotype intervention improved older participants' memory performance, but an explicit-positive-false-feedback intervention showed no effect (Levy, 1996). The explicit intervention might have failed because it did not change participants' age stereotypes. In the current study, the explicit-positive-age-stereotype intervention was based on a single-session conscious-imagery technique that successfully reduced negative gender stereotypes (Blair, Ma, & Lenton, 2001).

The second question we considered was whether an implicit-positive-age-stereotype intervention would diminish negative age stereotypes and negative self-perceptions of aging. It is known that older individuals tend to hold contradictory positive and negative age stereotypes (e.g., "the old are wise" and "the old are senile") and that either type of stereotype can be activated by matching-valence implicit interventions (e.g., Levy & Leifheit-Limson, 2009; Meisner, 2012). Yet it is not known whether an implicit-positive intervention could counter negative age stereotypes, as well as negative self-perceptions of aging. We expected that the implicit reinforcement of positive age stereotypes over time would challenge the premises (e.g., old-age debilitation) of negative age stereotypes and negative self-perceptions of aging and, therefore, diminish their negativity.

The third question we considered was whether self-perceptions of aging would mediate an implicit-positive-age-stereotype intervention's potentially favorable influence on outcomes. Two conflicting theories relate to this question. According to ideomotor theory, a successful implicit-positive-age-stereotype intervention would directly affect behaviors (James, 1896; Shin, Proctor, & Capaldi, 2010). In contrast, stereotype-embodiment theory posits that self-perceptions of aging would mediate the influence of

age stereotypes (Levy, 2009). Evidence supporting stereotype-embodiment theory comes from single-session experiments showing that age stereotypes influenced behavior only among, or more strongly among, older individuals, for whom the stereotypes were self-relevant, in contrast to younger individuals, for whom the stereotypes were self-irrelevant (e.g., Levy, 2009; Marques, Lima, Abrams, & Swift, 2014; Meisner, 2012). In those studies, unlike the current one, self-perceptions of aging were not examined as part of the process.

In the present study, we made three predictions regarding the influence of an implicit-positive-age-stereotype intervention on older individuals. First, this intervention would strengthen positive age stereotypes and positive self-perceptions of aging, and improve physical function; further, these effects would be greater than those resulting from an explicit-positive-age-stereotype intervention. Second, it would weaken negative age stereotypes and negative self-perceptions of aging. Third, it would strengthen positive age stereotypes, which would strengthen positive self-perceptions of aging, which would, in turn, improve physical function.

Method

Participants

The study cohort consisted of 100 individuals who were 60 years or older, able to read and write English, and able to commit to weekly sessions held over 2 months. Participants ranged in age from 61 to 99 years ($M = 81$, $SD = 10$). In most cases, they were female (78%), high-school graduates (89%), and White (83%). Fifteen percent identified themselves as African American, 4% identified themselves as Hispanic, and 2% identified themselves as both. These factors, along with baseline assessments of physical function, did not significantly differ among the intervention groups. This suggests that the randomization procedure was successful.

Procedure

Participants were recruited by means of fliers distributed throughout housing complexes in greater New Haven, Connecticut. To increase ecological validity, we conducted the study in a quiet room in each participant's complex. Participants were interviewed at seven time points over 8 weeks and exposed to the intervention once a week from Weeks 2 through 5. Follow-up measurements occurred at Weeks 5, 6, and 8; the 7th week was omitted, in order to extend the time preceding the last follow-up. The 4-week timing of the intervention was based on two factors: single-session studies showing that greater exposure to implicit stimuli increased their impact

(Levy, Hausdorff, Hencke, & Wei, 2000; Murphy et al., 1995) and clinical trials targeting physical outcomes with older individuals (e. g., Hiyama, Yamada, Kitagawa, Tei, & Okada, 2012).

Participants were unaware of the hypotheses and the nature of the group to which they had been assigned. Of the three experimenters, two (who tested 90% of the participants) were unaware of the hypotheses and intervention assignment; the pattern of significant results did not differ among the three experimenters.

Measures

Predictors: implicit and explicit interventions. The study followed a 2 (implicit activity: positive-age-stereotype intervention vs. neutral condition) × 2 (explicit activity: positive-age-stereotype intervention vs. neutral condition) design in which each participant was randomly assigned to an implicit-positive-age-stereotype-intervention group (with a neutral-explicit condition), an explicit-positive-age-stereotype-intervention group (with a neutral-implicit condition), a combined implicit- and explicit-positive-age-stereotype-intervention group, or a control group with neutral-implicit and neutral-explicit conditions. The time participants spent on each task was matched in all groups.

The implicit- and explicit-positive-age-stereotype interventions were dissimilar in form but had a similar intended purpose of producing aging images, or pictures, either subliminally (the implicit intervention) or by essay prompts (the explicit intervention). Stereotypes have been described as creating "pictures" that "we carry about in our heads" (Lippman, 1922, p. 60).

Implicit-positive-age-stereotype-intervention group. Participants in the implicit-positive-age-stereotype-intervention group were subliminally exposed to positive age stereotypes by a technique that has been successfully used in single-session laboratory studies with older participants (e.g., Levy, 1996; Levy et al., 2000; Levy & Leifheit-Limson, 2009; Marques et al., 2014). We used SuperLab 4.0 (Cedrus, Phoenix, Arizona) to determine subliminal speeds for each individual and to present the age-stereotype stimuli.

To generate the age-stereotype stimuli, we followed Banaji, Hardin, and Rothman's (1993) method of generating gender-stereotype stimuli. A list of positive-age-stereotype words was created by an intergenerational panel. The words used as stimuli were those rated by all members of a new intergenerational panel as 4 or lower on a scale that ranged from 1 (*extremely positive*) to 7 (*extremely negative*) and that were judged to be typically used in relation to old age (e.g., "spry").

Following the implicit-stereotype-presentation method developed by Devine (1989), we presented age stereotypes in five blocks, each containing 20 words, the first of which oriented the participant to the group category (i.e., "old" or "senior"). The subsequent 19 words were presented in a random order that included the other category word, four neutral words matched in length to the stereotype words (e.g., "another"), and the 12 positive-age-stereotype words, with two repeating. These words were flashed in black on a white background. To reduce the possibility of participants becoming familiar with the age-stereotype words, we created three implicit-intervention versions of the word list, among which the age-stereotype words varied. These versions were used in Weeks 2, 3, and 4, respectively; in Week 5, we repeated the words from Week 2.

As a result of the high variability in visual-processing speed between individuals at older ages (Wiegand et al., 2014), a descending-limits-paradigm method was used to determine the best stimulus-presentation speed that allowed perception without awareness for all participants. At the start of each of the four implicit-intervention sessions, stimuli with patterned masks (of nonsense symbols) flashed on participants' computer screens at gradually decreasing speeds. To prevent participants expecting to see words in actual trials, we used strings of random letters as stimuli. After each speed-specific block of stimuli presentations, the participant was asked, "Did you see any flashes on the screen?" If the participant reported seeing at least one flash, this speed was used for the intervention session. If the participant did not report seeing a flash, the speed-trials program ran at progressively slower speeds until the participant observed one (range = 70–215 ms, M = 170 ms). The longer average speed needed for perception without awareness, compared with other single-session implicit-age-stereotype studies conducted with older individuals, likely reflects the fact that the current study's participants were, on average, about a decade older (e.g., Levy, 1996; Marques et al., 2014); the speeds of parafoveal-vision processing and information processing tend to decline linearly with later age (Hahn et al., 2009; Papp et al., 2014).

Participants were then exposed to the implicit-age-stereotype intervention. After each stimulus was shown on the computer screen, participants indicated whether a flash appeared above or below a bull's-eye by pressing either an up or a down arrow on a computer keyboard. They were told to guess if they did not see anything, respond as quickly and accurately as possible, and keep their focus on the bull's-eye. The patterned mask covered the afterimage of the stereotype words to reduce the likelihood of perception with awareness.

Participants' response times did not significantly change over the four sessions, which suggests that there was not an increase in awareness. Further, when participants were asked after the intervention sessions what they had seen on the screen, their responses indicated

that they were unaware of the implicit-intervention content (e.g., "saw a blur").

The participants in this group also took part in the neutral-explicit condition. It was identical to the neutral-explicit condition of the control group (see the Control Group section).

Explicit-positive-age-stereotype-intervention group. As in the implicit-positive-age-stereotype intervention, we created three versions of the explicit-positive-age-stereotype intervention: Participants were asked to imagine and then write about "a senior citizen who is mentally and physically healthy" (Weeks 2 and 5), "a female senior citizen who is mentally and physically healthy" (Week 3), or "a male senior citizen who is mentally and physically healthy" (Week 4). The technique was derived from a successful single-session intervention that induced counterstereotypical mental imagery in young participants by asking them to imagine a strong woman (Blair et al., 2001). The validity of the explicit intervention was supported by an intergenerational panel that was unaware of participants' group assignments. This panel rated all essays according to the positivity of the aging image they presented, on a scale from 1 (*extremely positive*) to 7 (*extremely negative*), with 4 indicating neutral. The positive-explicit-age-stereotype essays were rated as significantly more positive ($M = 2.00$, $SD = 0.52$) than those essays generated by the neutral-explicit comparison condition ($M = 3.88$, $SD = 0.25$), $t(96) = 22.82$, $p < .0001$.

Participants in this group were also exposed to the neutral-implicit condition on a computer. It was identical to the neutral-implicit condition of the control group (see the Control Group section).

Combined implicit- and explicit-positive-age-stereotype-intervention group. Participants in this third group were exposed to both the implicit-positive-age-stereotype intervention and the explicit-positive-age-stereotype intervention.

Control group. Participants in the control group were exposed to both a neutral-implicit and a neutral-explicit condition. In the neutral-implicit condition, participants viewed neutral stimuli on a computer. These stimuli consisted of a random series of letters matched to the implicit-positive-age-stereotype words in length, number of syllables, beginning letter, and ending letter. In all other respects, the procedure for presenting the stimuli was identical to the one used in the implicit-positive-age-stereotype intervention. In the neutral-explicit condition, participants were asked to imagine neutral topics (e.g., "the kinds of uniforms or clothes that people wear in different types of transportation roles") and then to write about this image.

Outcome measures. Participants in all groups responded to outcome measures at baseline and at Weeks 5, 6, and 8.

Age stereotypes. Age stereotypes were assessed with the Image of Aging Scale (Levy, Kasl, & Gill, 2004), which asks participants to indicate whether 18 items match "the kinds of images that come to mind when you think of old people in general (not including yourself)." Half the items are positive (e.g., "capable"), and half the items are negative (e.g., "helpless"). Participants are given a choice from 0 (*not at all matches my image of old people*) to 6 (*exactly matches my image of old people*). The overall measure for this scale was determined by reverse-scoring the negative items and then summing all the items. The scale has previously shown good 1-week test-retest reliability, internal consistency, and convergent validity with older individuals (Levy et al., 2004). To examine the second hypothesis, we created a negative-age-stereotype subset by adding the nine negative items that were found to uniquely load on a single factor (Hatcher, 1994).

Self-perceptions of aging. The same Image of Aging Scale items used to assess age stereotypes were used to assess self-perceptions of aging. Participants were instructed to indicate how much the items matched their image of "yourself as an old person." They were given a choice from 0 (*not at all the way I think about myself as an old person*) to 6 (*exactly the way I think about myself as an old person*). The overall measure for this scale was determined by reverse-scoring the negative items and then summing all the items. A negative-self-perception-of-aging subset was created, in order to examine the second hypothesis, by adding scores from the nine negative items also used in the negative-age-stereotype subset.

Physical function. Physical function was assessed with the Short Physical Performance Battery (Guralnik et al., 1994), a well-established measure of physical function in older adults. It assesses strength, gait, and balance by examining (a) time to rise from a chair and return to the seated position five times, (b) time to walk 8 feet, and (c) ability to stand with feet together in the side-by-side, semitandem, and tandem positions for 10 s. Possible scores ranged from 0 to 12, with a higher score indicating better physical performance. Older individuals who receive lower scores on this measure have increased risk of disability, nursing-home placement, and mortality (Guralnik et al., 1994; Verghese, Holtzer, Lipton, & Wang, 2012).

Covariates. Age, sex, and health, as measured by number of medications, were included as covariates because they have been found to correlate with scores on the Short Physical Performance Battery (Buford et al., 2014; Guralnik et al., 1994; Verghese et al., 2012).
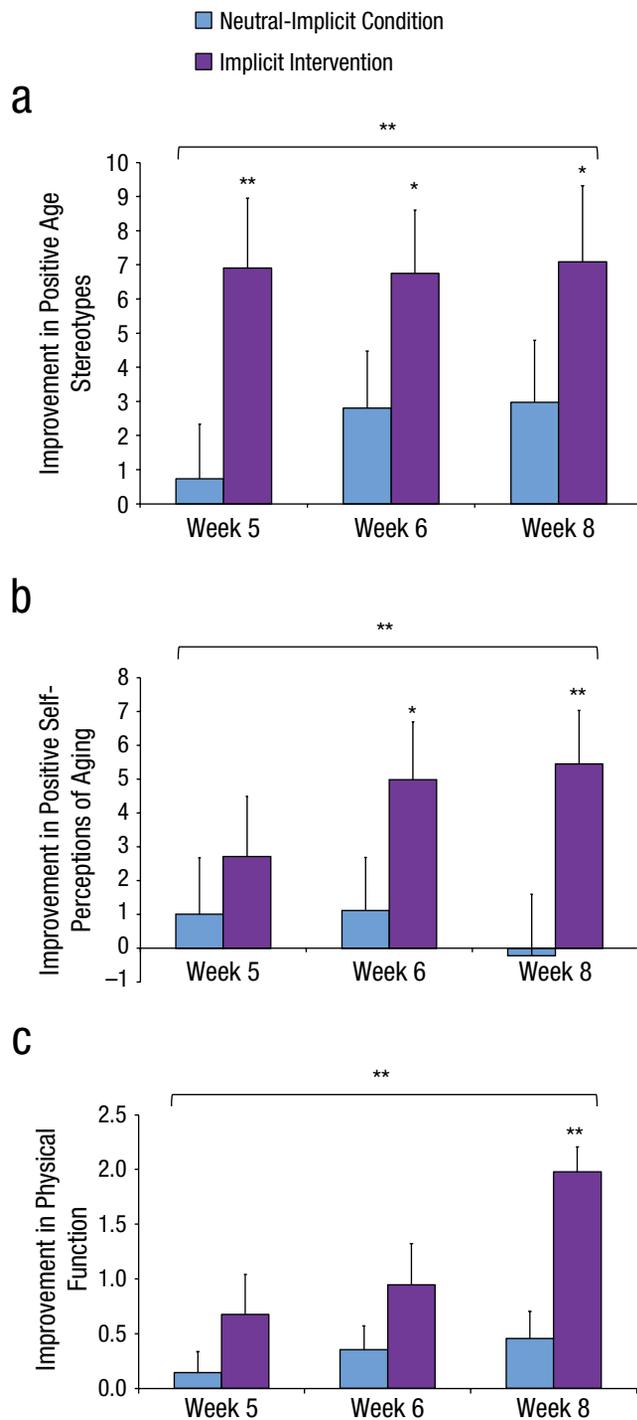
Fig. 1. Mean improvement from baseline, adjusted for covariates, in (a) positive age stereotypes, (b) positive self-perceptions of aging, and (c) physical function, separately for the implicit-positive-age-stereotype intervention and neutral-implicit condition at each time point. Error bars represent +1 *SEM*. The asterisks above the bars indicate significant differences between groups at a given time point, whereas the asterisks above the brackets indicate the significance of the implicit intervention across the three time points (**p < .05, **p < .01*).

Analytic plan

We examined the first and second hypotheses with a series of repeated measures analyses of covariance (ANCOVA) models, which included the implicit and explicit interventions as the predictors, adjusting for age, sex, health, and the baseline values of the outcome measures. To address the third hypothesis, we constructed a structural equation model according to the steps suggested by Hatcher (1994), which allowed us to simultaneously test the four variables of the conceptual model in a predicted time sequence: the implicit intervention that took place at Weeks 2 through 5, positive age stereotypes at Week 5, positive self-perceptions of aging at Week 6, and physical function at Week 8. Structural equation modeling was also employed to examine whether an alternative sequence of the variables could fit the data and whether our conceptual model fully mediated the relationship between the implicit intervention and the physical-function outcome. The *p* values are presented as one-tailed tests, because we hypothesized a direction of the effects on the basis of single-session studies in which positive-age-stereotype interventions improved outcomes (Cumming, 2012; Levy, 2009; Marques et al., 2014; Meisner, 2012). All analyses were conducted with SAS (Version 9.3; SAS Institute, Cary, NC).

Results

In support of the first hypothesis, findings showed that the implicit-positive-age-stereotype intervention significantly strengthened positive age stereotypes, $F(1, 164) = 7.42$, $p = .004$, $\eta_p^2 = .065$, 95% confidence interval (CI) = [.009, .160]; significantly strengthened positive self-perceptions of aging, $F(1, 164) = 6.01$, $p = .008$, $\eta_p^2 = .051$, 95% CI = [.005, .142]; and significantly improved physical function $F(1, 164) = 5.93$, $p = .008$, $\eta_p^2 = .08$, 95% CI = [.023, .183] (see Fig. 1).

Further, the implicit-positive-age-stereotype intervention had a stronger influence on self-perceptions of aging and physical function than did the explicit-positive-age-stereotype intervention, which yielded no significant effects on these factors. Although the explicit intervention significantly strengthened positive age stereotypes, $F(1, 162) = 6.09$, $p = .01$, $\eta_p^2 = .05$, 95% CI = [.002, .142], the effect sizes indicated that the implicit intervention's influence on positive age stereotypes was 30% greater.

Additionally, the implicit-positive-age-stereotype intervention appeared to influence the content of the neutral essays. The participants exposed to this intervention were significantly more likely to present a positive image of aging than those in the neutral-implicit condition, $F(1, 42) = 4.69$, $p = .04$, after we adjusted for covariates.

Table 1. Comparison of Outcomes in the Implicit-Positive-Age-Stereotype Intervention and Neutral-Implicit Condition

Measure and condition	Week 1	Week 5	Week 6	Week 8
Positive age stereotypes				
Implicit intervention	55.62 (1.52)	63.36 (1.86)	61.20 (2.05)	61.56 (2.05)
Neutral-implicit condition	54.54 (1.41)	54.90 (1.49)	55.44 (1.55)	55.80 (1.66)
Positive self-perceptions of aging				
Implicit intervention	76.32 (1.96)	80.10 (2.20)	79.74 (1.88)	81.54 (1.91)
Neutral-implicit condition	74.88 (1.85)	75.42 (2.14)	73.44 (2.01)	74.34 (2.23)
Physical function				
Implicit intervention	6.94 (0.47)	7.61 (0.54)	7.81 (0.49)	8.28 (0.46)
Neutral-implicit condition	7.00 (0.56)	7.15 (0.55)	7.12 (0.52)	7.09 (0.55)
Negative age stereotypes				
Implicit intervention	29.88 (1.13)	26.28 (1.55)	28.44 (1.61)	27.63 (1.51)
Neutral-implicit condition	31.68 (1.22)	32.04 (1.04)	30.51 (1.41)	30.69 (1.22)
Negative self-perceptions of aging				
Implicit intervention	16.65 (1.34)	15.57 (1.38)	15.93 (1.23)	14.22 (1.25)
Neutral-implicit condition	18.54 (1.28)	18.99 (1.52)	19.17 (1.26)	18.72 (1.41)

Note: The table presents raw means with standard errors in parentheses.

In support of the second hypothesis, results from the repeated measures model showed that the implicit-positive-age-stereotype intervention significantly weakened negative age stereotypes, $F(1, 162) = 3.30$, $p = .04$, $\eta_p^2 = .04$, 95% CI = [.008, .113]. Similarly, the implicit-positive-age-stereotype intervention significantly weakened negative self-perceptions of aging, $F(1, 162) = 3.65$, $p = .03$, $\eta_p^2 = .03$, 95% CI = [.001, .111].

The pattern of raw means (see Table 1) and findings from repeated measures models for the implicit intervention, unadjusted for age, sex, and health, were similar to the results from the adjusted repeated measures models. The following are the findings for the effect of the implicit intervention on the five outcomes in the unadjusted models: positive age stereotypes, $F(1, 168) = 5.11$, $p = .01$, $\eta_p^2 = .04$, 95% CI = [.004, .123]; positive self-perceptions of aging, $F(1, 168) = 3.10$, $p = .04$, $\eta_p^2 = .03$, 95% CI = [.0001, .0966]; physical function, $F(1, 168) = 4.98$, $p = .01$, $\eta_p^2 = .05$, 95% CI = [.004, .137]; negative age stereotypes, $F(1, 166) = 2.08$, $p = .08$, $\eta_p^2 = .02$, 95% CI = [.002, .086]; and negative self-perceptions of aging, $F(1, 166) = 2.04$, $p = .08$, $\eta_p^2 = .017$, 95% CI = [.000, .079]. Although the last two outcomes did not meet the 95% level of significance ($\alpha = .05$) in the

unadjusted models, all five outcomes met the .05 level of significance in both the fully adjusted models and the models in which age alone was added as a covariate; age may therefore influence the processing of the implicit intervention (Hahn et al., 2009; Papp et al., 2014).

In support of the third hypothesis, results showed that the three predicted paths were significant in the expected direction and sequence (see Fig. 2 for the conceptual model). The structural equation model that tested the conceptual model met the goodness-of-fit criteria outlined by Hatcher (1994): comparative fit index = .99, root-mean-square error of approximation = .01, and $\chi^2(3) = 2.29$, $p = .51$.

Two alternative structural equation models were tested. In the first, the sequence of positive age stereotypes and self-perceptions of aging was switched by using positive self-perceptions of aging at Week 5 and positive age stereotypes at Week 6. The resulting model did not fit the data well; it resulted in a significant chi-square test, $\chi^2(3) = 8.97$, $p = .03$, which indicates that this model significantly differed from the data collected.

We also examined whether the conceptual model, with the two-part mediation of age stereotypes and
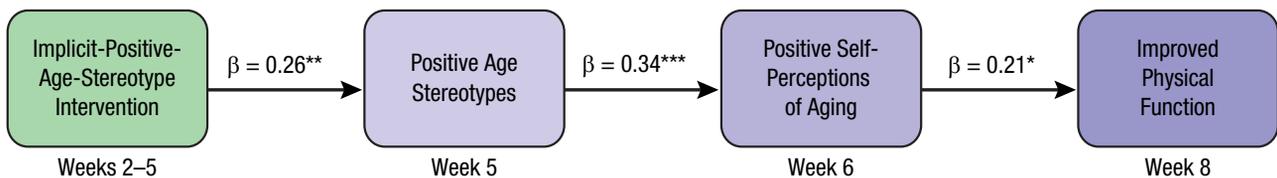
Fig. 2. Conceptual model with results from the structural equation model testing the predicted links between the intervention and the three outcomes. Asterisks indicate significant paths (*$p < .05$, **$p < .01$, ***$p < .001$).

self-perceptions, fully mediated the relationship between the intervention and the physical-function outcome. There were three results consistent with the structural-equation-modeling criteria for full mediation (Little, Card, Bovaird, Preacher, & Crandall, 2007). First, when the direct path between the implicit intervention and the physical-function outcome was added to the conceptual model, this path was nonsignificant ($\beta = 0.12$, $p = .21$). Second, the three paths of the conceptual model remained significant when this direct path was added. Third, the fit indices did not significantly change when the direct path between the implicit intervention and physical function was eliminated. In sum, the predicted conceptual model fit the data better, or more parsimoniously, than the two alternative models.

Discussion

This study demonstrated, for the first time, that an implicit intervention can significantly improve functioning over an extended period. The physical-function improvement that resulted from the 4-week implicit-positive-age-stereotype intervention was greater than the outcome of a 6-month-exercise intervention with a cohort of similar age (McAuley et al., 2013).

The implicit intervention seems to have exerted its influence through two processes. First, positive age stereotypes were immediately and significantly strengthened. Second, the structural equation modeling suggests that these enhanced stereotypes then acted, in effect, as an intervention that significantly strengthened positive self-perceptions of aging, which then acted as an intervention that significantly improved physical function.

It was also found for the first time that an implicit intervention could significantly decrease the negativity of age stereotypes and self-perceptions of aging. This was shown in the model that adjusted for relevant covariates. The effectiveness of the implicit intervention on the range of outcomes contrasts with the parallel explicit intervention, which only significantly improved positive age stereotypes.

In addition, the implicit intervention apparently helped the participants develop a positive-aging perception of their surroundings. As an example, a participant in this group wrote the following in response to the prompt to describe a room: "This room is designed principally to use the computers but we are doing many things to allow the world to see what can be done to enhance what elderly students do to help the world and themselves."

The longitudinal improvement of the positive age stereotypes is impressive because, prior to the implicit intervention, the participants were likely to have been habituated to the negative age stereotypes that prevail in society (e.g., Butler, 2008). The implicit intervention's success might have been due to its repetitive nature, which provided a countervailing habituation wherein the positive age stereotypes gained familiarity and, thus, initiated a cascade of positive effects.

This study extends and integrates two lines of research with older individuals. Experimental research has previously shown that implicit-age-stereotype interventions influence outcomes in stereotype-congruent ways, but these studies were confined to single sessions (e.g., Levy & Leifheit-Limson, 2009; Marques et al., 2014; also see two meta-analyses: Horton, Baker, Pearce, & Deakin, 2008; Meisner, 2012). Additionally, community-based longitudinal studies have previously shown that more-positive views about aging predict better outcomes, but these studies did not include an implicit intervention (e.g., Cheng, Yip, Jim, & Hui, 2012; Levy et al., 2002; Moser, Spagnoli, & Santos-Eggimann, 2011; Sargent-Cox et al., 2012).

Assimilated negative stereotypes exist in other targeted groups, with injurious outcomes (e.g., Rivera & Paredez, 2014). Whether a repetitive implicit intervention would also succeed in those cases awaits investigation. For older individuals, however, this approach led to a process that appeared to create an implicit fitness center.

Author Contributions

B. R. Levy developed the study concept. B. R. Levy, P. H. Chung, and C. Pilver developed the study design. C. Pilver oversaw data collection and data entry. C. Pilver and M. D. Slade conducted data analysis. B. R. Levy drafted and revised the manuscript with advice from the other authors.

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