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ABSTRACT

Assuming that the principle of an active-self account holds true in real life, priming certain constructs could selectively activate a working self-concept, which in turn guides behavior. The current study involved two experiments that examined the relationships between stereotypic identity, working self-concept, and memory performance in older adults. Specifically, Study 1 tested whether a stereotype threat can affect older adults' working self-concept and memory performance. A modified Stroop color naming task and a separate recognition task showed that a stereotype threat prime altered the activation of the working self-concept and deteriorated the older adults' memory performance. Additionally, the working self-concept mediated the effect of stereotype threat on memory performance. Accordingly, we designed Study 2 to assess whether priming different identities can alter the working self-concept of the elderly and buffer the stereotype threat effect on memory performance. The results not only were the same as Study 1 but also revealed that activating multiple identities could mitigate the stereotype threat. These results support an active-self account and the efficacy of stereotype threat intervention. This intervention strategy may be able to be used in real situations to help the elderly alleviate stereotype threats and memory impairment.

Introduction

People in their 60s and 70s usually experience the decline of a variety of cognitive functions, especially memory (Naveh-Benjamin & Old, 2008). Memory deterioration has been regarded as a sign of declining mental health and often brings negative consequences to the daily lives of older people (Smith, 2002). Age-related negative stereotypes, especially negative stereotypes associated with cognitive attributes such as senility, dementia, and forgetfulness have been studied extensively (e.g. McConnell, 2010). These negative stereotypes affect cognitive and behavioral outcomes via a stereotype threat (Scholl & Sabat, 2008). A number of studies about the relationship between stereotype threat and memory performance have revealed that stereotype threat has a detrimental effect on older adults' memory performance (Levy, Zonderman, Slade, & Ferrucci, 2012). To better understand the phenomenon of memory deficiency under stereotype threat, previous studies also tested possible mechanisms, such as self-efficacy

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(Desrichard & Köpetz, 2005) and lowered working memory (Mazerolle, Régner, Morisset, Rigalleau, & Huguet, 2012), underlying the relationship between stereotype threat and memory in the elderly (for a review see Wheeler & Petty, 2001).

Though many studies have investigated the effects of stereotype threat on the memory performance of older adults as well as the underlying mechanism, two important issues require further consideration. First, the relationship between stereotype threat and cognitive processing, especially the effect of stereotype threat on working self-concept, should receive more attention. The existing studies have been concerned primarily with dynamic changes in domain-specific self-schema under a stereotype threat that occur regardless of changes in the general self-schema in negative stereotype prime situations (Retelsdorf, Schwartz, & Asbrock, 2015; Schmader, Croft, & Whitehead, 2014). Scarcely any study has investigated the effects of stereotype threats directed at older adults' memory ability on their general working self-concept. The second important issue involves ways to reduce the detrimental effect of stereotype threat on memory performance in the elderly. Numerous studies have explored intervention strategies for the stereotype threat effect (e.g., Wheeler, Jarvis, & Petty, 2001; Shapiro, Williams, & Hambarchyan, 2013; Sherman et al., 2013). However, far fewer studies have investigated either the intervention strategies of age-related stereotype threat effects on memory performance or the working mechanisms of this relationship.

Given these issues discussed above, we designed the current study. The first goal of the current study was to explore the effects of stereotype threat on older adults' general working self-concept and memory performance. The second goal was to reveal the intervening effects of priming different stereotypic identities of the elderly on general working self-concept and memory loss. Furthermore, we wanted to explore the underlying mechanism and intervention strategies of stereotype threat effects on memory performance in the elderly.

Theoretical Framework and Hypothesis Development

Stereotype Threat, Working Self-Concept, and Memory Performance

Working self-concept, also termed the self-concept of the moment, has been put forward to reflect the malleability of a person's self-concept in the momentary social context (McConnell, 2010). It was defined by Markus and Kunda (1986) as a shifting array of continually active self- representations determined by ongoing social events. It is context-sensitive, and its content is determined by social contextual clues (McConnell, 2010; Smith, 2002). It accounts for the accessibility of some self-representations that have different valences (e.g., positive and negative self-representations) in specific motivational states or social conditions. When self-representations are competing for dominance, the dominant self-representation varies with situational changes (Mandel, 2003). Most studies have emphasized that among the arrays of self-concept, self-representations of different valences (either positive or negative) will alter according to the changing social context. Thus, the activated working self-concept fits the current social events (Wheeler, DeMarree, & Petty, 2007).

Established studies have revealed a possible relationship between stereotype threat and working self-concept. Stereotype threat refers to the phenomenon that individuals perform more poorly in situations in which a relevant negative stereotype or stigmatized social identity is made salient (Schmader & Johns, 2003; Steele & Aronson, 1995). Stereotype threats are pervasive and lead to a number of adverse influences on many areas of people's daily

lives, including women's math performance on mathematics tests (e.g., Inzlicht & Ben-Zeev, 2000), older adults' memory performance (e.g., Hess, Auman, Colcombe, & Rahhal, 2003, 2009), and African-American adults' intelligence performance (Thames et al., 2013). Based on Levy's stereotype internalization theory (Levy, Slade, Kunkel, & Kasl, 2002; Schmader et al., 2014), other research has showed that stereotype threat takes effect unconsciously as a self-fulfilling prophecy via a change in the general self-schema because individuals assimilate the attributions related to negative stereotypes into their self-concept throughout their life-long development (Levy, 2009).

Most previous studies focused on task-related and task-specific working self-concepts and found a negative association between stereotype threat and a person's domain-related working self-concept (Retelsdorf, Schwartz, & Asbrock, 2015; Schmader, Croft, & Whitehead, 2014). However, theoretical and empirical studies have indicated that self-concept is a multidimensional construct that includes a general construct and several specific facets (Hansen & Wänke, 2009). Existing studies have not paid much attention to the change in general working self-concept under stereotype threat. Andersen (1984) indicated that people's thoughts and feelings have a great effect on their self-representations. In fact, in negative stereotype situations, people tend to endorse more negative expectations (Haslam et al., 2012), so more negative self-representations are activated to fit the temporary social context. In light of the above arguments, in stereotype threat situations, negative self-representations can be expected to dominate the working self-concept.

In addition, active-self account has been put forward to explain that priming certain constructs (such as stereotypes, traits, and exemplars) can selectively activate the working self-concept and, in turn, guide behavior (Wheeler & DeMarrée, 2009). The working self-concept emphasizes the dynamics and flexibility of temporary social contexts and has been regarded as an interpretive structure in regulating ongoing behavior (Wheeler & DeMarrée, 2009). Several studies have investigated the mediating role of working self-concept in the relationship between stereotypic identity and relevant outcomes (Hansen & Wänke, 2009). Consequently, expecting that stereotypic situations will affect stereotyped individuals' task-related performance via the change of working self-concept is reasonable.

Accordingly, in line with previous studies and theoretical perspectives that a stereotype threat should have a detrimental effect on memory in older adults, we expected that, in situations where overt clues of the stereotype threat exist, older adults will perform unfavorably in memory tasks and that negative self-representations will dominate the working self-concept of the elderly. What is more, working self-concept may mediate the effect of stereotype threat on older adults' memory performance.

Hypothesis 1: A stereotype threat prime will impair older adults' memory performance.

Hypothesis 2: A stereotype threat prime will activate more negative self-representations that will dominate the working self-concept.

Hypothesis 3: Working self-concept will play a mediator role in the relationship between stereotype threat and memory performance in older adults.

The Intervening Effects of Different Stereotypic Identities

Can the detrimental effects of stereotype threat be eliminated? The answer is yes. Previous studies have identified several effective strategies that reduce stereotype threat and

consequently improve domain performance. Some common strategies involve directing individuals to deflect the activation of negative stereotypes (Ambady, Paik, Steele, Owen-Smith, & Mitchell, 2004), priming an exemplar to elicit a judgmental contrast by evoking social comparisons (Mandel, 2003), providing positive social comparisons, and teaching intervention strategies (Johns, Schmader, & Martens, 2005). For example, when women participants were provided a female role model who did well at mathematics (this can be seen as an intervention) after they were told that they would be completing a math test on which women typically perform worse than men (the description of the test can be seen as activating a stereotype threat), they tended to think that they could do well like the successful women. This reduced their anxiety about their potential underperformance on the diagnostic test, and, as a consequence, their performance improved (McIntyre et al., 2005). Among these intervention strategies, priming different identities has received increasing attention because it is flexible and easy to operate (e.g., Rydell, McConnell, & Beilock, 2009; Martiny et al, 2015).

Several studies have investigated the intervention of priming multiple competing identities on stereotype threat effects. Because people tend to manage good impressions of themselves and to control others to establish and maintain a positive impression on themselves (Baumeister, 1982), when confronted with negative stereotypes, people are highly motivated to assimilate into a more positive group identity and avoid the negative self-image (Alicke & Sedikides, 2009). Once threatened individuals increase their identification with a positive identity, the adverse effects induced by the negative stereotype may be reduced and, as a result, their subsequent performance improved. Evidence for this came from studies of the stereotype threat toward females in math performance, which have demonstrated that when positive and negative social identities related to their math ability were presented (a female college student vs. a supposedly typical female), the women's math performance did not suffer from the stereotype threat (Rydell et al., 2009).

Although many studies have investigated intervention strategies for the stereotype threat effect as well as the underlying mechanisms, the intervention effect of priming competing stereotypic identities toward the stereotype threat effect among the elderly has scarcely been studied. Older adults have been suggested as possessing more complex representations of the age group to which they belong with advancing age (Brewer & Lui, 1984) and are also targeted by competing positive and negative age-related stereotypes in cognitive domains (Levy & Leifheit-Limson, 2009). Given the fact that people are more willing to maintain a positive identity when faced with two incompatible identities simultaneously, we expect that priming multiple stereotypic identities is an effective strategy for eliminating the negative consequences caused by stereotype threat on older adults' memory performance.

Hypothesis 4: Priming multiple stereotypic identities will increase the memory performance of older adults who are under a stereotype threat.

In addition, based on the previous overview, the working self-concept adjusts in response to the triggering events to adapt itself to social events. Consequently, we may also expect that different intervention strategies will alter the characteristics of the working self-concept.

Hypothesis 5: Priming a negative stereotypic identity (vs. a positive stereotypic identity) will activate a more negative (vs. positive) self-representation that will dominate the working self-concept in older adults (H5a); priming multiple identities will result in a predominance of positive self-representations in older adults (H5b).

The Current Study

The goal of the current research was to extend previous studies by exploring the effects, mechanism, and interventions related to the way that stereotype threats impact memory performance in the elderly. In Study 1, after priming a negative identity in older adults, we computed the elderly people's performance on a modified Stroop color naming task and a separate recognition task. We first examined whether situationally priming a stereotype threat would alter the working self-concept and memory performance of the older individuals. Then we tested the mediating effect of a working self-concept. Experiment 2 adopted the same basic procedures as Study 1 but activated different stereotypic identities. The purpose of this study was to examine the effect of intervention strategies on memory impairment and on different identities in relation to the activation of a working self-concept. In addition, previous research suggested that age identification may affect the stereotype threat effect (e.g., O'Brien & Hummert, 2006). Therefore, to avoid the potential impacts of age identification, that variable was measured and controlled as a covariate variable.

Study 1

Method Study 1

Design and participants. For this experiment, we used a 2 (experimental condition: stereotype threat vs. control) × 3 (self-representation valence: negative, neutral vs. positive) mixed design to test the memory performance of older adults under stereotype threat with the experimental condition being the independent variable, the memory score being the dependent variable, and working self-concept as an intervening variable.

60 healthy older adults aged above 55 years (women) or 60 years (men)[1] were voluntarily recruited either from a senior center or through posters. People with age-related cataracts, heart disease, cerebral infarction, or other brain illnesses were politely rejected from participation in the study because of the possibility of greater increases in the response time or the inability to read the materials. All the participants were native Chinese speakers and were naïve to the study's hypothesis.[2] The participants were assigned randomly and equivalently to either the stereotype threat group or the control group.

Materials Study 1

Working self-concept. A modified Stroop color-naming task which had been confirmed to be effective was used to test the activation of the working self-concept (Zhang, Wang, Li, Yu, & Bi, 2011). The classic color word Stroop task requires participants to respond to the color of colored word stimuli (e.g., responding "green" when the word "red" is colored green) while ignoring the meaning of the word (e.g., red). The hypothesis underlying the Stroop task is that when the color of a word and the meaning of the word are incongruent, the participants' response time will be longer than the response time when they responded to a non-colored

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[1]Because the general provision for retirement age in China is 60 for males and 55 for females, we used these ages as the starting points of old age to adapt to China's current situation.
[2]The participants in this study had not participated in similar psychological experiments before this study. At the end of the procedure, they were asked for their opinion about the purpose of the study. No one guessed the actual research purpose.

word (Stroop, 1935). The modified Stroop color-naming task used in the current study presented different qualities of the elderly (positive, negative, and neutral). The hypothesis was that when the semantic content of colored words matches with the activated valence of self-representations, response time will be prolonged. For example, when a negative self-representation dominates a person's self-concept, the person will respond slowly to negative qualities. Positive qualities, however, will not function in the same way in this situation (Luo, 1999).

Memory performance. Memory performance was measured using a recognition task, measured by an old-new paradigm. We chose 100 two-character Chinese words according to *Modern Chinese Frequency Dictionary (1986)*, half for learning (old words) and the other for the test (new words). The old words and new words did not differ significantly in either the mean frequency or the mean of number of strokes per character.

Manipulation check. Three items were used to check whether the experimental manipulation was effective (e.g., I am worried that my performance on the test will be affected by my age). The participants were asked to provide their answers from 1 (strongly disagree) to 7 (strongly agree), and their scores were calculated by averaging the items. A high score represented a more saliently activated stereotype threat. These three items have a satisfactory reliability (Cronbach $\alpha = .71$).

Age identification. A five-item self-report measure similar to the Scientific Identity Scale used by Woodcock, Hernandez, Estrada, and Schultz (2012) was adopted. The participants indicated whether they agreed with the description of each item on a 5-point Likert scale ranging from "1 = strongly disagree" to "5 = strongly agree". An example of the items was "I have a strong sense of belonging to the community of older adults". The value of age identification was calculated by averaging the score of the five items altogether. A higher score indicates a higher level of identification to the group of the elderly. These items formed a reliable scale (Cronbach $\alpha = .77$).

Other materials. Research has suggested that depression, sleep quality, and social support may affect the physical and mental health of older adults (e.g., Andrew & Dulin, 2007; Tanaka & Shirakawa, 2004; Brown et al., 2009). Thus, to ensure the homogeneity of the subjects, during the preparation session, the Pittsburgh sleep quality index (PSQI, $\alpha = .83$) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989), a short version of the Center for Epidemiologic Studies Depression Scale (CES-D-13, $\alpha = .75$) (Zhang & Li, 2011), and a social support scale ($\alpha = 0.89$, Zimet, Dahlem, Zimet, & Farley, 1988) were used to measure the sleep quality, depression symptoms, and social support of the elderly people in the study.

Procedure Study 1

The study was carried out in two stages. Before each stage, the participants signed a consent form that stressed that their participation was confidential and voluntary. The preparation stage was conducted 2 to 3 days before the formal session. The participants completed PSQI, CES-D-13, the revised Chinese version of the perceived social support scale, and age identification questionnaires. Subsequently, they were asked to write down five words that represented their positive qualities and five words that represented their negative qualities, which were used as colored words in the Stroop task.

The formal testing stage was conducted on an individual basis in individual cubicles. The procedures were as follows:

(a) The participants were randomly assigned to either the stereotype threat group or the control group. The materials used to activate the stereotype threat were similar to those proposed by Hess et al. (2003). Specifically, in the stereotype threat condition, the participants read an article describing theories and research findings confirming that memory declines with increasing age. The control group read an article that was irrelevant to the memories of older adults. The number of words used as threat activation materials was basically the same for the two groups.[3] After the participants read the article, they were told that in the subsequent study they would take a widely adopted test that was designed to test whether the article they read was right.

(b) The participants were asked to finish an experimental manipulation check measure.

(c) Five minutes were given for them to read fifty Chinese two-character words.

(d) The participants finished the modified Stroop color naming task programmed in E-prime. They were asked to press the keyboard in response to the color of the words. Each participant underwent 10 practice trials (of colored English nonword letters) and 240 formal trials per task. The randomly presented words, were composed of five positive self-representation words (e.g., hardworking), five negative self-representation words (e.g., sulking) and five neutral words (e.g., leaf) that had been collected in the preparation session. The left-right hand balance was controlled.

(e) The participants then finished the recognition task by deciding whether the 100 words presented randomly on the screen had been "read" or "not read" (i.e., in step c) by pressing one of the keys on the keyboard. The left-right hand balance was also controlled between the participants. On completion of the recognition task, the participants were thanked, debriefed, and paid.

The study was approved by the human research ethics committee of the institute for which the authors work and by the university's institutional review board.

Results Study 1

Control variables. First, a series of independent t-tests were conducted to test the differences in the control variables, including age, education years, depression symptoms, perceived social support, and sleep quality, between the test subjects and the controls. The results revealed that the two groups did not differ significantly with regard to these variables (see Table 1), ensuring that the participants assigned to the two groups were homogenous.

Manipulation check. Descriptive statistics about the working self-concept, memory, and manipulation check, as well as the results of the mean difference tests of these variables, were presented in Table 2. The results confirmed that the stereotype threat manipulation was successful.[4]

Memory performance. An independent t-test showed that the experimental condition was marginally significantly predictive of memory performance in older adults, $t(58) = -1.86$, $p = .069$, Cohen's $d = .48$, in that the recognition score for the stereotype threat group was lower than that of the control group. This result indicated that the stereotype threat impaired the memory performance of older adults and supported hypothesis 1.

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[3] Those articles about priming different stereotypic identities in both Study 1 and Study 2 are available upon request from the corresponding author.
[4] The differences in the manipulation check between the threat group and the control group were significant, $t(58) = 2.05$, $p = .045$, Cohen's $d = 0.53$.

Table 1. Means and standard deviations for control variables in Study 1(N = 60).

	stereotype threat group N = 30	control group N = 30	t
Age	66.23(5.16)	65.80(5.54)	0.31
Education(years)	12.27(3.86)	13.57(3.62)	−1.35
Depression	0.64(0.52)	0.52(0.44)	0.96
Social support	5.67(0.64)	5.57(0.76)	0.59
Sleep quality	5.81(3.69)	5.11(3.91)	0.72

Note. Standard deviations are in parentheses. None of the *t*-values in the table were significant.

Working self-concept. First, in the working self-concept measure with the modified Stroop color-naming task, incorrect responses (about 3% of the trials) were eliminated prior to the analysis. Reaction times (RTs) by each participant that exceeded 3 standard deviations from the means of the correct latencies (around 1% of the trials) were identified as outliers.

Then, to test hypothesis 2, a 2 (experimental condition: stereotype threat vs control) × 3 (self-representation valence: negative, neutral vs. positive) mixed-design ANCOVA was performed. In addition, we controlled age identification as a covariate variable. The partial eta squared (η^2) was reported as an indicator of effect size (Cohen, 2013). The mean RTs and standard deviations of the cross between the experimental conditions and the self-representation valences are shown in Table 2. The results showed that the main effect of neither the valence nor the experimental condition was significant, $F(2, 116) = .97$, $p = .382$, $\eta^2 = .001$ and $F(1, 58) = .49$, $p = .487$, $\eta^2 = .01$, respectively. However, the interaction between valence and priming was significant, $F(2, 116) = 3.83$, $p = .025$, $\eta^2 = .06$. Further simple main effect analyses indicated that the RTs of the negative, neutral, and positive self-representations were not significantly different from each other in the control condition (all ps ≥ .127). However, in the stereotype threat condition a significant main effect of valence emerged, $F = 5.96$, $p = .004$, with the RTs of negative self-representations significantly longer than those from neutral self-representations ($p = .001$) and those from positive self-representations ($p = .020$). The results confirmed hypothesis 2. That is, the stereotype threat activation resulted in a prolonged response to negative self-representations that dominated the working self-concept.

Stereotype threat, working self-concept, and memory. The correlation analysis showed a high negative association between working self-concept and memory performance, $r = -.31$, $p < .050$. Next, a mediation analysis was carried out to test hypothesis 3 that working self-concept mediates the effects of stereotype threat on memory performance in the elderly. The working self-concept was calculated by subtracting the RTs of the group that

Table 2. Descriptive statistics from working self-concept, memory, and manipulation check in Study 1 (N = 60).

Working Self-concept (RTs)	stereotype threat group N = 30	control group N = 30	t
Negative	611.48(115.69)	583.32(111.15)	1.17
Neutral	595.08(95.15)	583.51(115.39)	0.42
Positive	602.22(113.62)	577.00(112.79)	0.86
Memory	0.74(0.09)	0.78(0.09)	−1.86[†]
Manipulation check	4.18(1.27)	3.57(1.00)	2.05[*]

Note. Standard deviations are in parentheses.
$05 < {}^†p < .10$; ${}^*p < .05$.

Table 3. Bootstrap analysis of the mediating effects in Study 1 (N = 60).

	a	b	ć	c	ab(boot)
Coefficients	−16.5863	−.0008	.0286	.0423	.0130
SE	6.9480	.0004	.0233	.0228	.0079
t	−2.3872[*]	−1.9695[*]	1.2255	1.8562[*]	
Bias corrected CI					[.0013,.0336]

Note. a = path from IV to mediators, b = path from mediators to DV, ć = direct effect of IV on DV, c = total effect of IV on DV, ab(boot) = indirect effects of IV on DV through proposed mediator by bootstrapping procedure; 1,000 bootstrap samples; [*]$p < 0.05$.

had been primed for a neutral self-representation from those with a negative self-representation. The procedures outlined by Preacher and Hayes (2008) for testing mediation in small samples were then followed. A bootstrapping procedure revealed an indirect effect of .01 and a 95% confidence interval ranging from .00 (low confidence interval was .0013) to .03. This suggested a significant indirect effect because zero was excluded from the interval (Preacher & Hayes, 2008). Therefore, hypothesis 3 was supported; that is, the working self-concept was a significant mediator of the stereotype threat effect on memory performance in the elderly. In addition, the mediating relationship model with regression coefficients and *p*-values is shown in Table 3.

Study 1 revealed that older adults in the two groups were not significantly different in age, education, depression symptoms, perceived social support, or sleep quality. The results also showed that a stereotype threat impaired memory performance in the elderly and altered the activation of self-representations. More importantly, the results supported the mediating effect of working self-concept.

Discussion Study 1

The results from Study 1 supported hypothesis 1: "A stereotype threat prime will impair older adults' memory performance" and hypothesis 2: "A stereotype threat prime will activate more negative self-representations that will dominate the working self-concept." What is more, Study 1 demonstrated that working self-concept was a mediator, which supported hypothesis 3: "Working self-concept will play a mediator role in the relationship between stereotype threat and memory performance in older adults." These results add to a small but growing set of studies that have established the importance of working self-concept in the mechanism by which stereotype threat works on older adults' memory performance. Based on the findings from Study 1 in which stereotype threats resulted in more negative self-representations and a finding that the self-representations with different valences (either positive or negative) alter according to the changing social context (Wheeler, DeMarree, & Petty, 2007), if stereotype threat effects are eliminated by intervention strategies, the working self-concept of older adults should be altered and their memory performance should also be improved. Consequently, we conducted Study 2 to further explore the relationships between stereotype threat, working self-concept, and memory performance.

Study 2

Study 2 was designed to eliminate or buffer the stereotype threat effect by priming different stereotypic identities in older adults who had been confronted with a stereotype threat

against their memory ability. In designing this study, we expected that priming different stereotypic identities in older adults would also activate different self-representations, especially the activation of negative self-representations that can dominate the working self-concept under a stereotype threat and can, in turn, affect the memory performance of older adults. Through the intervention, we endeavored to further confirm the relationships between stereotype threat, working self-concept, and memory performance in the elderly.

Method Study 2

Design and participants. 98 healthy older adults aged above 55, recruited either from a senior center or through posters, participated voluntarily in this study. People with age-related cataracts, heart disease, cerebral infarction, or other brain illnesses were politely rejected from participation in the study because of the possibility of greater increases in the response time or the inability to read the materials. All the participants were native Chinese speakers and were naïve to the study's hypothesis. Three participants were removed from the final data.[5] The remaining 95 older adults were assigned randomly to the following four groups: stereotype threat group, positive identity group, negative identity group, and multiple identities group.

Materials Study 2

Except for the materials used to activate different stereotypic identities, all other materials were identical to those used in Study 1.

Procedure Study 2

Study 2 was carried out in two stages. Before each stage, the participants signed a consent form that stressed that their participation was confidential and voluntary. The preparation procedure used in Study 2 was the same as that used in Study 1, and the formal experiment also followed the task order used in Study 1. The procedures were as follows:

(a) When the participants arrived, they were told that the purpose of the study was to test age differences in memory ability and that they would complete a widely adopted test used to diagnose their memory ability.[6] Then, they were randomly assigned to one of the four experimental contexts. In the positive identity group, the participants read an article about the advantages of the elderly compared with young adults. The participants in the negative identity group read an article that discussed some disadvantages of older adults compared with young adults. The adults assigned to the multiple identities group read an article about both the advantages and disadvantages of being older compared with being younger. The participants in stereotype threat group did not receive any additional information. The total lengths of the articles in the three groups

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[5]The data from two participants who had a response time in excess of 2,000 ms and one participant who left in the middle of the test for personal issues were deleted from the final data.

[6]The reason why we told participants to complete a diagnostic test was as follows: first, the diagnostic information instead of article reading can avoid conflicting with further intervention materials in positive and multiple stereotypic identity groups; second, the priming method used in study 2 had been widely adopted and supported to be effective (e.g., Hess, Emery, & Queen, 2009).

Table 4. Means and standard deviations for the control variables in Study 2 (N = 95).

	ST(N = 24)	PSI(N = 23)	NSI(N = 25)	MSI(N = 23)	F
Age	68.83(4.26)	67.83(5.14)	67.36(5.96)	66.35(5.66)	0.89
Education(years)	11.54(3.31)	11.00(2.84)	10.88(3.40)	11.22(3.15)	0.26
Depression	0.69(0.48)	0.49(0.40)	0.81(0.54)	0.67(0.49)	1.82
Social support	5.72(0.90)	6.08(0.77)	5.75(0.80)	5.55(0.89)	1.63
Sleep quality	6.35(3.78)	5.00(2.54)	6.81(3.41)	5.56(3.02)	1.48

Note. ST = stereotype threat group, PSI = positive stereotypic identity condition, NSI = negative stereotypic identity group, MSI = multiple (positive and negative) stereotypic identities group. Standard deviations are in parentheses. All *F*-values in the table are non-significant.

(b) The participants were asked to finish an experimental manipulation check.
(c) After that, 3 minutes were given for them to learn fifty Chinese two-character words.[7]
(d) Next, the participants finished the modified Stroop color naming task.
(e) Finally, the participants completed the recognition task. On completion of the recognition task, the participants were thanked, debriefed, and paid.

The study was approved by the human research ethics committee of the institute for which the authors work and by the university's institutional review board.

Results Study 2

Control variables. First, a series of one-way ANOVAs were conducted to test the differences in the control variables between the different experimental groups to ensure the participants' homogeneity. Descriptive statistics, including the means and standard deviations of the control variables, are summarized in Table 4. The results showed that the four groups did not differ significantly in age, $F(3, 91) = .89$, $p = .449$, partial $\eta^2 = .03$; social support, $F(3, 91) = 1.63$, $p = .188$, partial $\eta^2 = .05$; depression, $F(3, 91) = 1.82$, $p = .149$, partial $\eta^2 = .06$, respectively; or sleep quality, $F(3, 91) = 1.48$, $p = .225$, partial $\eta^2 = .05$.

Manipulation check. A one-way ANOVA showed that the experimental manipulation was successful, $F(3, 91) = 4.46$, $p = .006$, partial $\eta2 = .13$. Specifically, the scores of the positive identity group and the multiple identity group were lower than the score of the negative identity group ($ps \leq .005$), but the negative identity group did not significantly differ from the stereotype threat group, $p = .105$. In addition, the score of stereotype threat group was marginally significantly higher than the positive identity group ($p = .092$). These results indicated that the older adults in the stereotype threat group and the negative stereotypic identity group endorsed more negative stereotypes toward the elderly than did the positive stereotypic identity group or the multiple identities group. The means and standard deviations are shown in Table 5.

Memory performance. A one-way ANOVA showed that the experimental condition was marginally significantly predictive of memory performance in older adults, $F (3, 91) = 2.55$,

[7]Compared with study 1, study 2 improved task demands by shorten the learning time. Research suggested task demand may impact the effect of stereotype threat on memory performance (Hess et al., 2009). Older adults subjected to threat performed worse when task constraints were high than those confronted with lower task constraints. Thus, in order to worsening stereotype threat, the elderly were asked to learn those words within three minutes.

Table 5. Descriptive statistics of working self-concept, memory, and manipulation check in Study 2 (N = 95).

	ST(N = 24)	PSI(N = 23)	NSI(N = 25)	MSI(N = 23)
Working self-concept(RT)				
Negative	575.20(113.27)	576.09(109.25)	647.14(172.99)	535.67(102.32)
Neutral	563.37(109.06)	574.06(110.42)	630.54(161.56)	545.21(108.62)
Positive	564.87(107.10)	574.20(114.23)	630.42(163.29)	546.49(116.77)
Memory	0.70(0.07)	0.73(0.07)	0.70(0.09)	0.75(0.06)
Manipulation check	4.22(1.17)	3.60(1.25)	4.80(1.10)	3.78(1.42)

Note. ST = stereotype threat group; PSI = positive stereotypic identity group; NSI = negative stereotypic identity group; MSI = multiple stereotypic identities group. Standard deviations were in parentheses. One-way ANOVA was used to test the memory performance and experimental manipulation. The results were $F(3, 91) = 2.55$, $p = .061$, partial $\eta2 = .08$ and $F(3, 91) = 4.46$, $p = .006$, partial $\eta2 = .13$, respectively.

$p = .061$, partial $\eta^2 = .08$. A post hoc analysis revealed that the recognition score of the multiple identities group was significantly higher than that of the negative stereotypic identity group and stereotype threat group (both $ps \leq .030$). These results supported hypothesis 4, showing that the activation of multiple identities improved the older adults' memory performance.

Working self-concept. First, incorrect responses (about 3% of trials) were eliminated prior to the analysis; reaction times (RTs) that exceeded 3 standard deviations from the mean of the correct latencies (about 1% of trials) of each participant were identified as outliers.

Then, to test hypotheses 5a and 5b, a 4 (experimental conditions: stereotype threat group, positive identity group, negative identity group vs. multiple identity group) × 3 (self-representation valence: negative, neutral vs. positive) mixed-design ANCOVA was performed after controlling age identification as a covariant. The mean RTs and standard deviations of the cross between the experimental conditions and the self-representation valences are shown in Table 5. The main effect of the experimental condition was not significant, $F(3, 91) = 1.29$, $p = .282$, $\eta^2 = .04$; the main effect of self-representation valence was also not significant, $F(2, 182) = .17$, $p = .847$, $\eta^2 = .002$; but the interaction between the self-representation valence and the experimental condition was significant, $F(6, 182) = 2.70$, $p = .016$, $\eta^2 = .08$. So we conducted a further simple main effect analysis and post hoc analysis to reveal the differences between the three self-representation valences in the different experimental groups.

In the stereotype threat group, the mean RT of the participants who were asked to respond to the Stroop test while they had a negative self-representation was marginally significantly higher than the neutral self-representation significantly ($p < .068$). Similarly, the negative identity group had a significantly prolonged mean RT compared to the neutral self-representation ($p = .002$) and positive self-representation ($p = .007$) groups. These results were consistent with Study 1 and supported hypothesis 5a, showing that being exposed to a stereotype threat resulted in a negative self-representation. However, in the multiple identities group (as well as the positive identity one), the differences between the RTs of the negative, neutral and positive self-representation groups were non-significant (all $ps \geq .942$ in the positive identity group and all $ps \geq .261$ in the multiple identities group). These findings did not support hypothesis 5b, suggesting that being primed with multiple identities did not lead to a positive self-representation.

Discussion Study 2

Study 2 showed that priming multiple identities improved memory performance in older adults, a finding which supported hypothesis 4: "Priming multiple stereotypic identities will increase the memory performance of older adults who are under a stereotype threat.". Furthermore, Study 2 revealed that having a negative identity (including the participants in the stereotype threat group and in the negative identity group) altered the participants' self-representations, but these results were not found in the other two groups (the positive identity group and the multiple identities group). Thus, these results partially supported hypothesis 5 in that it supported hypothesis 5 a: "Priming a negative stereotypic identity (vs. a positive stereotypic identity) will activate a more negative (vs. positive) self-representation that will dominate the working self-concept in older adults." but did not support hypothesis 5b: "Priming multiple identities will result in a predominance of positive self-representations in older adults.". These results suggested that if the effects of stereotype threat are alleviated by intervention strategies, the working self-concept of older adults will be altered and their memory performance will also improve.

General Discussion

We conducted two experiments to explore the mechanism and intervention of the stereotype threat effect on older adults' memory performance. Study 1 was designed to examine whether being primed with a stereotype alleging that older adults' memory impairment influences their memory performance by altering their working self-concept, with negative self-representations dominating the various self-representations. The purpose of Study 2 was to test whether confronting older adults with different stereotypic identities, which directly targeted their self-schema, would influence their working self-concept by changing the dominant position of their negative self-representations and improve their memory performance.

The results of Study 1 not only extend previous studies by confirming that stereotype threat can impair older adults' memory performance in an Eastern culture (Cohen, 2013; Hess, 2005; Stein et al., 2002) but also support the active-self account concept by illustrating the effect of priming constructs on the working self-concept and on a subsequent behavioral outcome (Wheeler et al., 2007; Wheeler & DeMarrée, 2009). Based on the active-self account, priming negative stereotypes in the elderly can influence their behavior by selectively activating a subset of their usual self-concept by assimilating the information in the prime. In addition, our study extends and enriches the active-self account by considering how stereotype threats affect the general working self-concept. Previous studies testing the role of working self-concept in stereotype threat-to-behavior effects have primarily focused on a domain-specific working self-concept (e.g., Wyer, Neilens, Perfect, & Mazzoni, 2011). However, studies have suggested that the temporary and transient domain attribution-self link could spread to other-related self-concepts (Moskowitz, 2005). Consequently, the general working self-concept, which is high on the hierarchy of the working self-concept, can also be expected to be affected by priming conditions. The general working self-concept has been used to examine the association strength of the links between "self" and "good/advantages", "bad/disadvantages", or neutral attributes (Hinkley & Andersen, 1996). Our results showed that, because a stereotype threat can lead to negative self-representations that

dominate the array of active self-representations in the working self-concept and can cause a prolonged response time to negative self-representations, situationally priming a stereotype threat can affect the general working self-concept.

Study 2 revealed that priming multiple identities was an effective intervention for reducing stereotype threat, a result which was consistent with previous literature (e.g., Gresky et al., 2005). More importantly, the results enrich the research about stereotype threat interventions for older adults. Our results did not provide evidence that older adults in multiple stereotypic identity groups would establish and maintain the activation of positive self-representations dominating the working self-concept as expected. One possible reason is that the negative stereotypes had a much stronger influence on memory performance than did the positive stereotypic identity (for example, Meisner, 2012). Thus, priming multiple stereotypic identities effectively alleviates the activation of negative self-representations but is not powerful enough to activate more positive self-representations. Even though priming multiple stereotypic identities did not result in the dominance of positive self-representations, such priming is still effective for reducing the detrimental effect of stereotype threat on older adults' memory performance.

Because the intervention strategy was targeted directly at self-schemas, the effects of the intervention strategy on working self-concept and memory further confirmed the relationships between stereotype threat, working self-concept, and memory performance in older adults. Thus, the older people were able to inhibit negative self-images when confronted with negative age stereotypes and flexibly change their self-knowledge about old age stereotypes to ensure better outcomes.

Limitations of the Current Research

Some limitations need further consideration. First, studies have demonstrated that older adults are able to control the detrimental effect of stereotype threat given explicit and blatant clues. Moreover, when older adults are manipulated using implicit and subtle clues they are able to detect the negative consequences of the stereotype threat (for example, Hess, Hinson, & Statham, 2004). Such studies that have investigated implicit activations as a more effective approach for detecting stereotype threat effects add to the multidimensional approaches for the study of age-related stereotype threat on memory. For example, Wheeler and Petty (2001) activated a stereotype threat using subtle and subliminal word presentations. Consequently, further studies should adopt more implicit activations because implicit priming can operate without deliberate processing or evaluation of the information and may have a stronger priming effect on older adults' memory performance.

A second limitation involves ecological validity. Because negative age-related stereotypes are often quite subtle and deeply-rooted in real life, experimentally manipulating such stereotypes and situational intervening strategies cannot be expected to have equivalent effects in everyday life. Thus, our experimental manipulation of the stereotype threat and the intervention strategy used in our study may have limited generalizability. The generalizability of the stereotype threat effect and the intervention strategy could possibly be enhanced if a similar effect occurs in older adults after they experienced subtle and unobtrusive manipulations, such as they are likely to encounter in everyday life.

Finally, the chosen participants were all healthy older adults who may have been more inclined to assimilate positive stereotypic identities than a less-abled set of older adults

would have. In keeping with this, studies have shown that the age-related negative stereotypes increase with advancing age (Kornadt & Rothermund, 2012). Also, many older adults experience serious illness or suffer from great depression. People in these situations may not easily change their self-concept even when primed with positive stereotypic identities because the negative stereotypes may have a stronger effect on their working self-concept (Meisner, 2012). So the elderly in poorer health states need to be considered in future studies.

Implications for Stereotype Threat Research

Theoretical implications. The present study advances the research related to stereotype threat and older adults' memory in a number of ways. Our study provides a more comprehensive understanding of the causal factors impacting memory decline in the elderly and enriches the theories related to older adults' memory. Past studies have paid more attention to the physiological function of aging while ignoring the role of social factors in memory decline in the elderly. A major goal of our study of the effect of stereotype threat on the memory of older adults was to reveal a possible reason for memory decline from the perspective of social factors, and our results enriched the theoretical system in the field of stereotype threat and older adults' memory.

Practical implications. Our study may be greatly significant for preventing and intervening in memory decline in the elderly. Compared with the physiological functions of aging, the negative effects of stereotype threat on older people' memory ability is more easily controlled and improved. Our study not only studied the effect of stereotype threat on memory, but also explored the mechanism and the results of intervention on the stereotype threat effect. Our results may supplement medical intervention strategies traditionally directed at physiological aging by enabling practitioners to consider utilizing a combination of social factors and biological factors to enhance the memory of the elderly more effectively.

The current research not only indicated that stereotype threats lead to memory impairment and negative self-representations that dominate the working self-concept but also implied that the working self-concept had a mediating effect. In addition, the research suggested that multiple identities could be used to alleviate stereotype threats. The findings help to elucidate the internal mechanism of stereotype threat and may help older adults improve their lives by improving their memory.

Acknowledgments

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