ON ATTENTIONAL CONTROL AND THE ELDERLY DRIVING STEREOTYPE

by

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STATEMENT OF DISSERTATION APPROVAL

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ABSTRACT

Anecdotal evidence exists for a stereotype of poor elderly driving performance but this stereotype has not been empirically documented despite possible detrimental effects through stereotype threat. Study 1, Experiment 1, measured implicit and explicit associations between aging and driving in older (>60) and younger (<31) adults. Individual differences in attentional control were measured using an operation span (OSPAN), working memory task. Associations between advanced age and impaired driving were found in both groups, and individual differences in attentional control correlated with implicit associations for older, but not younger adults. Study 1, Experiment 2, determined the extent to which attentional control moderates the stereotype's implicit expression in young adults. Younger adults in Experiment 2 took the implicit association test (IAT) twice. Half were asked to control the stereotype by responding as if they were an older adult the second time. In this latter condition, individual differences in attention control predicted young adults' change in IAT scores.

Older adults from Study 1 also participated in Study 2. To test for the effects of stereotype threat, participants completed a car following scenario in a driving simulator, either under stereotype threat or control conditions. Dependent measures included brake reaction time, following distance, and collision occurrence. Compared to the control group, participants under stereotype threat were over six times more likely to collide with other vehicles. Further, under stereotype threat, participants lower in attentional control showed increased brake reaction times and following distances; a pattern often associated with distracted/impaired driving.

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INTRODUCTION

Older adults (age 60+) in the United States perceive the possession of a driver's license as the key to independence and as an integral part of their personal and social identity (Eisenhandler, 1990). In a focus group study, Yassuda, Wilson, and von Mering (1997) found that older drivers planned to continue driving until severe physical limitations forced them to stop. As described by one group member, "they will pry my cold dead hands off the wheel before I stop driving" (p. 534). While young adults' self-reported attitudes toward older adults appear to be positive (Valeri-Gold, 1996), anecdotal evidence supports the notion that older adults' desires to retain their driving privileges are at odds with stereotypes about their driving abilities. For example, in a television episode of *South Park*, upon realizing that a senior center meeting is adjourning, a character runs through town yelling, "Get off the streets! Old people driving!" Other examples include an online blog, automoblog.net, which posted a discussion about whether or not older adults should be banned from driving. Blogger Chris Burdick (2007) stated, "I know *for a fact* that old people are a danger on the roads."

The stereotype of older adults as bad drivers has not been examined in the otherwise voluminous literature on implicit and explicit stereotypes. This absence is puzzling given the role that such stereotypes may have in older adults' on-road driving performance through stereotype threat mechanisms (Steel & Aronson, 1995; Yeung & von Hippel, 2008). Stereotypes of stigmatized groups can have harmful effects on performance in stereotype-relevant domains (Davis & Simmons, 2009). In the domain of driving, the safety of our roadways may thus be jeopardized. Nearly 50,000 people die per year in car accidents and older adults are overrepresented. In 2009, older adults comprised 13% of the US population but accounted for 16% of all traffic fatalities (National Highway and Traffic Safety Administration, 2009). Examining negative stereotypes of older drivers may improve our understanding of a socially stigmatized group and ultimately save lives.

This dissertation addressed four primary aims carried out through two studies. The first study 1) documented explicit and implicit stereotypes of older adults as hazards behind the wheel and 2) demonstrated a mechanism that allows control over the expression of implicit associations between aging and driving safety. The second study 3) established that older adult driving performance was susceptible to stereotype threat and 4) determined that attentional control predicted susceptibility of older adults to the impact of stereotype threat on some measures of driving performance.

STUDY 1

Background

Social psychologists approach ageism as a phenomenon similar to sexism or racism in that it involves negative attitudes, stereotyping, and behavior. However, in the case of ageism, these negative attitudes, stereotypes, and behaviors are directed toward older adults based solely on their perceived age (Richeson & Shelton, 2006). This form of prejudice has been studied in terms of its applied manifestation explicitly and implicitly. For example, explicit ageism in the work place has affected seniors in the form of mandatory retirement ages (Hedge, Borman, & Lammlein, 2006). Implicitly, ageism can affect seniors in terms of health care decisions that are made by medical professionals but based on their negative attitudes and stereotypes toward the elderly (Adelman, Greene, Charon, & Friedman, 1990). Specific stereotypic trait components of older adults have also been examined (Hense, Penner, & Nelson, 1995; Nosek, Banaji, & Greenwald, 2002). Within the laboratory, investigations of the elderly stereotype have focused on identifying stereotypic traits such as “traditional,” “conservative,” and “lonely,” and more recently the trait of “forgetfulness” (Brewer, Dull, & Lui, 1981; Hess & Hinson, 2006; Horton, Baker, Pearce, & Deakin, 2008). However, despite the wide circulation of anecdotal evidence for a poor driving component of the elderly stereotype, little scientific attention has been paid to this possibility.

Several scholars (Hense et al., 1995; Nosek et al., 2002) have empirically examined implicit and explicit stereotypic traits of older adults. Two studies alluded to stereotypes of older-adult drivers but did not systematically examine them. Moreover, these studies focused on positive aspects of older adult driving, such as slower, less aggressive driving tendencies (Branaghan & Gray, in press; Davies & Patel, 2005). Branaghan and Gray demonstrated that priming of the elderly stereotype caused young adult participants to drive slower and take longer to reach their destination. Davies and Patel collected ratings of aggressiveness for hypothetical drivers of different ages and genders. Elderly females were rated least aggressive followed by elderly males. These examples of positive older adult driving traits sharply contrast with the negative stereotype traits that surface within popular culture and the media. Given this discrepancy, the first aim of Experiment 1 was to empirically investigate the stereotype of older adult drivers.

Research on the structure and function of stereotypes has demonstrated that they can be explicitly endorsed, implicitly held, or both. Implicit measurement techniques show that individuals who explicitly refuse to endorse social stereotypes may still carry implicit stereotypical associations. Notable among these techniques is the Implicit Association Test (IAT), which measures the relative strength of an association between a target and an attribute (Greenwald, McGhee, & Schwartz, 1998). For example, White participants responded more quickly when the category *black* was paired with *unpleasant* than when the category *white* was paired with *unpleasant*, and more slowly when *black* was paired with *pleasant* than when *white* was paired with *pleasant.* This pattern persisted even when participants did not explicitly endorse negative stereotypes of Blacks (Nosek et al., 2002).

Converging evidence suggests that IAT scores may be related to attentional control (Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Klauer, Schmitz, Teige-Mocigemba, & Voss, 2010; Payne, 2005; Richeson & Shelton, 2003). Attentional control refers to one's ability to maintain a goal in working memory in the face of interference (Engle, 2002). This often requires overriding an automatic response in favor of a controlled response. Therefore, the IAT could recruit attentional control if individuals are encouraged to produce IAT scores consistent with their explicitly-endorsed egalitarian attitudes. Assuming a person has strong implicit associations between *dangerous* driving and *old*, successful goal maintenance would require overriding an automatic tendency to respond more quickly when *safe* or *young* and *dangerous* or *old* are paired, or overriding the tendency to respond more slowly when *dangerous* or *young* and *safe* or *old* are paired. Recently, Fiedler and Bluemke (2005) and Cvencek, Greenwald, Brown, Gray and Snowden (in press) demonstrated that some participants could successfully "fake" their IAT score by effectively suppressing stereotype expression on implicit tests.

Study 1 Overview

Study 1, Experiment 1, empirically addressed the discrepancy between positive driving traits of older adults in the scientific literature and negative traits in the media. The study assessed implicit associations between *old* and *young* with *safe* and *dangerous,* respectively, via a novel IAT while also collecting explicit measures of the stereotype in both young and older adults. It was hypothesized that young and older adults would produce IAT effects consistent with attitudes of dangerous older-adult drivers. This study also correlated individual differences in attentional control with IAT performance because implicit biases of older adults high in attentional control could differ from those lower in attentional control. High functioning older adults may not perceive themselves to be dangerous drivers and, in turn, may not hold strong negative associations between driving and aging. Older adults may also be motivated to control negative implicit associations of their own group, though it may be the case that only those high in attentional control have the ability to do so. To further investigate attentional control, Study 1, Experiment 2 tested whether younger adults were able to "fake" the IAT, responding as though they were older adults. Because faking likely requires goal maintenance to override automatic stereotypical associations, it was hypothesized that individual differences in attentional control would relate to young adults' ability to fake, or suppress, their implicit attitudes toward aging and driving. In other words, I suspected feigned IAT outcomes, whether occurring spontaneously (as for older adults in Experiment 1) or in the context of explicit instruction (as for younger adults in Experiment 2), would be governed by a central attentional control mechanism underlying the ability to successfully regulate stereotypes. Therefore, in Study 1, Experiments 1 and 2, it was hypothesized that individuals with greater attentional control would suppress the aging stereotype of driving, thereby changing their IAT effects.

Experiment 1

Method

Participants

One hundred and seven University of Utah undergraduates (age range 18-30 years, *M* = 21.34 years) participated in exchange for course credit. Fifty-two community-dwelling older adults (age range 61-89 years, *M* = 72.52 years) participated and were compensated with $15.

Materials and Apparatus

IAT

The IAT (Greenwald et al., 1998) is a reaction time task that measures the strength of association between two concepts. Associations are considered to be implicit because they can be activated automatically and measured outside of conscious control. The task involves comparing reaction times for classifying pairs of stimuli thought to be more strongly associated (e.g., *fear* and *heights*) than ones thought to be less associated (e.g., *fear* and *flowers*). When the pairing represents a strong implicit association, participants classify stimuli more quickly.

In the present study's seven-block IAT, modeled after Lane, Banaji, Nosek, and Greenwald (2007), participants sorted words as belonging to the categories of *safe* or *dangerous* and faces as belonging to the categories *old* or *young* (see Figure 1).

Verbal stimuli related to the concepts of safe and dangerous driving were compiled from the Nelson, McEvoy, and Schreiber (1999) word association norms as well as from the American Association of Retired Persons Driver Safety Program participant workbook. These lists, in addition to non-IAT safety relevant words and baseline nonsafety relevant words, were then rated by undergraduate students at the University of Utah in terms of the strength of their relationship to the concepts of safe and dangerous driving without any mention of aging. This was done to verify that the present stimuli differed from positively and negatively valenced verbal stimuli used in other aging IATs. The present stimuli were specifically driving-relevant[1] (e.g., *crash, observant)*, but the images of older and younger adults were taken from a previous IAT that examined associations between young/old and good/bad (Nosek et al., 2002).

Explicit Measures

Two explicit measures were created, a feeling thermometer, modeled after Greenwald et al. (1998) and a Likert scale questionnaire, created specifically for this study. The feeling thermometer asked participants to describe their general

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[1]IAT safety-relevant stimuli, non-IAT safety relevant words, and baseline non-safety-relevant words were rated by 70 undergraduate students on their relatedness to the concepts of safe and dangerous driving. IAT stimuli were judged to be significantly more related to the concepts of safe and dangerous driving than non-IAT safety relevant and baseline words.

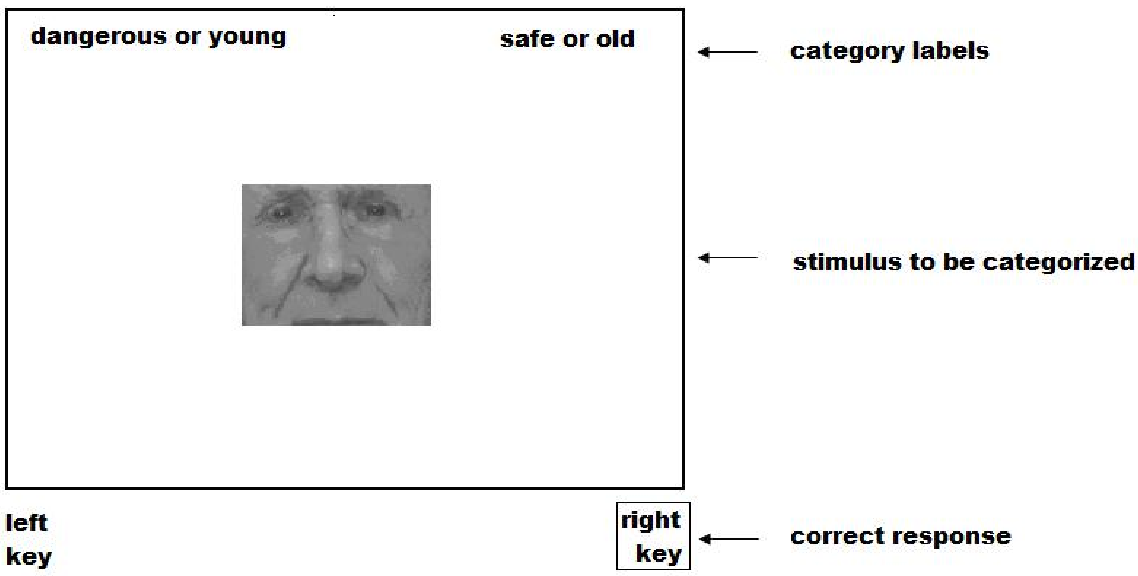

Figure 1. Sample IAT trial for which the participant’s job is to categorize the older adult image as old when the category is paired with safe by pressing the key on the right side of the keyboard.

level of warmth or coolness toward two target concepts: senior citizens' (≥ 60) and others' (< 60) driving. Participants indicated warmth or coolness by circling an answer on a scale from 0 (very cold) to 10 (very warm). The 7-point Likert scale questionnaire (1 being agree and 7 being disagree) asked participants to endorse eight statements related to older adult driving, half worded affirmatively (e.g., "Most old people drive too slow and disrupt the flow of traffic.") and half worded negatively (e.g., "Old drivers should not be required to retake driving tests more frequently than others.").

Attentional Control

An operation span (OSPAN) working memory task measured attentional control. The automated OSPAN task (Unsworth, Heitz, Schrock, & Engle, 2005) was administered to multiple young adult participants at once. Older adults were given an experimenter-guided version of the task (Turner & Engle, 1998) administered individually by an experimenter, thereby reducing potential technology-related anxiety that could confound scores. The OSPAN task requires individuals to solve math problems while concurrently remembering letters (automated task) or words (experimenter-guided task). Math and letter/word pairs were presented in sets that ranged in size from 3-7 (automated task) or 2-5 (experimenter-guided task), with the letters/words being recalled in the correct serial order at the end of each set. An absolute scoring system gave participants one point for each word recalled, but only for sets in which all words were recalled in the correct serial order. For the automated test, the maximum score was 75. For the experimenter-guided task, the maximum score was 42. While no normative data exist for older adults, the young adult distribution of OSPAN scores in this sample was reasonably similar to that of Unsworth et al. with a mean of 42.40, lower quartile of 30 and upper quartile of 54, where Unsworth et al. observed a mean of 39.16, lower quartile of 28 and upper quartile of 56. Participants (*N*=3) who scored below 80% on the math portion of the test were excluded from the final data set.

Procedure

All participants sat in front of a computer monitor, first for the OSPAN, and then for the IAT. IAT instructions informed participants that the purpose of the task was to measure implicit associations between the concepts of driving and aging. Category pairings appeared in the upper left and right corners of the computer screen. Words and images appeared in the middle of the screen. Each word and image appeared individually, and participants sorted it into the correct category label by pressing a key on the keyboard that corresponded to the spatial location of the correct category. Thus, if the category pairings were *safe* or *old* on the left and *dangerous* or *young* on the right, then participants correctly sorted the word *crash* by pressing the key on the right side of the keyboard. It was hypothesized that participants would be slower to categorize *crash* when *safe* was in the same spatial location as *old* compared to when *dangerous* or *old* were paired together. The IAT took approximately 10 minutes to complete. Presentation order of IAT stimuli was randomized for each block of trials. Words or faces remained on the screen until participants responded. Each stimulus presentation was separated by a 500 ms interstimulus interval (ISI) for trials in which the participant responded correctly. If the participant responded incorrectly, a screen indicating an error appeared in place of the 500 ms ISI for the same duration but participants did not need to correct their response. Participants then completed packets containing the explicit attitude measures.

Results

All means and standard deviations of implicit and explicit measures are displayed in the top half of Table 1. IAT *D* scores were calculated for each individual using Greenwald, Nosek, and Banaji's (2003) algorithm. For each participant, this *D* score represented the difference in mean reaction time across the two paired conditions (*safe or old*/*dangerous or young*, and *dangerous or old*/*safe or young*) divided by the standard deviation of all trials of each pairing for each participant. Consistent with Greenwald et al. (2003), trials with reaction times greater than 10,000 ms were removed from the data set prior to *D* score calculations. No participants' data were deleted because of unusually fast reactions times (<300 ms). Consistent with the improved IAT scoring algorithm, error trials were not removed from analyses. *D* scores above zero indicated stronger associations between the *safe-young* and *dangerous-old* category pairings than *dangerous-young* and *safe-old*, evidence for a negatively valenced aging stereotype of driving. Scores below zero indicated the opposite.

TABLE 1

Means (and standard deviations) of implicit scores (IAT *D*), attentional control (OSPAN), and explicit scores [feeling thermometer (FT), and Likert scale] in Experiments 1 and 2.

Group	IAT1 *D*	IAT2 *D*	OSPAN	FT	Likert scale
Experiment 1					
Young	.43 (.24)		42.40 (16.26	2.63 (2.35)	4.78 (.60)
Old	.37 (.33)		14.56 (7.69)	-.10 (2.21)	5.44 (.80)
Experiment 2					
Practice	.40 (.26)	.39 (.24)	42.00 (18.32)	2.17 (2.42)	4.38 (.56)
Faking	.45 (.25)	-.18 (.62)	43.48 (18.15)	2.39 (2.40)	4.30 (.60)

Both younger and older adults exhibited stronger associations between the *safe-young* and *dangerous-old* category pairings than *dangerous-young* and *safe-old* [young $t(106)=18.25$, $p<.001$, $d=1.79$; old $t(51)=8.73$, $p<.001$, $d=1.12$]. An independent samples *t*-test showed *D* scores were not significantly different between young and older adults, $t(157)=0.3$, $p=.12$, $d=.05$, suggesting the implicit association strength may not differ with age.

A feeling thermometer difference score was calculated by subtracting each participant's rating on item one (older-adult driving) from his or her rating on item two (others' driving); thus, positive scores indicated greater feelings of warmth toward others' driving than older-adults' driving and negative scores indicated the opposite. Younger adults reported greater feelings of warmth toward others' driving than older-adults' driving while the opposite was the case for older adults. One sample *t*-test confirmed that younger adults' mean difference score significantly differed from zero, $t(106)=11.56$, $p<.001$, $d=1.06$, but older adults' did not, $t(51)= -.31$, $p=.76$, $d=.05$.Younger adults felt colder toward older adults' driving than others' driving, but older adults did not show this difference. An independent samples *t*-test comparing younger adults' feeling thermometer difference scores to those of older adults showed young adults reported warmer feelings toward other drivers than older adult drivers, $t(157)=7.00$, $p<.001$, $d=1.12$. For the Likert scale questionnaire, an independent samples *t*-test comparing older adults' endorsements of stereotypes of older drivers to those of younger adults found younger adults reported slightly stronger endorsements than older adults, $t(157)= -.85$, $p<.001$, $d=.14$. However, both group averages were greater than the scale's neutral point of 4, suggesting that neither group was willing to explicitly endorse these overtly negative statements.

Bivariate correlations among IAT *D*, OSPAN, feeling thermometer, and Likert scales were examined for younger and older adults. The analyses showed attentional control did not correlate with younger adults' IAT *D*, $r(106) = .13$, $p = .18$; however, it correlated with older adults' IAT *D*, $r(51) = -.28$, $p = .04$ (see Figure 2). For older adults, as attentional control decreased, IAT *D*s increased.

Discussion

Experiment 1 demonstrated that both younger and older adults hold implicit associations between aging and dangerous driving; however, only older adults' IAT effects correlated with attentional control. As members of the stereotyped group, older adults may have spontaneously exerted attentional control toward the goal of appearing more egalitarian. If so, their relative success in controlling this stereotype would depend upon individual differences in attentional control. Also, older adults high in attentional control may have been more likely to attempt to control the stereotype. The relationship between aging and driving performance is greatly diminished once individual differences in attentional control are taken into account (Lambert et al., in preparation). In other words, older adults high in attentional control tend to be better drivers, so these individuals may be more able to control their reactions to stereotypes of aging and poor driving.

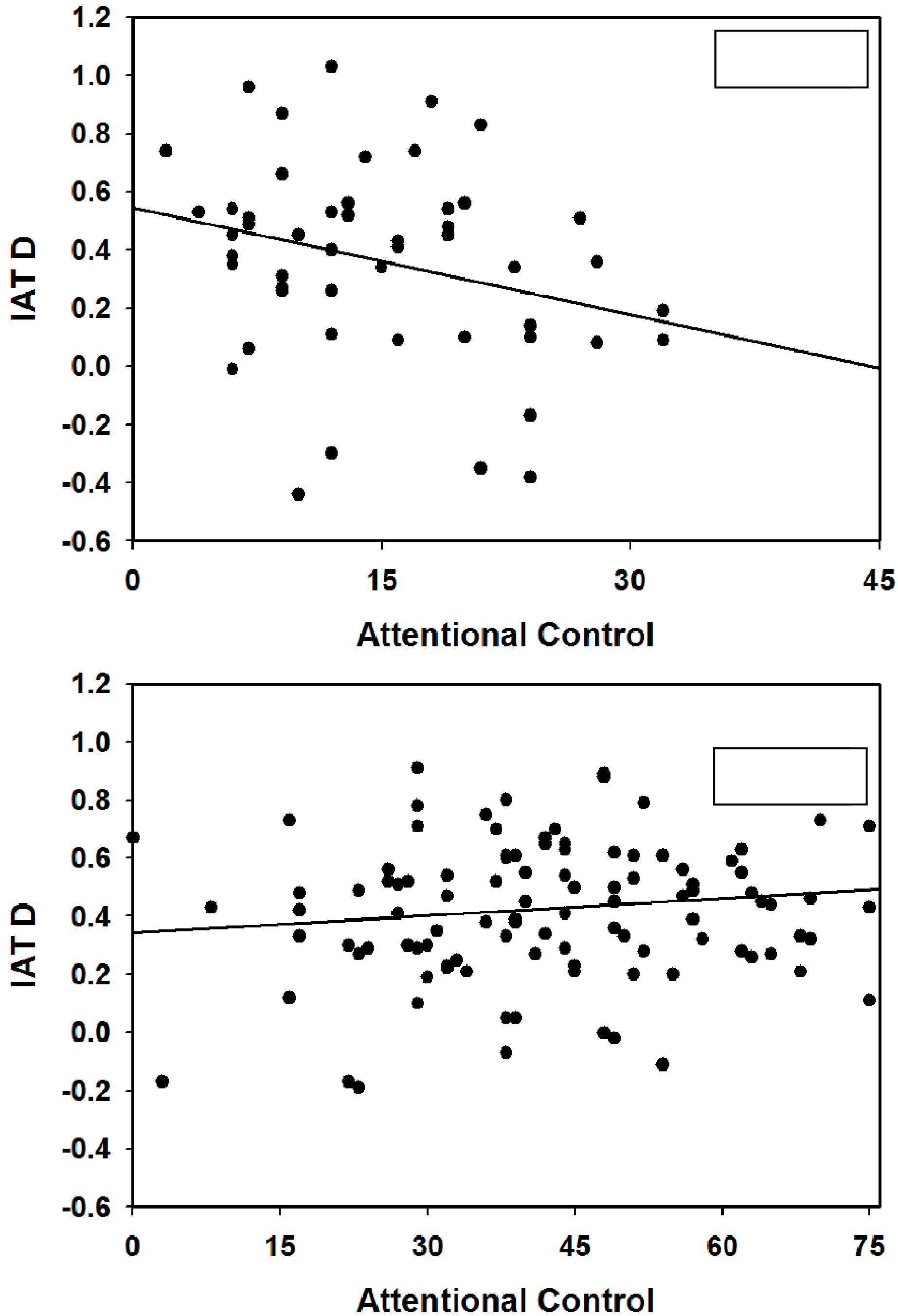

Figure 2. Scatter plots of IAT *D* and attentional control (automated OSPAN for young, experimenter-guided OSPAN for old) for younger (top panel) and older (bottom panel) adults in Experiment 1. Least squares regression lines indicate a nonsignificant positive correlation for young adults and a significant negative correlation for older adults

But, younger adults may also be able to control their implicit associations. When instructed to “fake” IAT effects by responding as though one were a member of another group (e.g., male responding as though he were female), some young adults can produce IAT effects contrary to their own implicit associations (Cvencek et al., in press; Fiedler & Bluemke, 2005; Steffens, 2004). Faking instructions give participants a specific goal; therefore, successful faking inherently involves goal maintenance. Because goal maintenance is a critical function of attentional control, individual differences in attentional control should correlate with IAT faking ability. Experiment 2 tested this hypothesis with only younger adults in the present novel IAT paradigm.

Experiment 2

Method

Participants

Two-hundred and twenty-six young adults (age range 18-30 years, *M* = 21.60 years) from the University of Utah participated in exchange for course credit. Data from 10 participants were not retained for analysis due to OSPAN math accuracy below 80%.

Materials and Procedures

The materials and procedures were identical to Experiment 1 with one notable exception. After completing the OSPAN and the first IAT (IAT1), 107 participants were given faking instructions modeled after Cvencek and colleagues (in press). These participants were told to take a second IAT test (IAT2) while responding as though they were older adults by 1) going slowly for the condition in which the *safe-young* and *dangerous-old* category pairings shared a response key and 2) going quickly for the condition in which *dangerous-young* and *safe-old* shared a response key. An additional 109 participants were given practice instructions to simply take the test again.

Results

Means and standard deviations for implicit, explicit, and attentional control measures are displayed in the bottom half of Table 1. For each participant, two IAT *D* scores, one for each time participants took the test, were calculated using the algorithm of Experiment 1. One participant's data were deleted from the practice condition because more than 10% of trials had latencies less than 300 ms.

On IAT1, mean *D* scores of both groups were consistent in magnitude and direction with the young adults in Experiment 1. One sample *t*-test determined that both means significantly differed from zero [faking group prior to faking instructions $t(106)=18.74$, $p<.001$, $d=1.80$; practice group prior to practice instructions $t(108)=15.93$, $p<.001$, d=1.67], replicating the findings of Experiment 1. On IAT2, mean *D* scores of the practice group were again consistent in magnitude and direction with Experiment 1; however, the magnitude and direction changed for participants instructed to fake [faking $t(106)= -3.02$, $p=.003$, $d=.30$; practice $t(108)=17.35$, $p<.001$, $d=1.63$], suggesting that they were successfully able to “fake” the IAT. Both groups reported greater feelings of warmth toward others driving than older-adults driving with both mean differences significantly differing from zero [faking $t(106)=10.30$, $p<.001$, $d=1.0$; practice $t(108)=9.32$, $p<.001$, $d=.90$]. Likert Scale questionnaire means between the two conditions were compared but did not differ $p>.10$.

IAT *D* change scores were calculated for each participant as the difference between IAT1 and IAT2 *D*s. Bivariate correlations among IAT1*D*, IAT2*D*, *D* change, OSPAN, feeling thermometer, and Likert means were computed. Consistent with Experiment 1, attentional control did not correlate with IAT *D* scores for either group’s IAT1 [practice $r(108)= -.13$, $p= .19$, faking $r(106)=.02$, $p=.836$], or IAT2 scores for the practice condition, $r(108)=.01$, $p=.913$]. While attentional control did not correlate with *D* change scores for the practice condition, $r(108)= -.19$, $p=.259$, it did correlate with IAT2 *D* scores $r(106)= -.20$, $p=.037$, and *D* change scores $r(106)= -.20.$, $p=.04$. Participants in the faking condition regulated their responses on the driving and age IAT, but those lower in attentional control showed a smaller *D* change. This suggests greater attentional control is necessary to maximally alter IAT response patterns.

Analysis of Variance

Again, observing a similar distribution to Unsworth et al. (2005) (mean = 42.40, lower quartile = 29 and upper quartile = 55), extreme groups were created by dividing participants into quartiles based on their OSPAN scores. Participants in the highest (high-span) and lowest (low-span) quartiles were retained for further analysis. OSPAN scores ranged from 0 to 29 (low-spans) and 55 to 75 (high-spans). These data were submitted to a 2 (attentional control: low-span vs. high-span) by 2 (condition: practice vs. faking) repeated measures ANOVA with IAT1 and IAT2 *Ds* (order) as the within-participants dependent variables. The other two factors were between-participants. There were main effects of order, $F(1,104)=52.74$, $p<.001$, $\eta^2_p=.34$, and condition, $F(1,104)=24.07$, $p<.001$, $\eta^2_p=.19$ but the main effect of attentional control was not significant $F<1$. There was also a two-way interaction between order and condition, $F(1,104)=38.04$, $p<.001$, $\eta^2_p=.27$. IAT1 scores only differed from IAT2 scores in the faking condition. Most importantly, there was a three-way interaction among condition, order, and attentional control, $F(1,104)=4.84$, $p=.030$, $\eta^2_p=.04$, such that in the faking condition, high-spans produced more IAT change from IAT1 to IAT2 than low-spans (see Figure 3). High-spans were better able to control implicit stereotype expression.

Discussion

These results demonstrate that attentional control can modulate implicit associations but, the degree to which modulation occurs depends on individual differences in attentional control. Fiedler and Bluemke (2005) and Cevencek et al. (in press) have shown that some participants can fake IAT effects spontaneously or when cued to do so. The present results extend this work by identifying an individual differences variable that predicts who will be most able to fake outcomes on the IAT. Cevencek et al. (in press) demonstrated that IAT

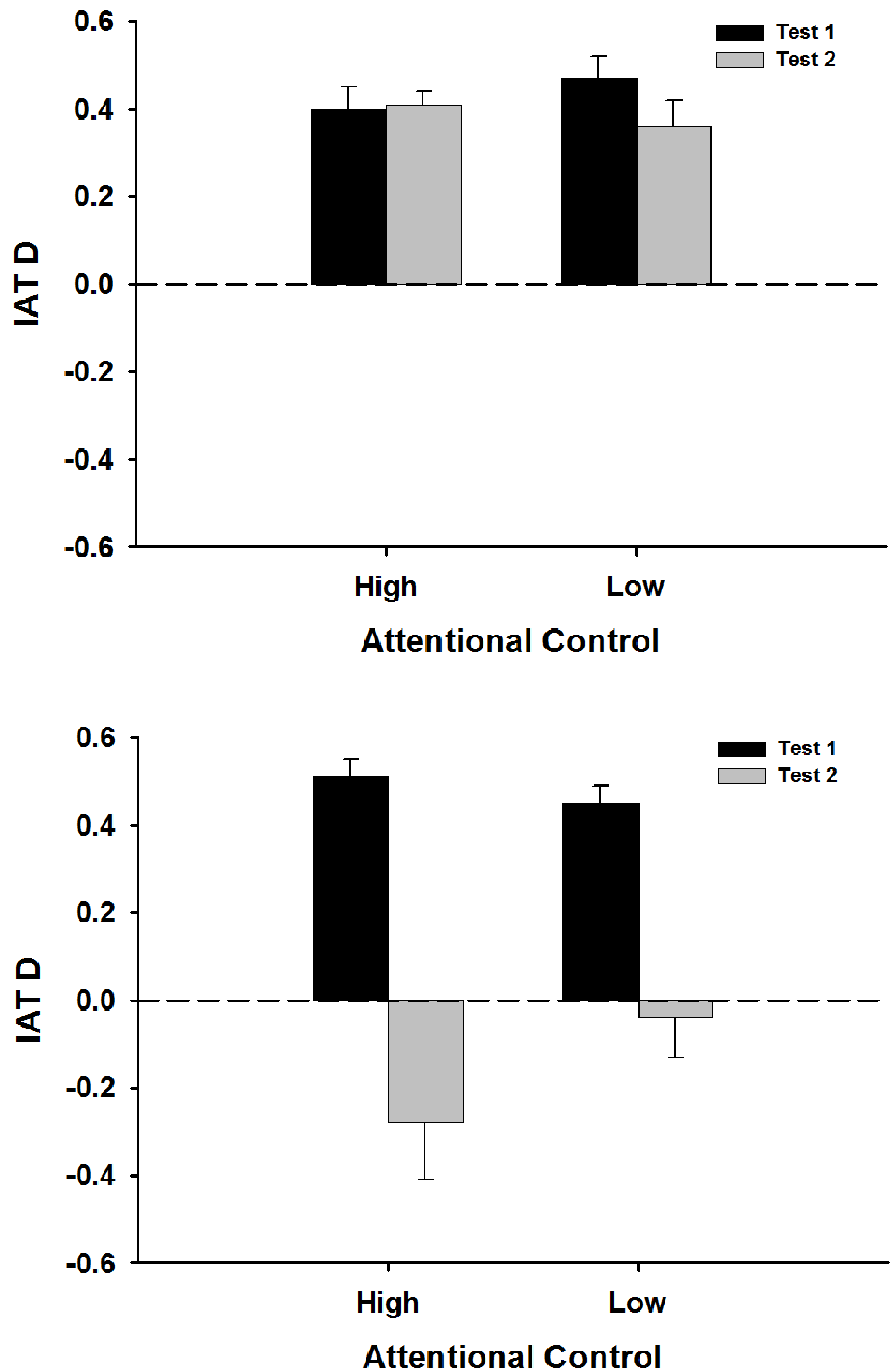

Figure 3. Mean IAT *D*s by condition [practice (top panel) vs. faking (bottom panel)] and attentional control (high=top 25%, low=bottom 25%). Error bars correspond to standard error of the mean. IAT *D*s only differ from IAT 1 to IAT 2 in the faking condition where participants high in attentional control show more change from IAT 1 to IAT 2 than those low in attentional control.

faking is detectable and correctable; thus, the finding that some people may be able to control their IAT is not likely a validity concern for the IAT. The more interesting implication of this finding is that it suggests that, in certain situations, people high in attentional control may be better able to control the expression of their own implicit associations.

Study 1 General Discussion

The present study is the first to empirically examine the stereotype of older adult driving ability despite the wide circulation of anecdotal examples in the media. It produced clear evidence that younger and older adults possess implicit attitudes of dangerous older adult driving, and that young adults explicitly endorse these attitudes when presented as feelings of warmth or coolness. Further, attentional control was related to older and younger adult IAT effects. Older adults higher in attentional control showed smaller IAT effects than older adults who had lower attentional control, possibly because they were internally motivated and able to control their response speeds. Attentional control was also related to young adults' abilities to alter their performance on the IAT. Those higher in attentional control showed greater change and less overt expression of the aging stereotype when instructed explicitly to do so. These patterns suggest that attentional control may be a critical factor in controlling implicit associations and may have implications for suppressing stereotypic associations outside the laboratory.

The role of attentional control discussed here is consistent with the broader literatures on social stereotypes and individual differences in cognition. For example, Schmader and Johns (2008) showed that stereotype threat affects performance through attentional control by depleting controlled processing resources. Watson, Bunting, Poole, and Conway (2005) found that individual differences in attentional control predicted young adults' abilities to reduce false memories, which are thought to be partially driven by automatic associations and implicit processes (Roediger, Watson, McDermott, & Gallo, 2001). Using a weapon identification task, Payne (2005) found that attentional control moderated the relationship between automatic stereotype activation and behavioral expression of race bias. The present work shows that attentional control can affect IAT outcomes as well, providing theoretical leverage on who is most likely capable of faking (or correcting) susceptibility to stereotype activation.

Implications, Applications, and Future Directions

There is a long-established relationship between negative stereotypes, prejudice, and discrimination (Fiske, 1998; Krueger, 1996), such that stereotypes of stigmatized groups impact behavior through stereotype threat (Steele & Aronson, 1995). Yeung and von Hippel (2008) found females were 50% more likely to hit jay-walking pedestrians in a driving simulator when negative stereotypes about female drivers were activated. Thus, stereotype threat could be endangering those on the road. Moreover, Steele and Aronson (1995) showed that stereotype threat need not be explicitly manipulated to impact behavior. When African American participants were asked to simply indicate their race on a demographic questionnaire, they underperformed on a subsequent intelligence test. Thus, simply making one's group salient can activate stereotype threat. For the purposes of the present study, the mere mention of senior driving restrictions could impact older adult driving performance. To the extent that older adults higher in attentional control can influence their implicit associations, similar patterns may emerge with regard to regulating stereotype threat in actual driving performance, such that the deleterious effects of stereotype threat might only be observed in older adults lower in attentional control. Future research endeavors aimed at elucidating these potential stereotype threat outcomes for older drivers could provide leverage toward the development of successful interventions and make the roads safer.

STUDY 2

Background

Steele and Aronson (1995) first demonstrated stereotype threat by making African Americans aware of the negative stereotype of inferior intellectual ability, leading them to subsequently underperform on standardized tests. This effect has been extended to other social groups and social stereotypes including poor performance across gender and race (Aronson et al., 1999; Spencer, Steele, Quinn, Hunter, & Forden, 2002). Stereotype threat manipulations that have involved older adults focused on the effect of stereotype threat on memory, demonstrating that threat-inducing task instructions can activate stereotype threat causing older adults to underperform on memory tests compared to age-matched controls (Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005; Hess & Hinson, 2006; Rahhal, Hasher, & Colombe, 2001). Because poor driving ability is an additional component of the older adult stereotype, as demonstrated in Study 1, older adult driving performance may be vulnerable to the deleterious effects of stereotype threat. If so, threat-induced performance decrements could endanger not only the stigmatized individuals, but others as well, because a single individual's quality of driving carries the potential to affect anyone on the roadway. To date, one stereotype threat study has investigated driving performance as a dependent measure. Yeung and von Hippel (2008) demonstrated that simulated driving performance can be impacted by stereotype threat manipulations. Women under stereotype threat conditions were 50% more likely to run over jay-walking pedestrians as those free from stereotype threat. The present study measured the impact of stereotype threat on older adult driving performance on two standard driving performance parameters (brake reaction time, and following distance) used extensively in research on driving and attention (Cooper & Strayer, 2008; Strayer & Drews, 2004; Strayer & Johnston, 2001) as well as the likelihood of in-simulator collisions.

If stereotype threat manipulations impact older adult driving performance, attentional control is a plausible moderator for these effects. Traditionally, stereotype threat effects have called upon explanations based on affect: the idea that activation of negative stereotypes about one's group leads to feelings of anxiety or apprehension related to the possibility that the individual might confirm those negative stereotypes. However, it is possible that the apprehension the threat manipulation induces could disrupt cognitive processing operations as well (Schmader & Johns, 2003). Eysenck and Calvo's (1992) processing efficiency theory holds that anxiety reduces the function of goal-directed attention while increasing stimulus-driven processing. Thus, the anxiety that stereotype threat manipulations induce should lead to decrements in performance on tasks that are demanding of attentional control functions such as working memory. Following this line of thought, Schmader and Johns (2003) argued that working memory capacity would be reduced in stressful testing situations due to the consumption of limited cognitive resources by stress-related thoughts. To test this idea, they manipulated instruction sets given to women prior to their engagement in an OSPAN task. Because the OSPAN task requires participants to solve simple arithmetic while also memorizing words, stereotype threat was induced in women by stressing the importance of the math component of the task as being diagnostic of mathematic ability. They hypothesized that, if stereotype threat interferes with working memory, then women exposed to threat-inducing instructions would show lower OSPAN scores than women in the control condition. Their results were consistent with this prediction. Similar results have also been found for Latino men and women compared to White men and women when task instructions included information that the OSPAN test was diagnostic of intelligence.

Schmader, Johns, and Forbes (2008) have since proposed an integrated process model of stereotype threat to further specify the role of attentional control in stereotype threat outcomes. This model holds that stereotype threat effects are driven by three interrelated mechanisms: a physiological stress response that directly impedes attentional control, an increased tendency to actively monitor performance, and self-regulatory efforts to suppress negative thoughts and emotions. The concurrent operation of these mechanisms consumes cognitive resources needed to perform well on a variety of tasks, especially those highly demanding of attentional control resources. Further strengthening this view, the biological plausibility of a prefrontal neuro- anatomical correlate of stereotype threat effects is supported by neuroimaging work that has investigated the operation of stereotype threat using fMRI, and ERP methodologies (Forbes, Schmader, & Allen, 2008; Krendl, Richeson, Kelley, & Heatherton, 2008; Wraga, Helt, Jacobs, & Sullivan, 2007).

The integrated processing theory of stereotype threat extends conceptual explanations of stereotype threat by providing a neuro-anatomical correlate. Neuropsychological and neurophysiological studies have demonstrated the frontal lobes to be especially susceptible to aging (Watson, Balota, & Sergent-Marshall, 2001; West, 1996). Thus, populations suffering from problems rooted in frontal lobe atrophy, such as some older adults, should show enhanced susceptibility to stereotype threat manipulations when the affected task relies on controlled processing resources. If the frontal lobes play a role in stereotype threat, then individual differences in frontally mediated attentional control should predict which individuals will be most susceptible to the negative impact of stereotype threat. Because driving is an attentionally demanding task (Strayer, 2007; Strayer & Drews 2004; Watson, Lambert, Miller, & Strayer, 2011; Watson & Strayer, 2010), individual differences in attentional control should predict who is most at risk to experience the deleterious effects of stereotype threat on driving performance.

In addition to stereotype threat effects in pedestrian collisions, Yeung and von Hipple (2008) also tested for stereotype threat effects on more nuanced driving performance parameters, speed and lateral position; however, no effects were observed. This may have been because these particular parameters were unrelated to attentional control and thus did not change when attentional control was depleted by the stereotype threat manipulation. In a preliminary study, Lambert et al. (in preparation) demonstrated that attentional control, as measured by an OSPAN task, was predictive of younger and older adult driving performance parameters of brake reaction time and following distance but was unrelated to speed or lateral position. In light of this, the present study employed a car following paradigm wherein participants followed a lead vehicle in a highway environment, traveling at highway speeds, for approximately 15 minutes. Participants were trained to follow the lead vehicle at a 2-seconds-to-collision distance and apply their brakes periodically when the brakes of the lead vehicle illuminated. Half of the participants did this under stereotype threat. Measurements of brake reaction time, following distance, and occurrences of collisions, recorded as 1s (collision) and 0s (no collision) in a binary fashion, were collected as well as whether or not participants remembered to take a prescribed exit to end the driving scenario [recorded as 1s (no exit) and 0s (exit) in a binary fashion]. It was predicted that participants under stereotype threat would show slower brake reaction times, longer following distances, higher collision rates, and lower likelihood of following exit instructions than those completing the drive without threat. Additionally, it was predicted that brake reaction times and following distances of participants lower in attentional control would be most impacted by the stereotype threat manipulation.

A second driving scenario was also created to in attempt to replicate Yeung and von Hippel's (2008) findings. A short unexpected event scenario measured the likelihood of collision with a swerving bicyclist under stereotype threat or control conditions. It was predicted that, under stereotype threat, participants would be more likely to collide with a swerving bicyclist.

Method

Participants

The 39[2] older adults from Experiment 1 of Study 1 were included in the present study. Participants ranged in age from 62 to 83 years with a mean age of 73 years. All participants were currently licensed drivers and all received $30.00 compensation for their participation.

Materials

PatrolSim Driving Simulator

A PatrolSim high-fidelity driving simulator, manufactured by L3 Communications/I-SIM with high resolution displays and 180-degree field of view was used. The simulator recreated a realistic driving environment through vehicle-dynamics, traffic-scenario, and road-surface software. Simulator dashboard instrumentation, steering wheel, and gas and brake pedals were taken from a Ford Crown Victoria with automatic transmission.

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[2]Sixty participants volunteered in Study 2. Of these, 39 were retained for analysis. The remaining 21 were excluded due to motion sickness (*n* = 12), inability to reach the gas and brake pedals with feet (*n*=2), answering a cell phone call while driving (*n*=1), a request to have data removed from the study (*n*=1), and maintaining an inappropriate following distance (greater than 3 times the interquartile range) (*n*=5).

Experimenter-Guided Operation Span Task

An experimenter-guided version of the OSPAN working memory task, described for older adults in Experiment 1 of Study 1, measured attentional control.

Implicit Stereotype Measure

An implicit association test, described in Experiment 1 of Study 1, measured implicit associations between driving safety and age.

Explicit Stereotype Measures

A feeling thermometer and a Likert Scale questionnaire, described in Experiment 1 of Study 1, measured explicit associations between driving safety and age.

Manipulation Check

A five-question measure of perceived stereotype threat, adapted after Steele and Aronson (1995), was used as a manipulation check. These five questions assess people's beliefs about age and driving performance using a 5-point scale ranging from (1) strongly disagree to (5) strongly agree (see Appendix A).

Procedure

Participants completed two sessions carried out 1 day to 2 weeks apart. During their first session, stereotype threat was manipulated and driving performance was measured. During their second session, attentional control and implicit and explicit stereotype associations between age and driving were measured.

Session 1

All participants were tested individually. Upon arrival at the cognitive science lab, participants were greeted by an experimenter in a lab coat who obtained informed consent. Visual acuity and colorblindness were tested, after which, participants were introduced to the driving simulator. They were familiarized with the simulated driving environment using a short adaptation sequence in which they drove down a low traffic residential road for approximately 5 minutes. Next, participants were trained to follow a lead vehicle on the highway at a 2-second-to-collision following distance, braking whenever they saw the lead vehicle's brake lights illuminate. If they fell too far behind, a horn sounded. This was their cue to reduce their following distance by increasing their speed. Once they reduced their following distance to 2 seconds, the horn stopped. Participants were told that, while there would not be a horn in future driving scenarios, they were to use the practice as a guide for appropriate following distance in subsequent drives.

Stereotype Threat Manipulation

Participants were randomly assigned to the stereotype threat or control condition. After the car following adaptation sequence, participants assigned to the stereotype threat condition were told the following:

> "OK, before we begin collecting driving data, I want to tell you a little more about the purpose of this study. Older adults, as a group, are stereotyped to be bad drivers. While it may not be the case that all older adults are bad drivers, there is some evidence that this stereotype may be true. Here are some examples of evidence that older adults may be bad drivers."

Participants were then handed two study material sheets. One contained two news clippings reporting on elderly drivers in severe traffic accidents (see Appendix B) and the other contained a graph of national statistics on fatal crashes (adjusted for 100 million miles driven) by driver age (see Appendix C). The graph formed a U-shaped function such that fatal crashes were high for teenage drivers and then dropped off dramatically by age 25. Fatal crashes remained low and stable throughout middle age only to rise again later in life. At age 80, fatal crashes rose exponentially. News clippings were read aloud to the participant as participants read them silently. The experimenter explained elements of the graph to each participant, focusing on the rise in fatal crashes later in life. Participants were then told the following:

> "One purpose of this study is to test whether or not this stereotype is valid. To do so we will be recording data on your driving performance in the next two driving scenarios."

Following this statement, participants began the experimental drives.

Control Condition

Participants in the control condition did not receive any stereotype threat instructions or materials and simply progressed to the experimental drives following the two adaptation sequences.

Experimental Drive 1

All participants drove for approximately 15 minutes in the center lane of a multilane highway following a pace car programmed to drive in the right lane and brake sporadically throughout the scenario. There were other vehicles on the road in the lanes to the left and right of the participant and the lead vehicle, but these vehicles were programmed to remain in the adjacent lanes and, as such, did not interfere with the participant or the lead vehicle. Like in the practice, participants were to follow at an approximately 2-second headway, braking whenever the lead vehicle braked. They were instructed to follow the lead vehicle until they came to the exit to Murray. They were also told to take the exit to Murray to end the drive. This maneuver required participants to make a lane change to the right into free flowing traffic prior to taking the exit. If participants failed to remember to take the exit, the scenario ended automatically approximately 30 seconds after the exit was missed. Collisions and exit attempts were recorded and measurements of following distance from the lead vehicle and brake inputs were collected to assess driving performance.

Experimental Drive 2

Following a 5-minute break, participants completed a second experimental drive. The purpose of this drive was to create a driving situation similar to the one employed by Yeung and von Hippel (2009) using the constraints of the driving simulator available in the present study. In this scenario, participants were instructed to drive straight down the highway at 60 miles per hour until the scenario automatically ended. The duration of the drive was short (approximately 3 minutes) and consisted of rural and residential scenery. Driving visibility was hampered by foggy, nighttime conditions. Participants proceeded uneventfully down the road until they approached a man riding a bicycle. The cyclist was traveling in the same direction and in the same lane as the participants. There were cones blocking most of the opposing lane of oncoming traffic. Unexpectedly, the bicyclist swerved, turning toward the participant's vehicle, and began to move into the participant's lane. This created a situation that required the participant to swerve to avoid hitting the bicyclist. Pilot testing allowed these events to be calibrated such that they occurred simultaneously if the participant was driving 60 miles per hour, as instructed. If the participant collided with the bicyclist, the scenario ended. If the participant did not collide with the bicyclist, the participant proceeded down the road for about 30 seconds until the scenario automatically ended.

Following this scenario, participants completed the five-question measure of perceived stereotype threat. They were then partially debriefed, wherein they were made aware of the true purpose of the study: to measure stereotype threat effects on older adult driving performance. All participants were paid $15.00 for their time and effort prior to leaving the lab.

<u>Session 2</u>

Participants returned to the lab as early as 1 day or as late as 2 weeks later for their second session. They were again consented and tested individually. Participants then completed the Study 1 Experiment 1 procedure. The experimenter-guided OSPAN task was administered, followed by the implicit and explicit stereotype measures. All participants were fully debriefed and paid $15.00 for their time and effort prior to leaving the lab.

<u>Results</u>

Manipulation Check

A mean score on the perceived stereotype threat questionnaire was computed for each participant with higher means indicating stronger perceptions of stereotype threat. An independent samples *t*-test then compared perceived stereotype threat of control participants to stereotype threat participants. While mean scores of stereotype threat participants were numerically higher ($M = 2.50$) than control participants ($M = 2.22$), this difference was not statistically significant, $p > .10$. However, it may have been the case that the manipulation only impacted those low in attentional control. In order to test for the possibility of an obscured interaction between attentional control and stereotype threat, hierarchical multiple regression was used. In this regression, stereotype threat and attentional control were entered simultaneously in the first step and the interaction term of stereotype threat and attentional control was entered in the second step with perceived stereotype threat as the dependent variable. Neither the first step [R^2 =.089, *F*(2,36) = 1.76, *MSe*=.94, *p* =.186] nor the second step [R^2 =.097, *F*(3,36) = 1.26, *MSe*=.94, *p* =.304] resulted in significant models.

Experimental Drive 1

Brake RT

Mean brake RTs were computed for each participant. Hierarchical multiple linear regression was used to examine the effects of the independent variables of stereotype threat and attentional control on the dependent variable of brake RT. In this regression, stereotype threat and attentional control were entered simultaneously in the first step and the interaction term of stereotype threat and attentional control was entered in the second step with brake RT as the dependent variable. The first step resulted in a significant model [R^2 =.238, *F*(2,36) = 5.63, *MSe*=.49, *p* =.007] with a main effect of stereotype threat (β = .333, *p*=.042), and a main effect of attentional control (β = -0.028, *p*=.016). The second step of the regression also resulted in a significant model [R^2 =.380, *F*(3,35) = 4.50, *MSe*=.45, *p* =.001] where an interaction between stereotype threat and attentional control (β = -0.058, *p*=.008) qualified the main effects observed in step 1.

In order to better understand the direction of this interaction, attentional control was treated categorically. Attentional control scores were divided into thirds to create three groups (low, medium, and high attentional control). Analysis of variance (ANOVA) was then used to examine effects of the independent variables of attentional control and stereotype threat on brake reaction time. This resulted in a main effect of stereotype threat [$F(1,33) = 4.34$, $p = .045$, η^2_p=.116] and a main effect of attentional control [$F(2,33) = 3.58$, $p = .039$, η^2_p=.178] that was qualified by an interaction between attentional control and stereotype threat [$F(2,33) = 6.94$, p =.003, η^2_p=.296] such that stereotype threat increased brake reaction time (see Figure 4)

Following Distance

Mean following distances were computed for each participant. Hierarchical multiple linear regression was used to examine the effects of the independent variables of stereotype threat and attentional control on the dependent variable of following distance. In this regression, stereotype threat and attentional control were entered in the first step and the interaction term of stereotype threat and attentional control was entered in the second step with following distance as the dependent variable. The first step resulted in a significant model [R^2 =.190, $F(2,36) = 4.229$, *MSe*=.15.27, p =.022] with a main effect of stereotype threat (β = 41.341, p=.047), and a marginal effect of attentional control (β = 10.063, p=.057). The second step of the regression also resulted in a significant model [R^2 =.320, $F(3,35) = 5.487$, *MSe*=14.197., p =.003] where an interaction between stereotype threat and attentional control (β = -1.668, p=.014) qualified the main effects observed in step 1.

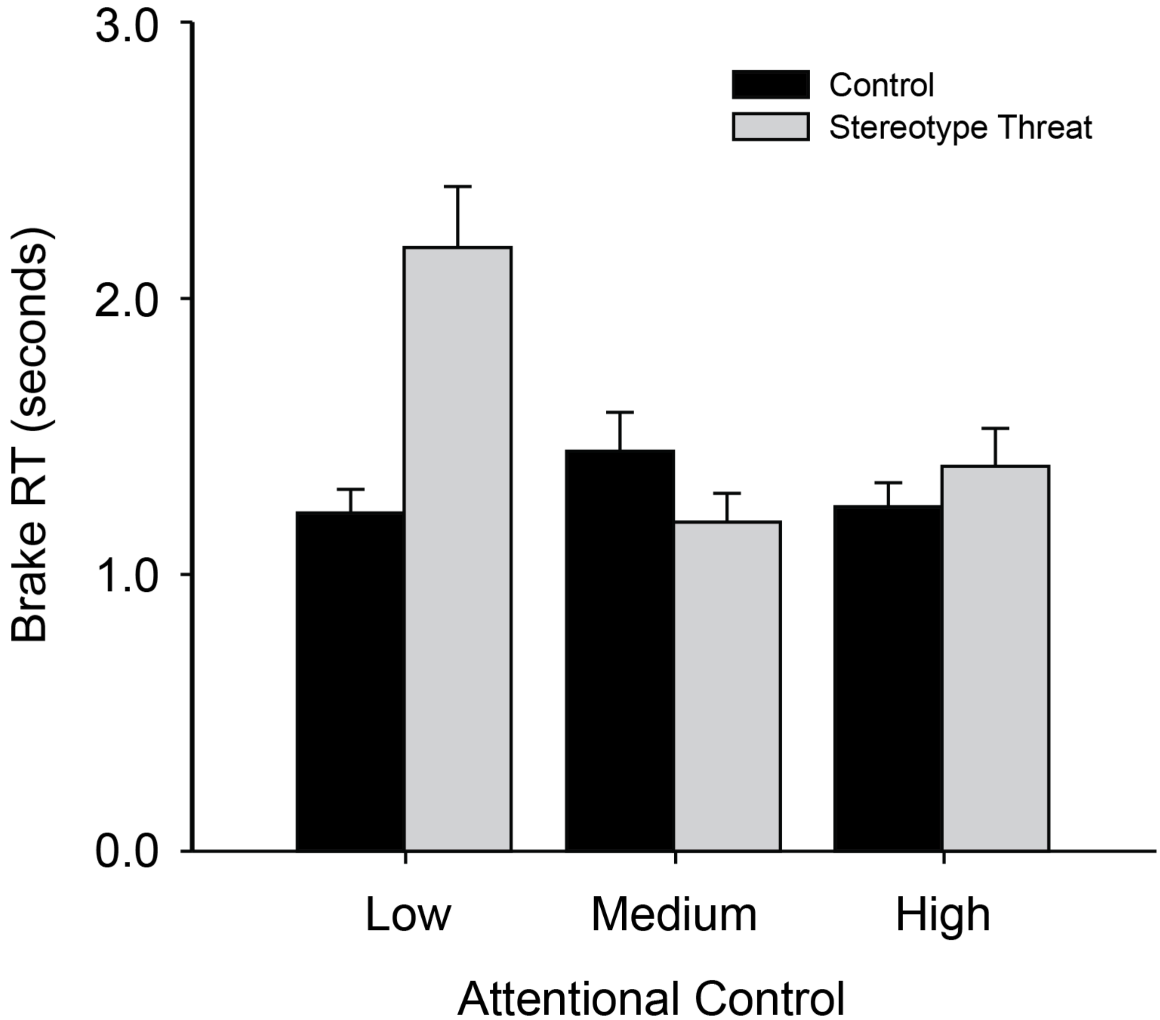


Figure 4. Mean brake RTs by condition (stereotype threat vs. control) and attentional control (high = top 33.3%, medium = middle 33.3%, low = bottom 33.3%). Error bars correspond to standard error of the mean. Only those low in attentional control show slower brake RTs under stereotype threat.

In order to better understand the direction of this interaction, attentional control was again treated categorically by dividing attentional control scores into thirds to create three groups (low, medium, and high attentional control). ANOVA was used to examine effects of the independent variables of attentional control and stereotype threat on following distance. This resulted in a main effect of stereotype threat [$F(1,33) = 4.21$, $p = .048$, $\eta^2_p=.113$] that was qualified by an interaction between attentional control and stereotype threat [$F(2,33) = 4.95$, $p =.013$, $\eta^2_p=.231$] such that stereotype threat increased following distance only for participants low in attentional control (see Figure 5).

Bivariate Correlations

Bivariate correlations were computed and scatterplots were created (see Figure 6) in order to represent the observed relationships between driving performance (brake RT and following distance) and attentional control. For control participants, no significant correlations were observed between attentional control and either of the driving performance parameters [brake RT: $r(18)= .113$, $p=.644$, following distance: $r(18)= .211$, $p=.385$]. However, for participants under stereotype threat, significant correlations were observed between attentional control and both of the driving performance parameters [brake RT: $r(19)= - .617$, $p=.004$, following distance: $r(19)= - .530$, $p=.016$] such that longer brake RTs and following distances were observed for participants lower in attentional control.

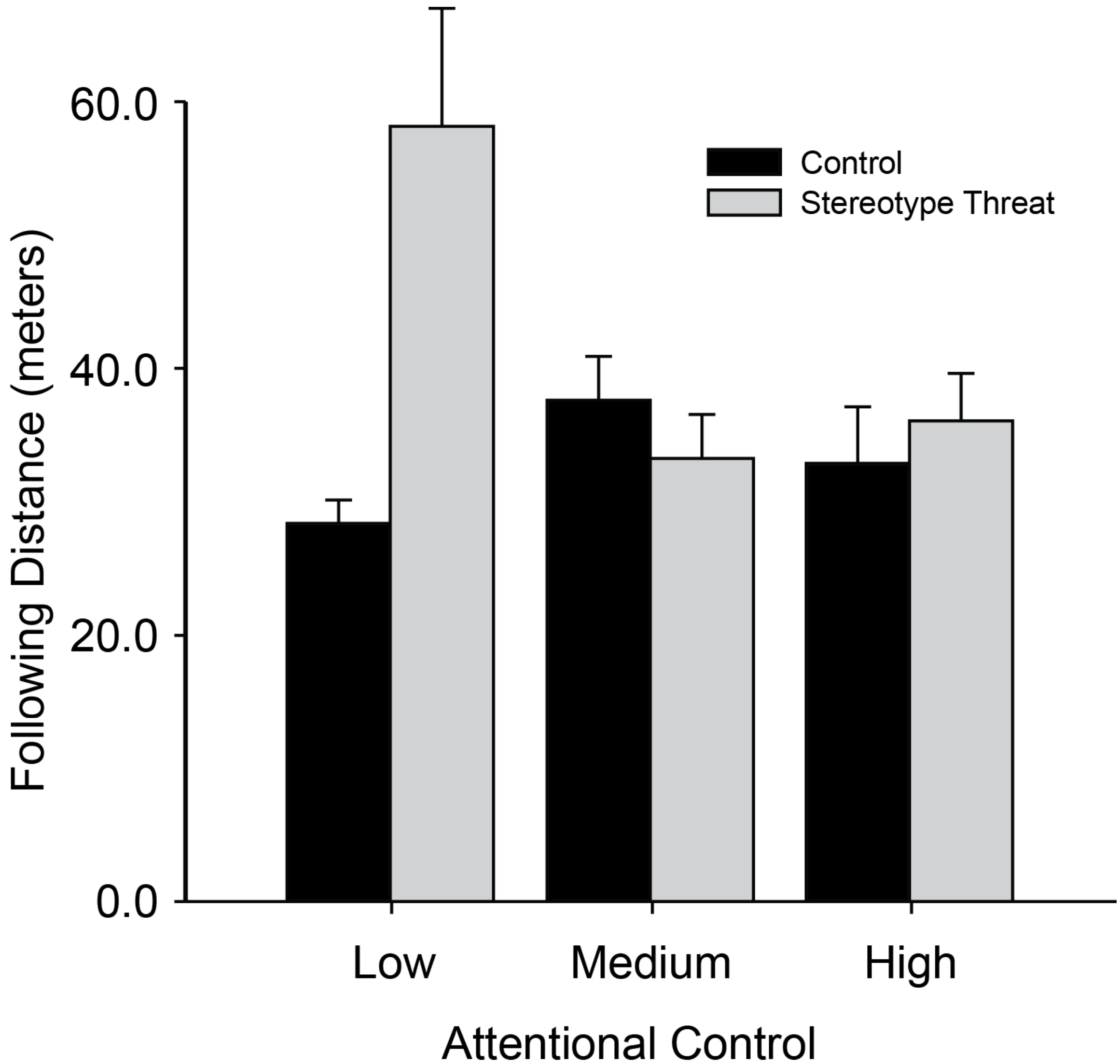
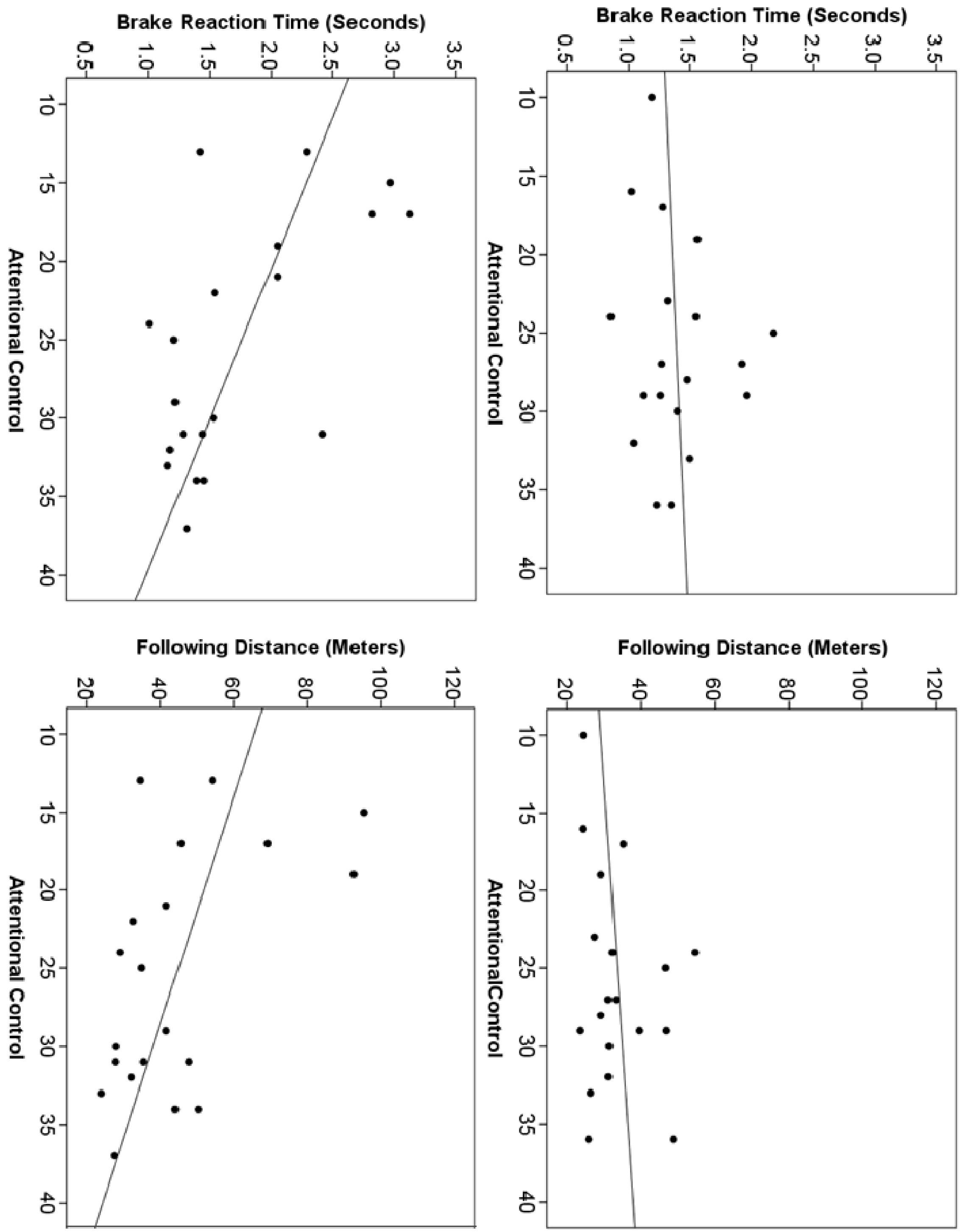


Figure 5. Mean following distances by condition (stereotype threat vs. control) and attentional control (high = top 33.3%, medium = middle 33.3%, low = bottom 33.3%). Error bars correspond to standard error of the mean. Only those low in attentional control elongated their following distance under stereotype threat.

Figure 6. Scatter plots of older adult driving performance (brake reaction time and following distance) and attentional control under control or stereotype threat conditions. Least squares regression lines in the top left (brake reaction time) and right (following distance) panels depict a nonsignificant correlation between attentional control and driving performance under control conditions. Least squares regression lines in the bottom left (brake reaction time) and right (following distance) panels depict significant correlations between attentional control and driving performance under stereotype threat conditions.


Brake Reaction Time (Seconds)
Attentional Control
Brake Reaction Time (Seconds)
Attentional Control
Following Distance (Meters)
AttentionalControl
Following Distance (Meters)
Attentional Control

Collisions

Six collisions occurred across participants in Experimental Drive 1. Five of the participants under stereotype threat experienced a collision compared to 1 control participant. Data were first examined using hierarchal binary logistic regression to assess the possible role of attentional control in collision likelihood. For this analysis, attentional control and stereotype threat were entered in the first step of the analysis and the interaction of these variables was entered in the second step. In the first step, neither main effect was significant [attentional control (Wald = .31, $p > .10$), stereotype threat (Wald = 2.380, $p > .10$)]. Likewise, the second step of the analysis revealed no main effects [attentional control (Wald = .65, $p > .10$), stereotype threat (Wald = .92, $p > .10$)], or interaction between attentional control and stereotype threat (Wald = .512, $p > .10$).

To quantify collision risk regardless of attentional control, an odds ratio was calculated. Traditional methods for calculating the significance of an odds ratio (Fisher's exact test) have been shown to be problematic (too conservative) for small samples (see Agresti, 2002). Thus, statistical significance (Odds Ratio > 1) was calculated using Barnard's method (Agresti, 2002). Barnard's exact test calculates the probability of getting the particular data combination or a more extreme combination out of all possible combinations and then uses the chi-square distribution with the degrees of freedom from the data to determine the significance. The risk of collision was significantly greater for stereotype threat participants compared to control participants [odds ratio = 6.25, $p = .048$ (one-tailed)].

Exit Likelihood

Thirty-six of the 39 participants remembered to take the Murray exit to end the driving scenario. All 3 participants who failed to take the exit had been assigned to the stereotype threat condition. Likelihood of remembering to take the exit to Murray to end the driving scenario as a function of stereotype threat was also examined using Barnard's exact test. However, because no control participant failed to take the exit, a constant of .5 was added to each cell in the 2 ×2 matrix so as to avoid an infinite odds ratio (Yates, 1934). This analysis resulted in a marginally significant odds ratio [odds ratio = 7.8, p=.090 (one tailed)]. Though caution is warranted in interpretation due to marginal significance, this trend suggests that, under stereotype threat, participants were more likely to forget to take the exit to end the scenario.

<u>Experimental Drive 2</u>

Likelihood of collisions with the bicyclist was examined using the Barnard's method as described above; however, no data were collected from 2 of the 39 participants reported in Experimental Drive 1 due to their request to discontinue the driving portion of the experiment after the first experimental drive. Thirty-two of the 37 participants collided with the bicyclist. Of the 5 who avoided collision, 4 were control participants and 1 was a stereotype threat participant. While numerically these data trended in the predicted direction, the risk of collision with the bicyclist was not significantly greater for the stereotype threat participants than the control participants Ratio = 4.5, p = .13 (one-tailed).

Supplemental Analyses

As reported in the procedures section, measures of implicit and explicit stereotype associations and attentional control were collected during participants' second session, after they had completed the driving simulation. A partial debriefing was administered at the end of the first session during which stereotype threat had been manipulated. In this debriefing, participants were told about stereotype threat and shown the stereotype threat induction materials. The experimenter explained to them that past research on stereotype threat has shown that awareness of the effect can serve as an inoculation against it. The debriefing was intended to provide immediate information about the true nature of the study and to address the possibility that stereotypes of aging and driving would be more salient to participants previously assigned to the stereotype threat condition than the control condition when they returned for their second session. Nonetheless, the possibility remained that the stereotype threat manipulation may have contaminated implicit and explicit measures of stereotype associations as well as the measure of attentional control collected during session 2. To address this possibility, independent samples *t*-tests were conducted on implicit and explicit stereotype associations and attentional control measures comparing those participants assigned to the threat condition to those assigned to the control condition. No differences were observed between threat and control participants in attentional control, Likert scale questionnaire responses, feeling thermometer ratings, or IAT *D* scores (all *p*-values > .10).

Study 2 General Discussion

Consistent with prediction, older adult participants under stereotype threat drove slower, produced longer following distances, were involved in more collisions, and, to some degree, were less likely to take the prescribed exit than control participants. Also consistent with predictions, brake RTs and following distances of participants lower in attentional control were most impacted by the stereotype threat manipulation. These results clearly demonstrate that, like memory performance, older adult driving performance is vulnerable to the harmful effects of stereotype threat, but the impact of stereotype threat is related to individual differences in attentional control.

Collisions and Stereotype Threat

Preliminary research (Lambert et al., in preparation) also tested older adults driving in a car following paradigm (without stereotype threat). Of the 20 older adult participants in that study, only 1 collided. Taken together, these studies suggest that collisions in car following paradigms are rare, even for older adults. Interestingly, four of the six collisions in the present study occurred when participants made a relatively difficult lane change to take the exit at the end of the scenario. Had the scenario provided more challenging diving situations such as this, more collisions may have been observed and possibly an interaction between attentional control and stereotype threat like those interactions observed for brake RT and following distance. On the other hand, in the preliminary study, attentional control was shown to be related to brake RT and following distance. It remains unclear whether the same is true for collisions. While the integrated processes model of stereotype threat is a popular one, it is not the only one. Many stereotype threat researchers would agree that disrupted attentional control is likely one of several mediating processes. If disrupted attentional control does not underlie the increased likelihood of collision observed under stereotype threat, then this tendency may have been due to some other stereotype threat mediator, such as lowered performance expectations (Cadinu, Maass, Frigerio, Impagliazzo, & Latinotti, 2003) or reduced effort (Stone, 2002), that could have affected anyone, regardless of attentional control.

Elongated Brake RT and Following Distance: Caution Under Pressure or Goal Neglect?

One might wonder whether the observed increases in brake RT and following distance under stereotype threat may be indicative of increased caution or vigilance rather than deteriorated driving performance. Arguably, it could be the case that the stereotype threat manipulation motivated participants to drive more safely. In light of slowed brake RTs, it could be considered prudent and strategic to adjust one's following distance to allow more time for braking execution. However, based on earlier research, this is not likely the case.

The pattern of increases in brake RT and following distance is not new to research on cognitive aging and driving. Strayer and Drews (2004) compared younger and older adult driving performance in a similar car-following scenario and found that older adults displayed slower brake reaction times (RTs) and longer following distances than younger adults. While they explained these differences in terms of compensation, a similar investigation, preliminary to the present research (Lambert et al., in preparation), elucidated the cognitive processes underlying these age differences and suggested that they are instead due to a combination of age-related changes in information processing speed and attentional control. Using a car following paradigm, this preliminary study replicated the results of Strayer and Drews (2004) while also measuring individual differences in speed of processing and attentional control. Bivariate relationships between attentional control and driving performance parameters (brake RT and following distance) indicated that participants lower in attentional control showed longer brake RTs and following distances than those higher in attentional control. Like in the present study, participants in this paradigm were given the explicit goal to follow the lead vehicle at a 2-second following distance and to brake quickly when the lead vehicle braked. Due to the negative relationship between attentional control and the driving performance parameters and because age-related declines in attentional control are associated with declines in goal maintenance, it was concluded these relationships likely reflected goal neglect rather than strategic compensation.

Interestingly, this pattern also typifies distracted driving where, despite the possible compensation interpretation, individuals driving while conversing on a cellular phone are more likely to be involved in collisions (Strayer & Drews, 2007). In the present study, not only did stereotype threat lead to increases in break RT and following distance, it also increased the likelihood of collisions.

Integrated Processes Theory of Stereotype Threat

The present results support the Integrated Processes Theory of stereotype threat (Schmader, Johns, & Forbes, 2008), particularly in the theory's assumption that cognitive processes reliant on the prefrontal cortex comprise a central role in stereotype threat outcomes. The interaction between stereotype threat and attentional control suggests that individual differences in frontally mediated attentional control determine older adult susceptibility to stereotype threat while driving.

That said, the approach of the present study differed from that of Schmader and Johns (2003) in one important way. Specifically, Schmader and Johns treated attentional control as a dependent variable and demonstrated that stereotype threat led to reductions in attentional control whereas, in the present study, attentional control was treated as an independent variable. Given the methodology of the present study, in which attentional control was measured after the stereotype threat manipulation, it could be argued that the stereotype threat manipulation was modulating attentional control rather than individual differences in attentional control modulating stereotype threat susceptibility. However, this alternative account is unlikely given that attentional control was not measured immediately after the stereotype threat portion of the experiment, but during a follow-up visit on a different day. Further, no differences in attentional control were observed between participants assigned to the stereotype threat condition and those assigned to the control condition.

While the present results support the Integrated Processes Theory of stereotype threat in that they implicate attentional control in stereotype threat outcomes, they cannot speak to which of the three interrelated processing mechanisms (the physiological stress response, active performance monitoring, or suppression effort) or what combination of these mechanisms underlie the stereotype threat outcomes observed. Future research could benefit from further mechanistic specification, possibly through the use of heart rate and blood pressure monitoring (Blascovich, Spencer, Quinn, & Steele, 2001; Croizet, Després, Gauzins, Huguet, Leyens, & Méot, 2004), self-report measures of suppression effort and difficulty (Magee & Teachman, in press), and possibly electroencephalography to detect performance monitoring activity of the anterior cingulate cortex (Miller, Watson & Strayer, under review). Identification of specific mechanisms could provide valuable information to guide intervention development. For example, if the effects are, in part, due to the depletion of attentional resources in the down-regulation of physiological stress responses, psychotropic antianxiety medications or cognitive behavioral therapy may reduce older adults' risk of collision due to stereotype threat.

Unresolved Issues

Despite the contributions of this work, important unresolved issues remain. First, while the present study observed an increased likelihood of collisions for participants under stereotype threat, this observation was made in the first experimental drive, which was designed to detect changes in brake RT and following distance and not specifically collisions. The second experimental drive, which was modeled after Yeung and von Hippel (2009) and designed to address collisions during an unexpected event, did not show the predicted increase in collisions under stereotype threat. Methodological differences between this study and that of Yeung and von Hippel may help to explain the inconsistency in results. For example, constraints of the driving simulator used in the present study made it impossible to replicate Yeung and von Hippel's simulated driving environment. In this study's simulator, we were unable to animate jay-walking pedestrians as Yeung and von Hippel did and instead relied on a swerving bicyclist for an unexpected event. Also, through extensive pilot testing that manipulated different speeds, corner angles, and timing parameters Yeung and von Hippel arrived at an unexpected driving event (jaywalking pedestrians) where the collision rate was close to 50%. In the present study, we attempted to conduct similar informal pilot testing for the swerving bicyclist event. Unfortunately, due to resource constraints, we were unable to conduct this pilot testing on the population of interest, older adults, and instead relied on young adults. As it turned out, ceiling effects were observed, as most collided with the bicyclist regardless of their assigned condition (threat vs. control), thereby suggesting the scenario was too difficult.

A second unresolved issue pertains to the manipulation check, which did not indicate differential feelings of stereotype threat, nor was there an obscured interaction between attentional control and stereotype threat. While it is not possible to definitively determine why this was the case, it may be that the manipulation impacted older adults' driving performance without their conscious awareness of its impact. In other words, participants may have been consciously aware of the stereotype threat manipulation but unaware of its impact on their affect and performance. In certain situations, particularly those in which the performance measure is an automated routine task, increased effort and vigilance can lead to stereotype threat effects (Beilock, Jellison, Rydell, McConnell, & Carr 2006). It could be argued that some driving situations become automated due to a lifetime of practice. In this situation, participants may have been aware of their intentional increases in effort and vigilance and thus may have mistakenly supposed these increases improved, rather than reduced, their driving performance. While this idea is clearly speculative, if correct, it has particularly troubling implications because it suggests that older adults who drive under stereotype threat may not be aware of their increased risk. Again, the use of physiological indices of distress and cognitive load, such as heart rate and blood pressure monitoring, in combination with additional self-reported instruments of affect such as the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) or the State-Trait Anxiety Inventory-Trait scale (Speilberger, Gorusch, Lushene, Vagg, & Jacobs, 1983) could be helpful in determining if, in fact, it is the case that the stereotype manipulation is operating without the individual's conscious awareness of its detrimental effects.

Conclusions

As a stigmatized group, older adults in the United States face many ageism-related challenges. The results of the present study underscore the detrimental impact of this unfortunate social phenomenon. This study demonstrated that the stereotype of poor older adult driving ability, when made explicit through the manipulation of stereotype threat, can have deleterious effects on multiple components of older adults' driving performance. Further, it appears that the more vulnerable members (those with reduced attentional control) of this already vulnerable group are most at risk. Future research is needed to further refine our understanding of the mechanism mediating these stereotype threat effects. Successful identification of specific cognitive mechanisms and neuroanatomical correlates may shed light on possible interventions.

CONCLUDING THOUGHTS

Because driving is commonplace in our culture, and because quality of driving performance can potentially affect anyone on the roadway, the findings of this dissertation present an urgent public safety concern. Study 1 clearly demonstrated that a negative stereotype of older adult drivers exists within our culture. Further, it demonstrated that individual differences in the ability to control the stereotype depend on individual differences in attentional control. Study 2 demonstrated that this stereotype can detrimentally affect older adults' driving performance through the operation of stereotype threat. Thus, it is possible that political efforts to limit older adults driving privileges could unintentionally serve as stereotype threat manipulations thereby additionally hampering driving quality of a group which is already at risk. Further, because stereotype threat susceptibility was moderated by attentional control, such that those individuals who are lower in attentional control were the ones susceptible to the negative consequences of stereotype threat, those individuals who are initially most vulnerable could additionally suffer most under stereotype threat conditions.

The safety of the roads is an important matter of public policy and, while federal legislation concerning advanced age and driving eligibility does not currently exist, state-based legislative efforts toward this end is ongoing. For example, the Florida Department of Highway Safety and Motor Vehicles created the Florida Grand Driver Program® through which concerned family members, medical doctors, or law enforcers can report senior drivers whom they believe to be safety risks. The program, then, has the authority to require the driver to take a written and/or road driving test with the possibility that the individual may lose his or her license to drive (Florida Department of Highway Safety and Motor Vehicles, 2009). Though safety is the ultimate goal of these legislative efforts, the widespread publicity and media coverage that they attract may have unintentional consequences that are counterproductive to that ultimate goal.

Future research is necessary to address this complicated problem. While the focus of this dissertation has been on attentional control as a mechanism of stereotype threat, multiple stereotype threat mechanisms have been identified. For example, negative cognitions (Cadinu, Maass, Rosabianca, & Kiesner, 2005), lowered performance expectations (Stangor, Carr, & Kiang, 1998), and reduced effort (Stone, 2002) are just a few of the alternate mechanisms through which stereotype threat effects may manifest. An improved understanding of the specific attentional control mechanisms (physiological stress activation, performance monitoring, and/or suppression effort) as well as the possible involvement of other social and cognitive mechanisms will be critical in the development of threat reduction interventions.

A variety of techniques have been shown to reduce stereotype threat including task reframing (Quinn & Spencer, 2001; Spencer et al., 1999), de-emphasizing social identities (Stricker & Ward, 2004), encouraging self-affirmation (Schimel, Arndt, Banko, & Cook, 2004), and providing external attributions for difficulty (Ben-Zeev, Fein, & Inzlicht 2005; Johns, Schmader, & Martens 2005). However, the majority of this work has focused on stereotypes of racial/ethnic minorities and women while comparatively little work has focused on reducing the impact of stereotype threat in older adults. Of this smaller body of literature, research on stereotype threat in older adults has primarily addressed changes in cognition, namely memory. De-emphasizing the memory component of cognitive tests appears to reduce stereotype threat's impact on older adult memory performance (Chasteen et al., 2005; Hess, Auman, Colcombe, & Rahhal 2003; Hess, Hinson, & Statham, 2004; Rahha et al., 2001). However, it remains unknown as to whether this type of intervention would be successful for driving performance. Further, implementation may be more difficult given that it is unclear as to how to go about de-emphasizing the driving performance component of safe driving.

Taken together, the present studies implicitly and explicitly document a negative stereotype of older drivers and demonstrate that this stereotype has serious implications for driving safety in the form of stereotype threat. They improve our understanding of the structure of the elderly stereotype and suggest promising future directions that may help to attenuate the impact of stereotype threat on driving safety. What's more, they highlight the fact that stereotypes can be harmful not only to those who are stereotyped but to the entire social group perpetuating the stereotype. This is particularly salient for the stereotype explored in the present study. Perpetuation of a negative stereotype of elderly drivers has both immediate implications for the safety of the roadways we all share and long-term implications for the safety of younger individuals who may one day be the direct victims of a stereotype they perpetuated years ago.

The present studies suggest that motivation and ability, as they pertain to attentional control, may represent important factors for avoiding these outcomes. They also underscore the utility of adopting a cognitive neuroscience perspective to better understand behavior in social and applied settings. In traditional lab settings, individual differences in attentional control have been shown to predict performance on a plethora of cognitive outcomes including dichotic listening (Colflesh & Conway, 2007), inattention blindness (Seegmiller, Watson, & Strayer, 2011), and the Stroop color naming task (Kane & Engle, 2002) to name but a few. It has also been predictive of performance in more applied contexts, like driving (Lambert et al., in preparation). In the present context, where aging stereotypes likely created a distraction to be managed, individual differences in attentional control again demonstrated predictive utility, suggesting a fundamental need for attentional control in real-world settings like driving and stereotype control.

APPENDIX A

LIKERT SCALE

INSTRUCTIONS: Please indicate how much you agree or disagree with each of the statements below by circling the appropriate number using the scale below:

1	**2**	**3**	**4**	**5**
strongly disagree				**strongly agree**

- Some people feel I have poor driving ability because of my age.

1	2	3	4	5
strongly disagree				strongly agree

- Based on my age, people often underestimate my driving ability.

1	2	3	4	5
strongly disagree				strongly agree

- I often feel I have to prove to others that their perceptions of my driving ability are wrong.

1	2	3	4	5
strongly disagree				strongly agree

- The experimenter expected me to do poorly because of my age.

1	2	3	4	5
strongly disagree				strongly agree

- In driving situations people my age often face biased evaluations.

1	2	3	4	5
strongly disagree				strongly agree

APPENDIX B

STEREOTYPE THREAT INDUCTION INSTRUMENT 1

Vignettes

Vignette 1: On July 16, 2003, 86-year-old George Weller crashed into a packed farmer's market in Santa Monica, California, at highway speed, killing 10 people and injuring dozens more. Found guilty of vehicular manslaughter with gross negligence, Weller was nearly assured of prison time. But on November 21, 2006, a California judge decided that Weller, now 89 and in very poor health, was too old and sick to go to prison and would receive fines and probation instead.

Vignette 2: An elderly driver crashed his car right through the front of a Barnes & Noble bookstore Saturday. Police say the man was driving through the parking lot when his foot slipped off the brake and hit the gas. He tried to swerve the car to avoid impact but ended up inside the store. Police say no one was hurt. They also say they are not planning to cite the driver because the accident happened on private property.

APPENDIX C

STEREOTYPE THREAT INDUCTION INSTRUMENT 2

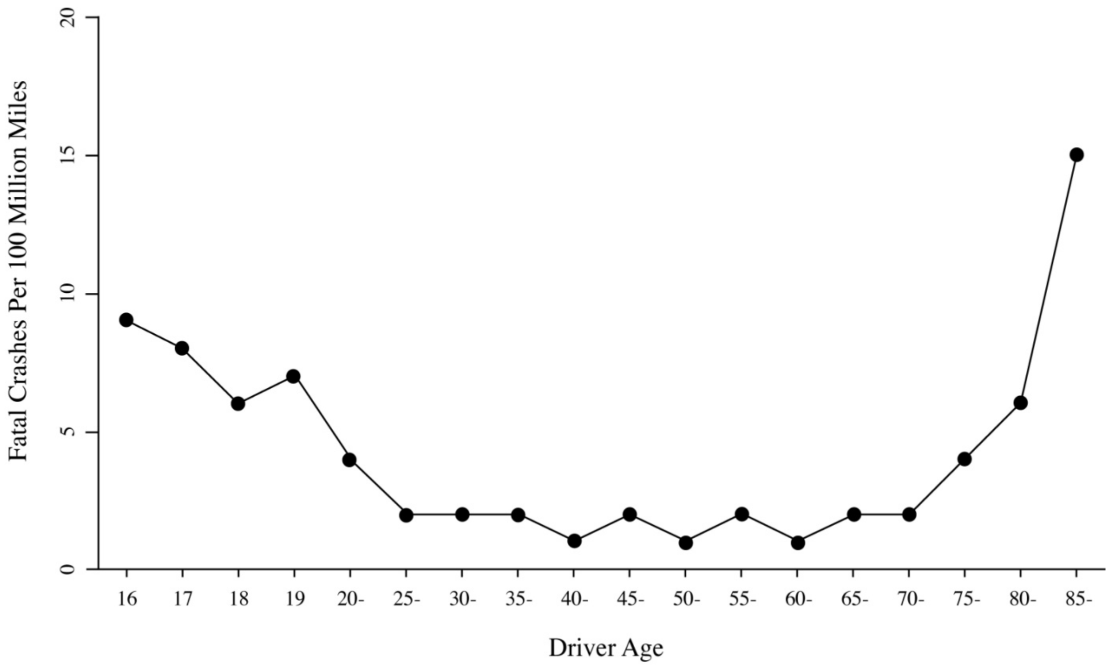


Figure 7. Sample stereotype threat induction instrument 2 depicting fatal crashes per 100 million miles driven as a function of driver age.

REFERENCES

Adelman, R. D., Greene, M. G., Charon, R., & Friedman, E. (1990). Issues in the physician-geriatric patient relationship. In H. Giles, N. Coupland, J. M. Wiemann, H. Giles, N. Coupland, & J. M. Wiemann (Eds.) , *Communication, health and the elderly* (pp. 126-134). Manchester England: Manchester University Press.

Agresti, A. (2002). *Categorical data analysis* (2nd ed.). Hoboken, New Jersey: John Wiley and Sons.

Aronson, J., Lustina, M. J., Good, C., Keough, K., Steele, C. M., & Brown, J. (1999). When white men can't do math: Necessary and sufficient factors in stereotype threat. *Journal of Experimental Social Psychology, 35,* 29-46.

Beilock, S. L., Jellison, W. A., Rydell, R. J., McConnell, A. R., & Carr, T. H. (2006). On the causal mechanisms of stereotype threat: Can skills that don't rely heavily on working memory still be threatened? *Personality and Social Psychology Bulletin, 32,* 1059–1071

Ben-Zeev, T., Fein, S., & Inzlicht, M. (2005). Arousal and stereotype threat. *Journal of Experimental Social Psychology, 41,* 174-181.

Blascovich, J., Spencer, S. J., Quinn, D. M., & Steele, C. M. (2001). African-Americans and high blood pressure: The Role of stereotype threat. *Psychological Science, 12,* 225-229.

Branaghan, R. J., & Gray, R. (2010). Nonconscious activation of an elderly stereotype and speed of driving. *Perceptual and Motor Skills*, *110(*2), 580-592.

Brewer, M. B., Dull, V., & Lui, L. (1981). Perceptions of the elderly: Stereotypes as prototypes. *Journal of Personality and Social Psychology, 41*(4), 656-670.

Burdick, C. *Should old people be banned from driving.* Retrieved April 12, 2010, from http://www.automoblog.net/.

Cadinu, M., Maass, A., Frigerio, S., Impagliazzo, L., & Latinotti, S. (2003).

Stereotype threat: The effect of expectancy on performance. *European Journal of Social Psychology, 33,* 267–285.

Cadinu, M., Maass, A., Rosabianca, A., & Kiesner, J. (2005). Why do women underperform under stereotype threat? *Psychological Science, 16,* 572-578.

Chasteen, A. L., Bhattacharyya, S., Horhota, M., Tam, R., & Hasher, L. (2005). How feelings of stereotype threat influence older adults' memory performance. *Experimental Aging Research*, *31*(3), 235-260.

Colflesh, G. H., & Conway, A. A. (2007). Individual differences in working memory capacity and divided attention in dichotic listening. *Psychonomic Bulletin & Review*, *14*(4), 699-703.

Comedy Central (2010, April 20). Retrieved from: http://www.thecab.tv/php/networkprofiles/08profileData/08_pdfs/COMEDYCENTRAL.pdf.

Croizet, J., & Claire, T. (1998). Extending the concept of stereotype threat to social class: The intellectual underperformance of students from low socioeconomic backgrounds. *Personality and Social Psychology Bulletin, 24,* 588-594.

Croizet, J., Després, G., Gauzins, M., Huguet, P., Leyens, J., & Méot, A. (2004). Stereotype threat undermines intellectual performance by triggering a disruptive mental load. *Personality and Social Psychology Bulletin, 30*, 721-731.

Cvencek, D., Greenwald, A.G., Brown, A., Gray, N.S., & Snowden, R.J. (in press). Faking of the implicit association test is statistically detectable and partly correctable. *Basic and Applied Social Psychology.*

Davies, G. M., & Patel, D. (2005). The influence of car and driver stereotypes on attributions of vehicle speed, position on the road and culpability in a road accident scenario. *Legal and Criminological Psychology, 10*(1), 45-62.

Davis, C., & Simmons, C. (2009). Stereotype threat: A review, critique, and implications. In H. A. Neville, B. M. Tynes, & S. O. Utsey, (Eds.) , *Handbook of African American psychology* (pp. 211-222). Thousand Oaks, CA US: Sage Publications, Inc.

Eisenhandler, S. A. (1990). Asphalt identikit: Old age and the driver's license. *International Journal of Aging and Human Development*, *30*(1), 1-14.

Engle, R. W. (2002). Working memory capacity as attentional control. *Current*

Directions in Psychological Science, *11*(1), 19-23.

Fiedler, K., & Bluemke, M. (2005). Faking the IAT: Aided and unaided response control on the implicit association tests. *Basic and Applied Social Psychology*, *27*, 307–316.

Fiske, S. T. (1998). Stereotyping, prejudice, and discrimination. In D. T. Gilbert, S. T. Fiske, G. Lindzey, D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.) , *The handbook of social psychology, Vols. 1 and 2* (4th ed., pp. 357-411). New York, NY US: McGraw-Hill.

Forbes, C. E., Schmader, T., & Allen, J. J. B. (2008).*The role of devaluing and discounting in performance monitoring*. Unpublished manuscript, University of Arizona.

Greenwald, A. G, Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, *85*, 197-216.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology, 74*(6), 1464-1480.

Hedge, J. W., Borman, W. C., & Lammlein, S. E. (2006). Age stereotyping and age discrimination. In J. W. Hedge, W. C. Borman, S. E. Lammlein (Eds.) , *The aging workforce: Realities, myths, and implications for organizations* (pp. 27-48). Washington, DC US: American Psychological Association.

Hense, R. L., Penner, L. A., & Nelson, D. L. (1995). Implicit memory for age stereotypes. *Social Cognition, 13*(4), 399-415.

Hess, T. M., Auman, C., Colcombe, S. J., & Rahhal, T. A. (2003). The impact of stereotype threat on age differences in memory performance.*Journal of Gerontology: Psychological Sciences, 58B,* 3–11.

Hess, T. M., & Hinson, J. T. (2006). Age-related variation in the influences of aging stereotypes on memory in adulthood. *Psychology and Aging, 21*(3), 621-625.

Hess, T. M., Hinson, J. T., & Statham, J. A. (2004). Implicit and explicit stereotype activation effects on memory: Do age and awareness moderate the impact of priming? *Psychology and Aging, 19,* 495–505.

Hofmann, W., Gschwendner, T., Friese, M., Wiers, R. W., & Schmitt, M. (2008). Working memory capacity and self-regulatory behavior: Toward an individual differences perspective on behavior determination by automatic versus controlled processes. *Journal of Personality and Social Psychology*, *95*(4), 962-977.

Horton, S., Baker, J., Pearce, G. W., & Deakin, J. M. (2008). On the malleability of performance: Implications for seniors. *Journal of Applied Gerontology, 27*(4), 446-465.

Johns, M., Schmader, T., & Martens, A. (2005). Knowing is half the battle: Teaching stereotype threat as a means of improving women's math performance. *Psychological Science, 16,* 175-179.

Klauer, K., Schmitz, F., Teige-Mocigemba, S., & Voss, A. (2010). Understanding the role of executive control in the implicit association test: Why flexible people have small IAT effects. *The Quarterly Journal of Experimental Psychology*, *63*(3), 595-619.

Krendl, A. C., Richeson, J. A., Kelley, W. M., & Heatherton, T. F. (2008). The negative consequences of threat: A functional magnetic resonance imaging investigation of the neural mechanisms underlying women's underperformance in math. *Psychological Science*, *19*, 168-175.

Krueger, J. (1996). Personal beliefs and cultural stereotypes about racial characteristics. *Journal of Personality and Social Psychology*, *71*(3), 536-548.

Lambert, A.E., Watson, J.M., Cooper, J.M., Boyle, I.V. & Strayer, D.L. (in preparation) *Diminished attentional control and reduced processing speed explain age-related changes in driving.*

Lane, K. A., Banaji, M. R., Nosek, B. A., & Greenwald, A. G. (2007). Understanding and using the Implicit Association Test: IV. What we know (so far) (Pp. 59–102). In B. Wittenbrink & N. S. Schwarz (Eds.). *Implicit measures of attitudes: Procedures and controversies*. New York: Guilford Press.

Magee, J.C., & Teachman, B.A. (in press). Distress and recurrence of intrusive thoughts in younger and older adults. *Psychology and Aging.*

Miettinen, O., & Nurminen, M. (1985). Comparative analysis of two rates. *Statistics in Medicine*, *4*(2), 213-226.

Miller, A.E., Watson, J.M., & Strayer, D.L. (under review) Individual differences in working memory capacity predict action monitoring and the error-related negativity. Submitted for review at the *Journal of Experimental Psychology: Learning, Memory, and Cognition*.

National Highway and Traffic Safety Administration (2009). *Traffic safety facts: Identifying situations associated with older drivers' crashes.* Retrieved from: http://www-nrd.nhtsa.dot.gov/Pubs/811391.PDF.

Nelson, D. L., McEvoy, C. L., & Schreiber, T. A. (1999). *The University of South Florida word association, rhyme, and word fragment norms*. Unpublished manuscript, University of South Florida, Tampa.

Nosek, B. A., Banaji, M., & Greenwald, A. G. (2002). Harvesting implicit group attitudes and beliefs from a demonstration web site. *Group Dynamics: Theory, Research, and Practice, 6*(1), 101-115.

Quinn, D. M., & Spencer, S. J. (2001). The Interference of stereotype threat with women's generation of mathematical problem-solving strategies. *Journal of Social Issues, 57,* 55-71.

Rahhal, T. A., Hasher, L., & Colcombe, S. J. (2001). Instructional manipulations and age differences in memory: Now you see them, now you don't. *Psychology and Aging, 16,* 697–706.

Richeson, J. A., & Shelton, J. (2003). When prejudice does not pay: Effects of interracial contact on executive function. *Psychological Science*, *14*(3), 287-290.

Richeson, J.A., & Shelton, J.N. (2006). A social psychological perspective on the stigmatization of older adults. In L.L. Carstensen & C.R. Hartel (Eds.). National Research Council, *When I'm 64* (pp. 174-208). Committee on Aging Frontiers in Social Psychology, Personality, and Adult Developmental Psychology. Washington, DC: The National Academies Press.

Roediger, H. L. III, & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 21,* 803–814.

Schimel, J., Arndt, J., Banko, K. M., & Cook, A. (2004). Not all self-affirmations were created equal: The cognitive and social benefits of affirming the intrinsic (vs. extrinsic) self. *Social Cognition, 22,* 75-99.

Schmader, T., & Johns, M. (2003). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology, 85,* 440-452.

Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of ST effects on performance. *Psychological Review, 115*(2), 336-356.

Schnabel, K., Banse, R., & Asendorpf, J. (2006). Employing automatic approach and avoidance tendencies for the assessment of implicit personality self-concept: The Implicit Association Procedure (IAP). *Experimental Psychology*, *53*, 69–76. doi:10.1027/1618-3169.53.1.69.

Seegmiller, J. K., Watson, J. M., & Strayer, D. L. (2011). Individual differences in susceptibility to inattentional blindness. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *37(4),* 785-791.

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology, 35*, 4-28.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory (Form Y)*. Palo Alto, CA: Consulting Psychologists Press.

Stangor, C., Carr, C., & Kiang, L. (1998). Activating stereotypes undermines task performance expectations. *Journal of Personality and Social Psychology*, *75*, 1191-1197
.

Steffens, M. (2004). Is the Implicit Association Test immune to faking?. *Experimental Psychology*, *51*, 165–179. doi:10.1027/1618-3169.51.3.165.

Steele, C. M., & Aronson, J. (1995). ST and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology, 69*(5), 797-811.

Stone, J. (2002). Battling doubt by avoiding practice: The effect of stereotype threat on self-handicapping in white athletes. *Personality and Social Psychology Bulletin, 28,* 1667-1678.

Strayer, D.L., & Drews, F.A. (2004). Profiles in driver distraction: Effects of cell phone conversations on younger and older drivers. *Human Factors, 46,* 640-649.

Strayer, D. L., & Drews, F. A. (2007). Cell-phone-induced driver distraction. *Current Directions in Psychological Sicence, 16,* 128-131.

Stricker, L. J., & Ward, W. C. (2004). Stereotype threat, inquiring about test takers' ethnicity and gender, and standardized test performance. *Journal of Applied Social Psychology, 34,* 665-693.

Unsworth, N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. *Behavior Research Methods*, *37*(3), 498-505.

Valeri-Gold, M. T. (1996). College developmental learners' perceptions, knowledge, and experiences with aged persons. *Educational Gerontology*, *22*(4), 303-316.

Watson, J.M., Balota, D.A., & Sergent-Marshall, S.D. (2001). Semantic, phonological, and hybrid veridical and false memories in healthy older adults and in individuals with dementia of the Alzheimer Type. *Neuropsychology, 15*, 254-267.

Watson, J.M., Bunting, M.F., Poole, B.J., & Conway, A.R.A. (2005). Individual differences in susceptibility to false memory in the Deese-Roediger-McDermott paradigm. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 31*, 76-85.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063-1070.

Watson, J.M., Lambert, A.E., Miller, A.E., & Strayer, D.L. (2011). The magical ‘letters P, F, C, and sometimes U: The rise and fall of executive attention with the development of prefrontal cortex. Chapter to appear in K. Fingerman, C. Berg, T.Antonucci, & J. Smith (Eds.), *Handbook of Lifespan Psychology.* Springer.

Watson, J. M., & Strayer, D. L. (2010). Supertaskers: Profiles in extraordinary multitasking ability. *Psychonomic Bulletin & Review*, *17*(4), 479-485.

Wraga, M., Helt, M., Jacobs, E., & Sullivan, K. (2007). Neural basis of stereotype-induced shifts in women's mental rotation performance. *Social Cognitive and Affective Neuroscience*, *2*(1), 12-19.

Yassuda, M. S., Wilson, J. J., & von Mering, O. (1997). Driving cessation: The perspective of senior drivers. *Educational Gerontology*, *23*(6), 525-538.

Yates, F (1934). Contingency table involving small numbers and the χ^2 test. *Supplement to the Journal of the Royal Statistical Society, 1*(2), 217–235.

Yueng, N. C. J., & von Hippel, C. (2008). ST increases the likelihood that female drivers in a simulator run over jaywalkers. *Accident Analysis and Prevention, 40*, 667–674.