Journal of Applied Research in Memory and Cognition 9 (2020) 274–285

Contents lists available at ScienceDirect

Journal of Applied Research in Memory and Cognition

journal homepage: www.elsevier.com/locate/jarmac

Review

The Applied Implications of Age-Based Stereotype Threat for Older Adults

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Stereotype threat occurs when people feel concerned about the possibility of confirming, or being negatively judged by, a negative stereotype. This review highlights the applied implications of this phenomenon for older adults. In clinical settings, older adults often feel that their physicians have negative expectations about their abilities because of their age. These feelings of age-based stereotype threat can increase older adults' subjective cognitive complaints and impair their performance on mental status examinations. Other research has shown that stereotype threat also adversely affects older adults' physical performance, motor learning, and driving performance. In workplace settings, older adults who experience stereotype threat also report lower job satisfaction, poorer work-related mental health, and greater intentions to resign or retire. Overall, this review provides evidence that the situational phenomenon of stereotype threat can affect older adults' performance in a variety of applied settings, and this can contribute to age differences in performance.

General Audience Summary

As people get older, they often perform worse on tests of cognitive or mental abilities. This is usually attributed to age declines in brain structure and function. However, we also know that the way people perform on a cognitive test in a research lab or in a medical clinic may underestimate their actual abilities. When older people are tested in these situations they may feel anxious or concerned about why they are being evaluated, and they may worry that the researcher or physician expects them to do poorly because of their age. These concerns are called stereotype threat. Research has shown that when older people experience stereotype threat, it leads to a number of adverse outcomes. The goal of this review paper is to outline some of these results. In lab studies, manipulations of stereotype threat can lead older adults to do worse on the mental status examinations that physicians use to assess for cognitive decline and dementia. This can contribute to false diagnoses of cognitive decline or predementia. Stereotype threat can reduce older people's physical strength and performance. It can also impair their driving performance. When older people feel concerned about being negatively evaluated because of an age stereotype, they drive faster and are slower to brake. This can potentially lead to accidents. Finally, in the workplace, older people who chronically feel stereotype threat also feel less satisfied in their jobs and have greater intentions to quit or retire. Together, these findings highlight the importance of negative stereotypes about aging in affecting the lives of older people.

Keywords: Stereotype threat, Older adults, Cognitive testing, Mental status examination, Driving, Employment

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This work was supported in part by a grant from the National Institute on Aging to Sarah J. Barber and Kate Hamel (grant number R21-AG055801). The funding source had no involvement in the preparation of this manuscript.

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Older adults (OAs) typically perform worse than younger adults (YAs) on laboratory-based tests of fluid cognitive capabilities. Older age is associated with reductions in processing speed and attentional resources, and with declines in both episodic and working memory performance (for reviews, see Park & Festini, 2017; Salthouse, 2004). Based upon the pervasive age-related cognitive declines observed in laboratory tasks, it would be reasonable to expect that OAs would also experience difficulties in completing cognitive tasks in their daily lives. However, this is not always the case. Cognitive functioning as assessed via laboratory-type tasks and cognitive functioning in everyday situations can be quite discrepant. For example, whereas OAs often have poorer performance than YAs solving abstract problems during laboratory tasks, they often have better performance than YAs solving everyday ecologically-valid problems (e.g., Artistico, Cervone, & Pezzuti, 2003; Denney & Palmer, 1981). There is also a well-established prospective memory paradox: OAs typically perform worse than YAs on laboratory-type prospective memory tasks but these age differences are eliminated or reversed on everyday prospective memory tasks (for a meta-analysis, see Henry, MacLeod, Phillips, & Crawford, 2004). When considered together, these discrepancies suggest that laboratory-based estimates of OAs' cognitive capabilities may systematically underestimate their performance in ecologically valid settings. Furthermore, although it is common to explain age differences in cognitive performance as being due to age-related changes in brain structure, vasculature, and function (for a review, see Hedden & Gabrieli, 2004), adopting a purely biological perspective to explain the results of laboratory-based studies of cognitive aging obscures the key role of social context in contributing to these effects.

A good example of how social context can modulate age differences in cognitive performance comes from a study by Sindi, Fiocco, Juster, Pruessner, and Lupien (2013). In this study, YA and OA participants were tested in one of two environments. Some were tested in a "young-favoring" condition. In this condition, the testing took place on a university campus (i.e., a location that was only familiar to the YAs), the test was administered by a YA research assistant (i.e., an in-group member for the YAs), the testing occurred in the afternoon (i.e., a better time of testing for the YAs), and the test was framed as a test of memory abilities (i.e., a domain associated with negative age stereotypes). In contrast, other participants were tested in an "old-favoring" condition. In this condition, testing took place at a health institute (i.e., a location that was only familiar to the OAs), the test was administered by an OA research assistant (i.e., an in-group member for the OAs), the test was administered in the morning (i.e., a better time of testing for the OAs) and the test was framed as a social impression association task (i.e., a domain that is less associated with negative age stereotypes). Results of this study showed that the YA participants were relatively insensitive to these testing environment differences. However, a different pattern emerged for the OA participants; they had an increased stress response and greater memory impairments in the young-favoring test condition.

Stereotype Threat

There are multiple factors that contribute to the fact that OAs perform differently across test environments and as a function of social context. However, one concept that is useful for discussing these effects is that of *stereotype threat.* According to this framework, stereotype threat occurs in situations where people "must deal with the possibility of being judged or treated stereotypically, or of doing something that would confirm the stereotype" (Steele & Aronson, 1998; p. 401). When people feel concerned that these stereotypes are "in the air" (Steele, 1997), it can lead them to underperform within the stereotyped domain. Thus, the concept of stereotype threat suggests that social context can play a powerful role in creating and perpetuating underperformance by members of stigmatized groups.

Although stereotype threat was originally proposed as a concept contributing to the race gap between Black and White students in academic standardized test performance (Steele, 1997; Steele & Aronson, 1995), stereotype threat can theoretically occur for anyone who has a social identity associated with a negative stereotype. Consistent with this idea, hundreds of studies have now documented stereotype-threat effects for a wide variety of populations and across a wide variety of task domains (for a review, see Spencer, Logel, & Davies, 2016; but for critical reviews, see Flore & Wicherts, 2015; Stoet & Geary, 2012). For example, when stereotype threat is elicited, it can impair women's math performance (e.g., Spencer, Steele, & Quinn, 1999), women's negotiation abilities (e.g., Kray, Galinsky, & Thompson, 2002), and women's chess performance (e.g., Rothgerber & Wolsiefer, 2014). Stereotype threat can also impair overweight individuals' exercise and dietary intention (e.g., Seacat & Mickelson, 2009) and non-native speakers' ability to communicate in a second language (Paladino et al., 2009). However, the emergence of these stereotype-threat effects depends upon whether or not the situation elicits a negative self-relevant stereotype. For example, Stone, Lynch, Sjomeling, and Darley (1999; Experiment 1) found that Black participants performed better on a golf task when it was framed as measuring natural ability as compared to when it was framed as assessing sports intelligence. The reverse was true for White participants: they performed better when the task was framed as measuring sports intelligence as compared to when it was framed as measuring natural ability.

Stereotype threat can also affect the cognitive performance of OAs (for a review, see Barber & Lui, in press). For example, OAs are often stereotyped as being forgetful, cognitively incompetent, slower, and more prone to senility (e.g., Hummert, Garstka, Shaner, & Strahm, 1994), and beliefs that cognitive abilities decline steeply with age seem to be universally endorsed across cultures (e.g., Löckenhoff et al., 2009). These negative stereotypes can in turn can affect OAs' cognitive performance. When OAs are placed in situations with the potential to confirm that "OAs are less cognitively capable than YAs" their cognitive performance is often lower than their potential (e.g., Hess, Auman, Colcombe, & Rahhal, 2003), and this effect occurs at statistically equivalent levels for OAs in both Eastern and Western cultures (Tan & Barber, 2018).

Although there is still debate about the mechanisms underlying these stereotype-threat effects (for a review, see Barber, 2017), the purpose of this review is to focus on their applied implications for OAs. In particular, this review examines the effects of stereotype threat that extend beyond lab-based cognitive performance and focuses on the effects of stereotype threat for (a) clinical assessments of cognitive abilities, (b) physical performance and motor learning, (c) driving performance, and (d) employment outcomes. Finally, this review also outlines applied domains where age-based stereotype threat may play a role, but research has not yet documented the effects.

Clinical Cognitive Assessments

Across the adult lifespan, people aged 65 and older are the most likely to visit physicians for routine checkups (e.g., Ashman, Rui, & Okeyode, 2019), and this puts them at an increased risk for experiencing healthcare-related forms of stereotype threat. This occurs when patients perceive their physician to have negative expectations or assumptions about them due to one or more aspects of their social identity, such as their age, race, body size, or socioeconomic status. Unfortunately, these healthcare related forms of stereotype threat are relatively common: Data from the Health and Retirement Study show that amongst individuals aged 50 and older, approximately 17% of individuals reporting experiencing stereotype threat related to one or more aspects of their social identity (Abdou, Fingerhut, Jackson, & Wheaton, 2016), and about 8% felt worry or fear that their physician was negatively evaluating them because of their age (Phibbs & Hooker, 2018). These stereotype-threat related concerns are in turn associated with adverse health outcomes, including greater physician distrust, greater dissatisfaction with health care services, poorer self-reported mental and physical health, higher hypertension, and less preventative health care use (Abdou et al., 2016).

Complementing these survey-based findings, laboratory studies have also experimentally manipulated the presence or absence of age-based stereotype threat and tested the impact of these manipulations on OAs' subjective health reports. These studies show that compared to control conditions, experimental manipulations that elicit stereotype threat lead OAs to report feeling lonelier and in poorer subjective health (Coudin & Alexopoulos, 2010). Stereotype threat can also result in OAs reporting lower subjective hearing abilities (Barber & Lee, 2016), as well as poorer subjective memory abilities and memory self-efficacy (e.g., Bouazzaoui et al., 2016; Wong & Gallo, 2019). From a clinical standpoint, reports by OAs of subjective memory complaints are particularly problematic. Although the association between subjective memory reports and objective memory performance is small (for a meta-analysis, see Crumley, Stetler, & Horhota, 2014), subjective reports of cognitive decline are often seen as indicative of future non-normative cognitive declines and the progression to dementia (for a review, see Reid & MacLullich, 2006). Problematically, overreliance on patients' subjective cognitive complaints may contribute to the misdiagnosis of mild cognitive impairment (Edmonds, Delano-Wood, Galasko, Salmon, & Bondi, 2014).

Stereotype threat also has adverse effects on OAs' objective cognitive performance during clinically relevant performance assessments. The majority of these studies have focused on the effects of stereotype threat on OAs' mental status examination performance, using tests such as the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) or the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005). These tests take about 5 to 10 minutes to administer and are used as an initial screening to detect cognitive impairment. In clinical settings, they are often used when a physician senses that something is "not quite right" with their patient's cognition (Snyderman & Rovner, 2009). However, in the United States they may also be administered to fulfill the Medicare Annual Wellness Visit requirement that physicians assess for cognitive impairment (for visit guidelines, see Gorin & Resnick, 2019).

Several studies have now shown that stereotype threat can impair OAs' performance on these mental status examinations, and should therefore be taken into account when screening for cognitive impairment (for a review, see Régner et al., 2016). For example, in one study, OAs who were experimentally manipulated to self-categorize as *old* and were also manipulated to expect widespread (versus specific) cognitive declines exhibited poorer performance on a mental status examination. Furthermore, this was a clinically meaningful effect—70% of these OAs fell below the diagnostic screening cutoff for dementia as compared to only 14% in the comparison conditions (Haslam et al., 2012). Similarly, in another study the OA participants were asked to complete the MMSE and MoCA under stereotype threat or reduced-threat instructions. Results again showed that stereotype threat impaired performance. OAs in the stereotype-threat conditions performed more poorly on the assessments and were more likely to fall below the diagnostic screening cutoff for dementia as compared to OAs in the control conditions (Mazerolle et al., 2017). By itself, poor performance on these screening assessments is unlikely to lead to a diagnosis of dementia. However, falling below screening thresholds may trigger more careful monitoring or a referral for more extensive cognitive testing.

A personal anecdote may illustrate how these effects occur. Several years ago, I received a phone call from a former research participant who had recently seen that his medical chart included a suspected diagnosis of mild cognitive impairment which was being monitored by his physician.[1] He told me that he was surprised by this, in part because he believed that he had recently done quite well on the cognitive tests in our research study. Indeed, his assessment was correct. As part of the study he had participated in, we had administered the National Institute of Health (NIH) Toolbox Cognition Battery (www.nihtoolbox.com), and his age-normed scores were within expected ranges. Given that his lab-based performance was within normal ranges, what had happened in the clinic? According to this participant, at his annual check-up he had unexpectedly received a mental status examination, which based

[1] Some details have been changed to protect anonymity.

upon his description was most likely the MMSE. At the outset of the assessment, he made an error and misidentified the month. After realizing his mistake, he began perseverating on it, and as a result was distracted. He then misheard the words read by the physician and was unable to repeat them. At this point, he knew the assessment was not going well and he began to wonder why the physician was giving him this assessment. He concluded that it was most likely because of a recent milestone birthday and the physician must expect people his age to have cognitive difficulties. When he was later prompted to remember the previously read words, he was not confident that he could recall them. He did not report his best guesses because he did not want to appear "dumb" by making more mistakes. Based upon his account of this examination, his poor performance could be attributed to stereotype-threat related processes.

This anecdote also has similarities to the findings from a recent study by Schlemmer and Desrichard (2018). In this study, OA participants were asked to complete a cognitive status examination in one of two testing environments. For half of the participants, the study was described as "university research." These participants were tested in a standard university lab room by a student dressed in her normal clothes. However, for other participants the study was described as a "neuropsychological examination." These participants were tested in a room designed to resemble a medical environment by a student who wore a white coat on top of her clothes. Results showed that the testing environment affected OAs' performance. OAs tested in the proxy-clinical setting performed less well than those tested in the university setting, although this effect was limited to those OAs low in memory self-efficacy. Complementing this finding, another study found that the adverse effects of stereotype-threat on OAs performance during clinical assessments of cognition were more common amongst OAs high in dementia worry (Fresson, Dardenne, Geurten, & Meulemans, 2017). Likewise, other research has also shown increased stereotype threat effects for OAs with negative self-perceptions of aging (Fernández-Ballesteros, Bustillos, & Huici, 2015), and for OAs who believe cognitive declines with age are inevitable (Weiss, 2018).

Although the magnitude of stereotype threat related performance deficits is moderated by a variety of participant factors, it is worth noting that OAs' baseline cognitive abilities should also determine the clinical relevance of stereotype threat. Meta-analyses suggest that although stereotype-threat effects are reliable, they have small-to-medium effect sizes (Armstrong, Gallant, Li, Patel, & Wong, 2017; Lamont, Swift, & Abrams, 2015), and as a result should only have diagnostically meaningful effects for OAs whose optimal performance is just above clinical thresholds. Consistent with this idea, in another study a stereotype threat manipulation resulted in numerically poorer performance by OAs on mental status examinations that emphasized producing correct answers. However, in this study there were very few OAs who fell below screening thresholds, and falling below this threshold did not vary based upon stereotype threat condition (Barber, Mather, & Gatz, 2015).

Self-Concept Threat and Cognition

The studies discussed thus far have conceptualized stereotype threat as OAs' concerns that their physicians (or their researchers) had negative expectations or assumptions about them due to their age. However, it is worth noting that some theoretical frameworks suggest there are multiple forms of stereotype threat. People can also feel concerned that others will negatively evaluate their group based upon their performance (i.e., that they are being a bad ambassador), or worry that the stereotype is personally true of themselves (i.e., that they lack ability). Although these are all examples of "stereotype threat," each of these forms of threat is qualitatively distinct, with different moderators and interventions (Shapiro & Neuberg, 2007). However, for OAs, the form of threat experienced is often self-concept based (for a review, see Barber, 2017). This is reflected in OAs' personal concerns that their own cognitive abilities have declined due to age, and that because of this, negative age stereotypes were becoming true of themselves. Indeed, OAs not only report that their memory has declined over time (e.g., Lineweaver & Hertzog, 1998), but also report higher memory anxiety (e.g., McDonald-Miszczak, Hertzog, & Hultsch, 1995), and greater fears about their future selves' cognitive capabilities (Dark-Freudeman, West, & Viverito, 2006).

This way of describing stereotype threat also has similarities to research on *dementia worry* (Kessler, Bowen, Baer, Froelich, & Wahl, 2012) and *anticipatory dementia* (Cutler & Hodgson, 1996), which describe health-related fears and emotional responses that occur when people contemplate the possibility of developing dementia in the future. These concerns are particularly prevalent among OAs who believe their own memory is declining or have personal familiarity with Alzheimer's disease (AD; for a review, see Cutler, 2015). However, dementia worry also increases after exposure to negative age stereotypes (Molden & Maxfield, 2017) and is stronger for people who endorse negative age stereotypes (Suhr & Kinkela, 2007). Research has also shown that dementia worry can have negative health consequences (Cutler & Hodgson, 2014), and may lead OAs to catastrophize their forgetting and interpret minor memory lapses as being a sign of dementia.

Self-concept forms of stereotype threat and anticipatory dementia may also explain why disclosure of genetic risk information about AD can have adverse effects on OAs cognition. In a study by Lineweaver, Bondi, Galasko, and Salmon (2014) some OA participants learned about their AD genetic risk (i.e., their APOE genotype) but others did not. All participants then completed objective and subjective assessments of their memory abilities. Results showed that OAs who found out that they had a heightened genetic risk for developing AD underperformed on these assessments. They did worse than the non-disclosed control group on the objective verbal memory task, and also had lower perceived memory capacity ratings and increased perceived frequency of forgetting ratings. Although perceptions of stereotype threat were not assessed in this study, it is possible that these participants catastrophized their past forgetting experiences and worried that poor performance would confirm that

their own cognitive abilities had declined because of their AD genetic risk.

Although the findings reviewed thus far document clinically relevant effects of stereotype threat, one limitation is that all prior studies have focused on community-dwelling OAs, and it is unclear whether stereotype-threat-related concerns also occur—or are perhaps exacerbated—for individuals with a diagnosis of mild cognitive impairment or AD (for discussion, see Scholl & Sabat, 2008). There are also unanswered questions about which OAs are predisposed to various forms of stereotype threat, and how different forms of threat can best be mitigated in order to improve OAs' health-related outcomes. There is also a need to raise physicians' awareness of these issues in an effort to reduce false positive diagnoses of cognitive decline in the clinic (for further discussion, see Régner et al., 2016).

Physical Outcomes

Although the focus of the prior studies was on cognitive performance in clinical settings, a full understanding of cognitive aging must also include assessment of OAs' physical function. This is because there is now a considerable body of research showing that cognitive and physical function are strongly interrelated (e.g., Binder, Storandt, & Birge, 1999; Robertson, Savva, & Kenny, 2013), and negative age stereotypes exist about both cognitive and physical outcomes. For example, OAs are often stereotyped as being slow, weak, feeble, and frail (e.g., Hummert et al., 1994).

As in the cognitive domain, research has shown that these negative age stereotypes have adverse effects for OAs' physical outcomes. For example, amongst OAs, endorsement of negative age attitudes or stereotypes is associated with lower levels of physical activity (e.g., Meisner, Weir, & Baker, 2013; Sarkisian, Prohaska, Wong, Hirsch, & Mangione, 2005), poorer recovery from cardiovascular events (Levy, Zonderman, Slade, & Ferrucci, 2009), and greater declines in gait speed over time (e.g., Robertson, Savva, King-Kallimanis, & Kenny, 2015). This may be because OAs who attribute health conditions (such as sleep problems or heart disease) to old age are less likely to seek medical treatment to address the underlying conditions (e.g., Goodwin, Black, & Satish, 1999), and hence show greater declines over time (e.g., Sarkisian et al., 2001).

Activation of age stereotypes can also affect OAs' physical performance. For example, implicit priming of age stereotypes sometimes affects OAs' gait speed (e.g., Hausdorff, Levy, & Wei, 1999), and over time priming of positive age stereotypes can lead to improved physical function (Levy, Pilver, Chung, & Slade, 2014). There is also research examining the effects of explicit age-based stereotype threat on OAs' physical performance in lab-based settings. However, the results of these studies have been inconsistent. Whereas Swift, Lamont, and Abrams (2012) found that a stereotype threat manipulation reduced OAs' handgrip strength and persistence compared to a control condition, two subsequent studies found no impact of stereotype threat on these same measures (Horton, Baker, Pearce, & Deakin, 2010; Marquet et al., 2018). One potential explanation for these discrepant findings is that participants in these studies varied in their baseline abilities. A closer inspection reveals that stereotype-threat effects only emerged in the study using participants with poor functional ability levels (Swift et al., 2012), and were absent in the studies using participants with average, or above-average, functional abilities (Horton et al., 2010; Marquet et al., 2018).

Baseline abilities may moderate the effects of stereotype threat effects by affecting how people perceive their own resources (such as abilities and knowledge) relative to the demands of the task. In line with this, in a recent study, my collaborators and I asked community-dwelling OA participants to complete walking tasks that were either "easy" (i.e., walking at their own comfortable pace) or "difficult" (i.e., walking while keeping ones' feet within two tape-marked lines separated by 15 cm). This was done either in the presence or absence of a negative age-based evaluation to induce stereotype threat. Our results showed that the adverse effects of the stereotype-threat manipulation (i.e., slower and more variable walking speeds) were generally limited to the difficult walking task, and were also generally limited to participants who were less confident that they had the necessary resources to cope with the task's demands. Thus, the effects of stereotype threat on physical performance likely depends upon the tasks' objective difficulty as well as the participant's subjective assessments of their own resources to complete the task (Barber, Hamel, Ketcham, Lui, & Taylor-Ketcham, 2020).

In addition to affecting immediate performance, there is also evidence that stereotype threat can affect OAs' learning of motor skills. Using a motor learning paradigm, Chiviacowsky, Cardozo, and Chalabaev (2018) investigated the effects of stereotype threat on OAs' balance-task performance immediately, and again after a 24-hour delay. Although there were no effects on the initial test, OAs assigned to the stereotype-threat condition exhibited poorer performance on the delay task, suggesting impaired learning of this motor skill. Furthermore, given that positive expectancies have been shown to enhance OAs' motor learning (e.g., Lessa, Tani, & Chiviacowsky, 2018), this pattern could suggest that stereotype threat led OAs to have more negative task expectancies.

When considered together, these findings suggest that OAs' physical performance can be worse in stereotype-threat eliciting environments. However, within this domain there are many questions that are still unanswered. For instance, mobility-related performance in everyday life is only partially explained by lab-based measures of physical capacity (e.g., Giannouli, Bock, Mellone, & Zijlstra, 2016; Tudor-Locke, Barreira, Brouillette, Foil, & Keller, 2013), and OAs sometimes show impaired locomotor performance in lab settings as compared to more ecologically valid settings (Bock & Beurskens, 2010). Future research is needed to test the role of stereotype threat in contributing to these discrepancies. There is also a need for an examination of how stereotype threat affects other physical outcomes, such as stair and obstacle navigation tasks, as well as engagement in physical activity and exercise.

Driving

Another applied cognitive domain where age-based stereotype threat has been studied is that of driving performance. Driving is an important instrumental activity of daily living that can help OAs maintain social activities (e.g., Marottoli et al., 2000), and driving cessation can be accompanied by negative health-related outcomes, such as depression (e.g., Ragland, Satariano, & MacLeod, 2005) and decreased quality of life and health (e.g., Edwards, Lunsman, Perkins, Rebok, & Roth, 2009).

Despite the social and health benefits of driving for OAs, research has also suggested that driving performance declines with age (for a review, see Boot, Stothart, & Charness, 2014). Per mile driven, OAs have elevated crash rates compared to middle-aged adults (Massie, Campbell, & Williams, 1995). Fatality rates from crashes are also comparatively higher amongst OAs, particularly if they also have other physical problems (e.g., Li, Braver, & Chen, 2003). Although many of these deficits can be explained by age-related changes in vision, hearing, speed of processing, and working memory capacity (for a review, see Boot et al., 2014), given that there are also negative stereotypes about OAs driving abilities (Lambert, Seegmiller, Stefanucci, & Watson, 2013), OAs' driving performance can also be adversely affected by stereotype threat.

For example, in a study by Lambert et al. (2016), OA participants completed a driving task either under stereotype threat about their driving abilities or not. In the stereotype-threat condition, participants were told that the study was designed to test the assumption that OAs are bad drivers. In contrast, participants in the control condition were simply told that they would be completing a driving task. After receiving these instructions, all participants then completed a task in a high-fidelity driving simulator. Results showed that participants in the stereotype-threat condition had slower brake response times (which increased the risk of rear-end crashes) and increased following distances. These patterns were particularly pronounced amongst the OAs with lower working memory scores. The patterns also mirrored those associated with cognitive distraction (e.g., Strayer, Watson, & Drews, 2011), which could suggest that stereotype threat reduces the availability of working memory resources (for a discussion of this as a mechanism of stereotype threat, see Schmader, Johns, & Forbes, 2008).

Other studies have documented additional adverse effects of stereotype threat on driving outcomes, such as lower subjective driving confidence (Chapman, Sargent-Cox, Horswill, & Anstey, 2016), and higher road-edge excursions (Joanisse, Gagnon, & Voloaca, 2013). OAs exposed to negative age-related stereotypes about driving also perform more poorly on test questions from a written driver's license examination, although this effect only occurs when the test penalizes wrong answers and participants are instructed to avoid errors (Gaillard, Desmette, & Keller, 2011).

Although activating negative stereotypes often leads people to behave in line with the stereotype, this is not always the case. In fact, sometimes activating negative stereotypes can lead people to act in ways that are opposite to the stereotype. This process is known as stereotype reactance (Kray, Thompson, & Galinsky, 2001) and is more likely to occur when people feel they have sufficient self-efficacy and adequate personal resources to successfully meet the demands of the task (Hoyt & Blascovich, 2007). Within the domain of driving, there is evidence that OAs show stereotype reactance. In response to a stereotype-threat manipulation, OAs drive faster than they do in a control condition, and this response contradicts the stereotype that OAs are slow drivers (Brelet et al., 2016). Furthermore, faster driving in response to stereotype threat is particularly pronounced amongst OAs who highly value having the ability to drive (Joanisse et al., 2013).

Given that relatively few studies have examined the impact of stereotype threat on OAs' driving, many questions remain unanswered. For example, in the United States there are state-level differences in whether OAs are required to complete in-person renewals, road tests, and vision tests, and research is needed to examine whether these age-based renewal policies can result in feelings of stereotype threat and impair OAs' driving performance. There is also a need for research to examine on-road driving tests as the outcome and to test whether stereotype-threat related concerns relate to decisions about driving cessation. Finally, although some research has shown that stereotype threat can impair OAs' map learning and lead to lower spatial recall (Meneghetti, Muffato, Suitner, De Beni, & Borella, 2015), there is a need to examine whether similar effects occur for spatial-navigation performance while driving.

Employment Outcomes

The final applied domain included in this review is that of OAs' employment outcomes. Research has shown that older workers are increasing in number. For example, according to the U.S. Bureau of Labor Statistics, the participation of individuals aged 55 and older in the work force rose from 31.3% in 1998 to 40.0% in 2018. Furthermore, by 2024 nearly 1 in 4 American workers will be 55 years of age or older, and labor force participation will grow at the fastest rate amongst people aged 65 and older (Toossi & Torpey, 2017). Given these trends, organizations and firms need to understand how to maximize the benefits of OA workers, and how to reduce the negative impacts of age-based stereotypes and ageism in the workplace. This is made even more important by the illegality of treating workers differently based upon their age (for example, as specified in the United States by the Age Discrimination in Employment Act of 1967).

Many workplace contexts involve being evaluated by others; however, stereotype threat occurs when there is an added concern of being negatively evaluated based upon ones' group membership. In this review the focus is on the negative stereotypes associated with age. Although research suggests that a worker's age is generally unrelated to their work performance (Ng & Feldman, 2008), there are more negative than positive stereotypes about OA workers. OA workers are stereotyped as being less productive, less adaptive, more resistant to change, less willing to learn, less technologically oriented, and as having reduced physical and cognitive capabilities (e.g., Posthuma & Campion, 2009; Van Dalen, Henkens, & Schippers, 2010).

Furthermore, these ageist stereotypes are endorsed by both YAs and OAs (Chiesa et al., 2016).

In contrast to most of the studies previously reviewed, within workplace contexts the effects of stereotype threat on OAs' outcomes have primarily been studied using survey research focused on chronic feelings of stereotype threat. Participants in these studies are asked to report the extent to which their colleagues feel they have less ability because of their age, the extent to which their colleagues believe that they are less committed to their careers because of their age, and the extent to which their organization thinks OA workers are less capable than YA workers. In general, these concerns are more likely to occur when OA workers are underrepresented in their workplace (Oliveira & Cabral-Cardoso, 2017), and are more likely for OA workers in lower status positions (von Hippel, Kalokerinos, & Henry, 2013). Age-based stereotype threat concerns may also vary across industries. Other research has suggested that endorsement of negative age stereotypes is particularly strong in the financial sector, retail, IT/computing, and insurance (Posthuma & Campion, 2009). This is problematic as negative age-based meta-stereotypes (i.e., OAs beliefs about the age stereotypes held by relatively younger adults) can be an antecedent for OA workers experiencing stereotype threat (Oliveira & Cabral-Cardoso, 2017).

Amongst OA workers, perceptions of stereotype threat are associated with a variety of adverse job-related outcomes. Higher perceived stereotype threat is negatively associated with OAs' job satisfaction, work-related mental health (von Hippel et al., 2013) and overall wellbeing (Manzi, Paderi, Benet-Martínez, & Coen, 2019). For OAs, stereotype threat is also associated with lower occupational self-efficacy (Chiesa et al., 2016). In addition to these important outcomes, stereotype threat can also lead to disidentification from the stereotyped domain, which in this case is the workplace. For example, amongst OA workers stereotype threat is associated with less job commitment and with greater intentions to resign or possibly retire (e.g., Manzi et al., 2019; von Hippel, Kalokerinos, Haanterä, & Zacher, 2019; von Hippel et al., 2013).

There has also been research focused specifically on how stereotype threat affects older employees' learning and development. Although continued development is important for organizational effectiveness and performance there is a pervasive stereotype that OA workers are untrainable—that you "can't teach an old dog new tricks" (e.g., Posthuma & Campion, 2009). In situations where this negative stereotype is salient, OAs can experience stereotype threat and underperform. As reviewed earlier, a large number of lab studies have shown that stereotype threat can adversely affect OAs' memory and cognitive performance (Hess et al., 2003; for a review, see Barber & Lui, in press). Stereotype threat can also impair OAs' learning in a multimedia training activity (Cavanagh, Kraiger, & Peters, 2016) and is associated with more help-seeking while solving a novel cognitive task (Coudin & Alexopoulos, 2010). In addition, other research has shown that when training is targeted to OA workers, it actually heightens feelings of age-based stereotype threat (Oliveira & Cabral-Cardoso, 2017). For example, OA workers interpret Human Resource initiated programs targeted at OAs as organizational endorsements of ageist stereotypes (Hennekam & Herrbach, 2015), which can presumably trigger stereotype-threat concerns and adversely affect OAs training outcomes.

In workplace settings, the adverse effects of stereotype may also lead to a negative feedback cycle for OAs. As described by Roberson and Kulik (2007), when OA workers encounter a difficult task, they may first search for an explanation of why the task is difficult. They may think to themselves: Is it because I have not received the appropriate training? Am I too tired to complete the task today? Is the task actually impossible? Or is this task only difficult for me because of my age? This age-stereotype explanation may be particularly likely to come to mind if it supported by the context, as could occur if a YA coworker seemed to be completing the task faster or more effectively. The OA workers' feelings of stereotype threat can in turn disrupt their performance, which can lead them to feel frustrated and demotivated. However, when considering the long-term implications of stereotype threat, it is also important to consider the perspective of the other employees. It is likely that coworkers and supervisors will assume that the OA workers' stereotype-threat-impaired level of performance is actually an accurate reflection of their abilities. As a result, the OA workers may be given less difficult tasks in the future and be passed over for other opportunities, which may in turn exacerbate their feelings of stereotype threat in future scenarios.

It is also worth noting that the adverse effects of age-based stereotype threat seem to be limited to OA workers. In workplace settings there are also negative stereotypes about YA workers, such as being unreliable and inexperienced (e.g., Posthuma & Campion, 2009), and YA workers report experiencing stereotype threat in line with these stereotypes. In fact, several studies have now found that YA workers report higher levels of age-based stereotype threat than OA workers (von Hippel et al., 2019; von Hippel et al., 2013). However, the stereotype threat experienced by YA workers is not related to their job satisfaction, organizational commitment, or work-related mental health (von Hippel et al., 2013). There is also no significant relationship between age-based stereotype threat and occupational self-efficacy for adults under the age of 50 (Chiesa et al., 2016). This may be because YA and OA workers interpret the experience of stereotype threat differently. YA workers know they will eventually "outgrow" the negative age-stereotypes about youth, and are more likely than OAs to appraise stereotype-threat eliciting situations as challenges rather than threats. Challenge appraisals are in turn associated with increased job engagement and organizational commitment and reduced intentions to quit (von Hippel et al., 2019).

When considering age as a moderator of age-based stereotype-threat effects, it is also important to keep in mind that the chronological age at which people become "old" is ambiguous and can vary across contexts. For example, in workplace settings, individuals aged 45 or older are often considered to be older workers (for a discussion, see North, 2019). However, outside of employment contexts, older adulthood is often considered to begin at age 65 (i.e., the minimum age at which people could receive full retirement benefits in the original Social Security Act of 1935). Given that age-based stereotype threat effects

may be more pronounced during the transition to old age (for a discussion, see Barber, 2017), this may also explain why age-based stereotype-threat effects in the workplace appear at earlier ages (Chiesa et al., 2016) as compared to age-based stereotype-threat effects during cognitive testing (Hess & Hinson, 2006).

As in the previous domains reviewed, there are also open questions about how age-based stereotype threat affects OAs' employment outcomes. For example, research is need to examine whether stereotype threat also affects OAs' objective job performance, job-related stress, workaholism, work-family balance, compensation, and salary negotiations. There is also a need for research that examines the intersection between stereotypes about age identities and cohort identities. Developmental psychology has often stressed the importance of considering cohort effects, and some research has suggested that generational cohort membership is particularly important for OAs (e.g., Weiss & Lang, 2009, 2012). However, there is an abundance of stereotypes about generational differences in the workplace (e.g., Boomers vs. Millennials), and these are often accompanied by advice or interventions to help organizations and managers deal with these assumed differences. It would be good to know whether such organizational policies and programs can lead to generation-based stereotype threat, and also examine whether such experiences have antecedents and interventions that are similar to that of age-based stereotype threat.

Future Directions and Conclusions

There are also additional applied domains where there is a paucity of research examining the role of age-based stereotype threat. First, there is a need for more research to examine the role of computers and technology in contributing to stereotype threat for OAs. Semi-structured interviews show that computers can be a trigger of age-based stereotype threat and have a negative impact on OAs technology self-efficacy (Ivan & Schiau, 2016). It is also possible that stereotype threat elicited by technology may impair the efficacy of OAs' informational search online (Noeltner, Kroenung, & Kuhlmann, 2019), and also negatively impact their ability to use technology for communication, banking, or business needs. With the increase of online learning and technology-use in classrooms, stereotype threat elicited by technology may also have an adverse effect on educational learning outcomes for nontraditional OA college students. Although the effects of stereotype threat for this group have been relatively unexplored, one prior study found that age-based stereotype threat can be a deterrent for nontraditional OA students' math-related learning (Hollis-Sawyer, 2011). This may be because stereotype threat results in OAs choosing less effective strategies for solving math-based problems (Nicolas, Lemaire, & Régner, 2020).

There is also a need to better understand the impact of stereotype threat for OAs in the legal system. OA witnesses are often stereotyped to be less credible, both by mock jurors (Mueller-Johnson, Toglia, Sweeney, & Ceci, 2007) and also by actual police officers (Wright & Holliday, 2005). This may in turn result in age-based stereotype threat and impair the performance of OAs in legal contexts. Although no research has yet examined the implications of age-based stereotype threat for OA suspects (e.g., false or coerced confessions), there is some evidence suggesting that stereotype threat can impair the memory reports of OA witnesses (e.g., Thomas, Smith, & Mazerolle, 2020). For example, Rossi-Arnaud, Spataro, and Geraci (2018) found that stereotype threat significantly reduced the quantity of person, object, action, and location details that OAs learned from a mock-crime film. It also increased the number of "don't know" responses that OAs provided. However, these effects may only occur when stereotype threat is initiated prior to encoding. Other research has shown that whereas stereotype threat instantiated prior to encoding impairs OAs' memory performance, stereotype threat instantiated only prior to retrieval does not (Wong & Gallo, 2019). Likewise, Henkel (2014) found that stereotype threat instantiated at retrieval does not affect OAs' memory for a mock-crime. Although further research is needed to evaluate how stereotype threat unfolds across time for eyewitnesses in legal contexts, there is also a need for additional research to examine the effects of stereotype threat on OAs' eyewitness memory confidence, on their likelihood of making false identifications, and whether adverse effects of stereotype threat can be combated via cognitive interviews.

In summary, populations around the world are aging at an unprecedented pace, and this trend is predicted to continue in the coming decades. For example, within the next decade the World Health Organization predicts a 34% increase in the number of people worldwide who are aged 60 or older, with an increase from 1 billion in 2019 to 1.4 billion by 2030. The aging population brings both opportunities and challenges in a variety of domains, including in public health and the workforce. It also increases the importance of understanding age-related changes in cognitive capabilities, as this is a key component of "successful aging" (Rowe & Kahn, 1997). As reviewed here, one factor that affects OAs' performance in many applied cognitive settings—and hence affects the likelihood that OAs have successful aging outcomes—is that of age-based stereotype threat.

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Received 31 January 2020;
received in revised form 22 May 2020;
accepted 23 May 2020
Available online 29 July 2020