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RESEARCH ARTICLE

Sense of Control Mediates the Relation between Discrimination and Executive Functions in Middle-Aged and Older Adults: A Structural Equation Modeling Approach

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ABSTRACT

Background: Despite previous findings of a negative association between everyday discrimination and executive functions (EF) – a set of domain-general cognitive control processes – in middle-aged and older adults, less is known about the underlying mechanism. Thus, we focused on sense on control and its two facets – perceived constraints and personal mastery – as potential psychosocial mediators of this relation.

Methods: By analyzing a nationally representative adult cohort from the Midlife Development in the United States (MIDUS) 2 study, we examined two mediational models: a single mediation model with sense of control and a parallel mediation model with perceived constraints and personal mastery as mediators.

Results: Structural equation modeling analyses showed that sense of control, as well as personal mastery and perceived constraints, mediated the relationship between discrimination and EF in middle-aged and older adults. This held true when we controlled for age, race, gender, education, and health status.

Conclusion: Our findings underscore the unique and distinctive roles of sense of control and its two facets in the relation between everyday discrimination and EF in middle-aged and older adults.

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Introduction

Everyday discriminatory experiences, which are more prevalent in middle-aged and older adults (e.g., Kessler, Mickelson, & Williams, 1999; Luo, Xu, Granberg, & Wentworth, 2011) due to age-related preconceptions or stereotypes, are adversely associated with mental and physical health outcomes such as anxiety and depressive symptoms (Jang, Chiriboga, Kim, & Rhew, 2010; Soto, Dawson-Andoh, & BeLue, 2011). Importantly, everyday discrimination may have negative consequences for cognitive outcomes, including executive functions (EF) – a set of cognitive processes that are crucial for goal-oriented behaviors in middle-aged and older adults (Barnes et al., 2012; Hedden & Gabrieli, 2004; Zahodne et al., 2020). However, little is known regarding the psychosocial mechanism (e.g., depressive symptoms; Zahodne et al., 2020) that underlies the link between discrimination and declines in EF among middle-aged and older adults. Given the importance of EF for aging outcomes such as well-being and mortality (Davis et al., 2015; Hall, Dubin, Crossley, Holmqvist, & D'Arcy, 2009; Toh, Yang, Hartanto, 2020), it is critical that we identify a mediating variable that is

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relevant for middle-aged and older adults' EF and modifiable by life experiences. We sought to examine sense of control – the extent to which individuals perceive they have control over their life (Lachman & Weaver, 1998) – as a potential mediator for the link between discrimination and EF in middle-aged and older adults. Further, to address mixed findings regarding the relation between discrimination and EF, we employed a latent variable approach in our analyses.

Sense of control, which is modifiable by experiences such as social interactions, is acknowledged to be multifaceted and comprises both personal mastery (one's sense of efficacy) and perceived constraints (perceptions of uncontrollable obstacles; Lachman & Weaver, 1998). In line with the stress process theory (Pearlin, Menaghan, Lieberman, & Mullan, 1981), previous research has demonstrated that discrimination is related to a lowered sense of control in older adults (Jang et al., 2010; Jang, Chiriboga, & Small, 2008; Vogt Yuan, 2007). Moradi and Hasan (2004) suggest that as a stressor, discriminatory experiences may undermine sense of control among older adults in two ways. First, discrimination due to characteristics such as age, ethnicity, and gender may lower one's sense of personal mastery by eliminating opportunities that would otherwise allow one to feel efficacious (Hughes & Demo, 1989). Second, exposure to uncontrollable discrimination may also reinforce one's perceived constraints, since victims often feel a lack of control over discriminatory behaviors and attitudes (Moradi & Hasan, 2004). These effects are likely exacerbated for middle-aged and older adults, who may experience greater challenges in directly eliminating or avoiding discriminatory experiences due to the immutability of their age group and difficulty of upward mobility (Garstka, Schmitt, Branscombe, & Hummert, 2004). Taken together, discriminatory experiences likely undermine middle-aged and older adults' sense of control by lowering mastery and aggravating perceptions of constraints.

Further, previous studies suggest a link between sense of control and EF. Despite age-related declines in EF (Braver & Barch, 2002; MacPherson, Phillips, & Della Sala, 2002), sense of control as a modifiable psychological resource has been shown to produce better EF-related outcomes in older adults (Miller & Lachman, 2000). Cognitive-behavioral theory (Bandura, 1997) postulates that sense of control benefits cognitive performance by providing motivational resources such as perseverance and effort. Accordingly, researchers have found that control beliefs positively influence middle-aged and older adults' EF performance through increased effort and motivation to use adaptive strategies that compensate for cognitive limitations or losses (de Frias, Dixon, & Bäckman, 2003; Lachman & Andreoletti, 2006; Miller & Lachman, 1999). Given that daily interpersonal stressors (i.e., discrimination) attenuate control beliefs, which in turn adversely influence cognitive performance in middle and late adulthood (Lachman, Neupert, & Agrigoroaei, 2011; Windsor & Anstey, 2008), it is plausible that sense of control may serve as a critical mediator for the relation between discrimination and EF.

Despite this subject's empirical importance, previous studies are limited in several respects. First, although several studies have examined the relation between discrimination and EF, their findings have been equivocal. On one hand, some studies have demonstrated a negative association between discrimination and EF, as assessed in terms of perceptual speed (Barnes et al., 2012). Recently, Zahodne et al. (2020) used a latent variable approach and reported similar findings, although they focused on limited aspects of EF such as reasoning (assessed by the number series task and Raven's Standard Progressive Matrices) and shifting abilities (assessed by the Trail Making task). On the other hand, other studies

have reported the lack of an association between discrimination and EF components such as verbal fluency and working memory (Barnes et al., 2012; Shankar & Hinds, 2017). These mixed findings could, in part, be attributed to methodological limitations concerning the operationalization of EF. Previous studies were unable to address the task-impurity issue that is inherent to most EF tasks (Miyake & Friedman, 2012) due to their reliance on a single measure of EF (Shankar & Hinds, 2017) or a composite score of EF (Barnes et al., 2012). Since most EF tasks measure both the target EF (e.g., the Stroop task primarily measures the inhibition aspects of EF) and non-EF abilities (e.g., the Stroop task also measures color perception abilities), it is crucial that we use a latent variable approach based on multiple EF tasks to extract the pure target EF (i.e., variance that is common across various EF tasks) while excluding measurement errors (i.e., non-EF abilities) that are specific to each EF task.

Another limitation is that previous studies have often examined sense of control as a unitary construct (e.g., Jang et al., 2008; Kraus, Piff, & Keltner, 2009) without considering its distinct facets (i.e., perceived constraints and personal mastery). However, multiple studies suggest that these two aspects are conceptually distinct. Perceived constraints refer to individuals' perceptions that external factors beyond their control can influence circumstances and thwart desired outcomes, whereas personal mastery reflects beliefs concerning competence to attain desired outcomes (Elliott & Lachman, 1988; Infurna & Mayer, 2015). Further, there is compelling theoretical and empirical evidence to suggest that sense of control is a multifaceted construct, composed of two orthogonal facets of perceived constraints and personal mastery. Recent studies suggest that the two facets of sense of control have different implications for aging outcomes (e.g., Gore et al., 2016; Infurna & Mayer, 2015; Khoo & Yang, 2020; Lachman & Weaver, 1998; Toh et al., 2020). For instance, a longitudinal study found that perceived constraints exerted a stronger effect on older adults' positive and negative affect and physical health than personal mastery (Infurna & Mayer, 2015). In another study, perceived constraints, but not personal mastery, exhibited an independent association with mortality (Elliott & Lachman, 1988). Other studies demonstrated that perceived constraints, but not personal mastery, mediated the relation between several psychological variables (e.g., social media use and life satisfaction) and EF performance in older adults (Khoo & Yang, 2020; Toh et al., 2020).

These results are in line with learned helplessness theory, which posits that greater perceived constraints may reduce persistence on challenging tasks (Infurna & Mayer, 2015; Peterson & Seligman, 1984) and impair cognitive performance (de Frias et al., 2003). However, another stream of research emphasizes the relation between self-belief regarding efficacy and cognitive performance (e.g., Bandura, 1989). For instance, domain-specific self-efficacy (e.g., memory) indirectly influences cognitive performance through greater persistence (Beaudoin & Desrichard, 2016). Taken together, it would be appropriate to consider personal mastery and perceived constraints separately – rather than combining them to form a single, bipolar construct of sense of control – because the former approach could clearly identify the unique roles of perceived constraints and personal mastery in the association between discriminatory experiences and EF in middle-aged and older adults.

To address these limitations, therefore, we aimed to investigate whether sense of control – perceived constraints and personal mastery – would mediate, in parallel, the relation between everyday discrimination and EF in middle-aged and older adults. To this end, we used a latent variable approach and analyzed a large representative sample of middle-

aged and older adults (Brim, Ryff, & Kessler, 2004) from the Midlife Development in the United States (MIDUS) 2 study.

Method

Participants

The study sample consisted of American adults who completed the second wave of the MIDUS 2 and the Cognitive Project component. Following data cleaning (Tun & Lachman, 2008) and inclusion criteria for performance on EF tasks (Toh et al., 2020), we retained 3,934 participants for our analyses (see Table 1 for descriptive statistics and zero-order correlations). Our sample was large enough to detect a small effect size of .10 with 80% power at $\alpha = .05$ (Soper, 2018); for a structural equation model with a maximum of four latent variables and 17 manifest variables, a minimum sample size of 1,454 is required to achieve sufficient power.

Measures

Everyday Discrimination

Participants reported how frequently (1 = *often*; 4 = *never*) they encountered unfair treatment on a day-to-day basis. The scale contained nine items ($\alpha = 0.914$; Williams, Yu, Jackson, & Anderson, 1997). Items were subsequently reverse-coded such that higher scores reflected greater frequency of discrimination.

Sense of Control

The sense of control scale (Lachman & Weaver, 1998) contained 12 items that assessed two facets: personal mastery (4 items; $\alpha = 0.729$) and perceived constraints (8 items; $\alpha = 0.852$). Participants responded on a 7-point scale (1 = *strongly agree*; 7 = *strongly disagree*). Items were later reverse-coded such that higher scores represented higher standing in each dimension.

Executive Function

EF was measured using five tasks from the Brief Test of Adult Cognition by Telephone. Consistent with previous studies (e.g., Hughes, Agrigoroaei, Jeon, Bruzzese, & Lachman, 2018; Lachman, Agrigoroaei, Murphy, & Tun, 2010), our confirmatory factor analysis showed that these tasks loaded onto a single latent construct representing EF (Figure A1 in the Appendix).

The backward counting task required participants to count backward from 100. The number of items correctly reported served as an index of speed of processing – an important construct that shares variance with EF (Albinet, Boucard, Bouquet, & Audiffren, 2012). The task measured working memory, with participants repeating an increasing sequence of digits (maximum 8 digits) backward. The highest number of digits correctly recalled was recorded. For the category fluency task, participants were given 60 seconds to produce as many words as possible for a given category. The total number of unique responses served as an index of verbal ability and speed. The number series task measured fluid intelligence and reasoning by asking participants to deduce the next number in a string of numbers, and the total number of correct responses was recorded. Lastly, the stop and go switch task

Table 1. Descriptive statistics and bivariate zero-order correlations.

	M	*SD*	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Everyday Discrimination	0.00	0.46	-												
2. Personal Mastery	0.00	0.77	**−0.13**	-											
3. Perceived Constraints	0.00	1.11	**0.28**	**−0.66**	-										
4. Age	55.32	12.1	**−0.27**	−0.01	**−0.08**	-									
5. Gender[1]	1.54	0.49	−0.02	**−0.06**	0.02	−0.02	-								
6. Education[2]	7.36	2.51	**−0.04**	0.04	**−0.13**	**−0.13**	**−0.10**	-							
7. Health Status	2.38	2.44	**0.19**	**−0.15**	**0.28**	**0.20**	**0.12**	**−0.14**	-						
8. Race	1.19	0.81	**0.08**	−0.01	0.01	**−0.04**	−0.01	0.00	**0.05**	-					
9. Digit Backward	5.05	1.48	−0.01	0.04	**−0.08**	**−0.16**	0.03	**0.20**	**−0.10**	−0.02	-				
10. Category Fluency	19.05	6.04	0.03	−0.02	**−0.04**	**−0.29**	**−0.05**	**0.34**	**−0.11**	**−0.05**	**0.19**	-			
11. Number Series	2.29	1.52	**−0.06**	−0.02	−0.02	−0.23	**−0.11**	**0.41**	**−0.16**	**−0.07**	**0.34**	**0.37**	-		
12. Backward Counting	37.65	11.3	**−0.06**	−0.01	0.01	−0.41	**−0.13**	**0.29**	**−0.20**	**−0.06**	**0.30**	**0.40**	**0.47**	-	
13. SGST	1.07	0.22	**0.05**	−0.03	**0.10**	0.31	**0.10**	**−0.18**	**0.18**	0.04	**−0.19**	**−0.32**	**−0.29**	**−0.49**	-

Note. Significant statistics at $p < .05$ level appear in bold. [1]Gender was coded as 1 = *Male*, 2 = *Female*. [2]Education was reported on a scale of 1 = *No school* to 12 = *Doctoral or other professional degree*.

(SGST) was used to measure the task-switching aspects of EF. Depending on the given cue, participants had to vary their responses to the words "RED" and "GREEN." When participants received the "NORMAL" cue, they had to answer "STOP" and "GO" to the words "RED" and "GREEN," respectively. However, when they received the "REVERSE" cue, they had to reverse their responses. Participants' mean response times (RT) on switch trials (i.e., trials that required participants to switch tasksets) and non-switch trials (i.e., trials of the same taskset as a preceding trial) were used as an indicator of task-switching performance.

Covariates

Age[1], race, gender, education, and health status (indexed by number of recent chronic conditions) have been reported to influence both EF (Allan, McMinn, & Daly, 2016; Kirova, Bays, & Lagalwar, 2015; Phillips & Henry, 2008; Schillerstrom, Horton, & Royall, 2005; Zahodne et al., 2011) and sense of control (Mirowsky, 1995; Mirowsky & Ross, 2003; Ross & Mirowsky, 2002; Shaw & Krause, 2001), and thus were included as covariates in all structural paths of our parallel mediation model.

Results

Data Analysis

Analyses were conducted using M*plus* 7.4 (Muthén & Muthén, 1998–2007), with the full information maximum likelihood procedure. Model fit was evaluated using Hu and Bentler's (1999) criteria (i.e., CFI $\geq$ 0.95; RMSEA $\leq$ 0.05 and $\leq$ 0.08 for good fit and acceptable fit, respectively; SRMR $\leq$ 0.08).

Measurement Models

In line with the literature (de Frias, Dixon, & Strauss, 2006), the latent variable of EF was established using five EF tasks. Our confirmatory factor analysis revealed that a single-factor model of EF with the five EF tasks as indicators fit the data well (for detailed model fit indices, see Table 2). The latent variable of personal mastery (a subset of sense of control) was specified by its four scale items as indicators; its measurement model also showed good model fit. Further, since the latent variable of sense of control was represented by only two indicators – the subscale scores of perceived constraints and personal mastery – we obtained a locally unidentifiable measurement model; thus, we were unable to determine its model fit indices (Little, Cunningham, Shahar, & Widaman, 2002).

We used parceling for the remaining latent variables of perceived constraints and everyday discrimination because their scales contained too many item indicators (nine for discrimination and eight for perceived constraints), which may introduce potential problems in fitting a model (Hayduk & Littvay, 2012). Parceling has been shown to be appropriate for a unidimensional construct, since the method offers better psychometric properties (e.g., higher reliabilities), more stable factor solutions, and a reduction in random errors (Matsunaga, 2008) and various sources of sampling error (Little et al., 2002). Specifically, the latent variables of perceived constraints (a subset of sense of control) and everyday discrimination were established using four parcels, based on the "item-to-construct balance" approach in which parcels were created by balancing item

Table 2. Model fit indices for measurement and structural models.

	χ^2	*df*	RMSEA	CFI	SRMR
Measurement models					
Everyday discrimination	39.21***	2	0.076	0.996	0.008
Personal mastery	7.09**	1	0.043	0.998	0.006
Perceived constraints	31.87***	2	0.067	0.995	0.011
Executive function	7.47*	1	0.041	0.998	0.007
Full measurement models					
Sense of control	191.85***	37	0.033	0.989	0.021
Mastery and constraints	533.36**	108	0.032	0.981	0.027
SEM (single mediation)					
Unadjusted model	191.85***	37	0.033	0.989	0.021
Adjusted model[1]	849.84***	82	0.053	0.952	0.047
SEM (parallel mediation)					
Unadjusted model	1475.93***	109	0.056	0.940	0.099
Adjusted model[1]	2351.06***	179	0.061	0.912	0.082

[1]The adjusted model controlled for the covariates of age, race, gender, education, and health status.

discrimination and difficulty across four parcels (Little et al., 2002). Both measurement models for perceived constraints and everyday discrimination showed acceptable model fit.

Overall, the full measurement model, which included the latent variables of everyday discrimination, sense of control as a single mediator, and EF as an outcome variable, had excellent model fit. Similarly, another full measurement model of everyday discrimination, personal mastery and perceived constraints as parallel mediators, and EF as an outcome variable (i.e., the parallel mediation model) also demonstrated excellent model fit.

Structural Mediation Models

Using structural equation modeling, we tested two – a single and a parallel – mediation models. Since both mediation models are non-nested and contain structurally different parameters, the chi-square difference test was not appropriate for comparing the two models. Therefore, their model fit indices were instead compared. Although both the single mediation (CFI = .952; RMSEA = .053; SRMR = .047) and parallel mediation models provided acceptable fit (CFI = .912; RMSEA = .061; SRMR = .082), the single mediation model had a better fit than the parallel mediation model. Nevertheless, for each model's theoretical and empirical values, we tested those two mediation models.

First, we examined a single mediation model with the latent construct of sense of control as a single mediator. We found that the unadjusted model without any covariates showed good fit (CFI = .989; RMSEA = .033; SRMR = .021). The indirect effect of discrimination on EF via sense of control was significant ($\beta = -.030$, SE = 0.007, $p < .001$), but the direct effect of discrimination on EF did not reach significance ($\beta = -.037$, SE = 0.022, $p = .101$), which suggests a full mediation. Similarly, the adjusted single mediation model with covariates showed acceptable fit (CFI = .952; RMSEA = .053; SRMR = .047). Both the indirect effect of discrimination on EF via sense of control was significant ($\beta = -.008$, SE = 0.003, $p = .004$) and the direct effect of discrimination on EF were significant ($\beta = -.084$, SE = 0.018, $p < .001$), which suggests a partial mediation.

Next, we tested a parallel mediation model in which personal mastery and perceived constraints served as parallel mediators for the link between discrimination and EF (see Figure 1). Both the unadjusted (CFI = .940; RMSEA = .056; SRMR = .099) and adjusted parallel mediation models showed acceptable fit (CFI = .912; RMSEA = .061; SRMR = .082;

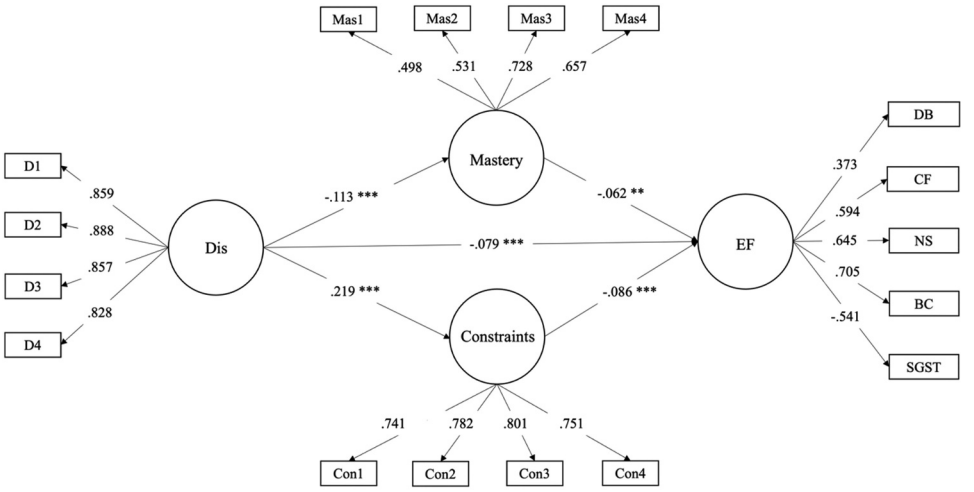

Figure 1. Adjusted structural model for personal mastery and perceived constraints as parallel mediators. Longer solid lines signify statistically significant (at the .05 level) standardized path coefficients. Values next to single-headed arrows that connect latent variables and indicators signify statistically significant standardized factor loadings (at the .05 level). Dis = Discrimination; DB = Digit Backward; CF = Category Fluency; NS = Number Series; BC = Backward Counting; SGST = Stop and Go Switch Task. * $p < .05$, ** $p < .01$, *** $p < .001$.

see Table 2). For the unadjusted parallel mediation model, we found that the indirect effects of discrimination on EF via both personal mastery ($\beta = 0.010$, SE = 0.004, $p = .014$) and perceived constraints ($\beta = -0.062$, $SE = 0.008$, $p < .001$) were significant, while the direct effect of discrimination on EF was not significant ($\beta = -0.015$, $SE = 0.022$, $p = .491$). Similarly, the adjusted parallel mediation analysis revealed significant indirect effects via both personal mastery ($\beta = 0.007$, $SE = 0.003$, $p = .017$) and perceived constraints ($\beta = -0.019$, $SE = 0.005$, $p < .001$) and a significant direct effect of discrimination ($\beta = -0.079$, $SE = 0.018$, $p < .001$), which suggests a partial mediation.

Discussion

Our results demonstrate that everyday discrimination is indirectly associated with impaired executive functioning in middle-aged and older adults via a reduced sense of control. Specifically, our study suggests that discrimination is related to reduced EF performance in middle-aged and older adults, likely because they feel less efficacious (i.e., reduced personal mastery) due to reduced opportunities (Hughes & Demo, 1989), and perceive little control over others' discriminatory attitudes or behaviors (i.e., greater perceived constraints; Moradi & Hasan, 2004).

Our findings from the parallel mediation model, compared with those from the single mediation model, highlight two empirically important facts regarding the multifaceted aspect of sense of control. First, our finding that the two facets of sense of control (i.e., perceived constraints and personal mastery) mediate the relation between discrimination and EF in the opposite directions implies that they are indeed distinct psychological constructs. Second, these two facets of sense of control play unique roles in the relation between discrimination

and EF, even when the influence of the other facet is taken into consideration. By investigating these two facets of sense of control simultaneously, our parallel mediation model provides more nuanced insights into the construct of sense of control, which suggests that future studies should treat its two facets separately.

In contrast to previous studies that report null findings between discrimination and EF in older adults (Barnes et al., 2012; Shankar & Hinds, 2017), our finding of a negative association between discrimination and EF corroborates a recent study based on a latent variable approach (Zahodne et al., 2020). Given this, discrepant findings in the literature can be attributed to two possible reasons. First, discrimination may have domain-specific or more pronounced influence on certain aspects of EF (e.g., verbal fluency or working memory; Barnes et al., 2012; Shankar & Hinds, 2017). Second, previous studies' null findings may be due to task impurity caused by the use of single EF measures, which failed to partial out non-EF abilities (Miyake & Friedman, 2012) and thereby obscured the true relation between discrimination and EF. Our study replicates – and, more importantly, extends – Zahodne et al.'s (2020) findings by (a) identifying new mediators, i.e., sense of control, as well as its facets of personal mastery and perceived constraints; and (b) assessing more comprehensive aspects of EF, including shifting, working memory, speed of processing, reasoning, and verbal ability, in operationalizing the latent variable of EF. Overall, our study underscores the importance of using multiple EF measures to more precisely estimate the true relation between discrimination and EF.

Consistent with the stress process theory (Pearlin et al., 1981), our study demonstrates the effects of discrimination on sense on control and both perceived constraints and personal mastery, which were found to mediate the relation between discrimination and EF. Building on research that emphasizes the role of control beliefs in relation to the mental health outcomes of discrimination (Jang et al., 2010, 2008), we demonstrate the importance of control beliefs for cognitive outcomes in middle-aged and older adults who experience discrimination. This is especially relevant for the aging process, given that discrimination undermines control beliefs in middle-aged and older adults (Jang et al., 2008) as they progress through notable changes in important life domains (Lachman, Rosnick, & Röcke, 2009; Lachman & Weaver, 1998) and inevitable and irreversible aging-related declines such as physical illness and constraints (Mirowsky, 1995). Further, our findings lend support to the notion that both facets of control beliefs constitute an important psychosocial resource that significantly affects cognitive performance in middle-aged and older adults. Overall, our results underscore the importance of promoting control beliefs to alleviate the negative association between discrimination and EF in middle and late adulthood.

Our study extends the literature on aging by elucidating the roles of personal mastery and perceived constraints in relation to cognitive outcomes in middle-aged and older adults. In light of previous findings that suggest that perceived constraints, compared with personal mastery, are more germane to impaired cognitive outcomes (Khoo & Yang, 2020; Yang, Tng, Ng, & Yang, 2020), our study emphasizes that both personal mastery and perceived constraints play pivotal roles in mediating the relation between discrimination and cognitive outcomes (e.g., EF) in middle-aged and older adults. This suggests that perceptions of reduced mastery and external constraints that arise from discriminatory experiences affect crucial cognitive abilities (Infurna & Mayer, 2015) such as EF, which has been suggested to be vital for successful aging (Oh & Yang, 2021). For instance, increased constraints regarding the use of new technology in response to discriminatory experiences

may necessarily hinder one's cognitive competence in some aspects of EF, such as processing speed or task-switching (i.e., multitasking). It is notable, however, that we found that reduced mastery was associated with better EF performance. This finding is at odds with our hypothesis, but further inspection suggests that the addition of covariates in the adjusted model may have suppressed the positive relation between personal mastery and EF that was evident in the unadjusted simple mediation model for personal mastery alone (Horst, 1941). Indeed, we found that of all covariates, gender (female) and health status are negatively associated with personal mastery but not with manifest variables of EF, which could have suppressed the influence of mastery in predicting EF performance.

Some limitations should be noted. First, our cross-sectional design limits causal inferences. Although our model assumes a conceptual mechanism underlying the link between discrimination and EF via perceived constraints, it is also possible that individuals with poorer EF may experience more constraints (Toh et al., 2020) or reduced mastery and, in turn, become more vulnerable to discrimination. Given the limitations of this dataset, we were unable to employ a cross-lagged panel mediation because the EF data were not available in the first wave of the MIDUS 2 study. However, future work should employ such longitudinal designs to clarify the causal relation between everyday discrimination and EF.

Second, the retrospective design of our study could be subject to reporting bias. Although retrospective self-reported measures are widely used, our use of participants' reports of past discriminatory experiences could be tainted by current physical and emotional states (Brondolo et al., 2008). Therefore, future studies should aim to employ less biased and more accurate and objective measures of discriminatory experiences.

Third, the study relied mainly on self-report rather than objective assessments, which raises the issue of common method variance (Campbell & Fiske, 1959). However, given that these constructs (i.e., control beliefs and discriminatory experiences) are perceptual in nature, we believe that the use of measures in which participants reported their own perceptions was appropriate and justified for the purpose of our study (Chan, 2009). Indeed, researchers have suggested that it is challenging to measure the objective amount of discrimination in a real-world context, given the complexity and ambiguity of events (Ruggiero & Taylor, 1995). Moreover, as shown in Table 1, the self-report measures that assessed personal mastery ($r = -.13$, $p < .001$), perceived constraints ($r = .28$, $p < .001$), and discrimination are considered to be weakly correlated ($r < .35$; Taylor, 1990).

Fourth, our data support a partial mediation, which suggests that additional mediators, such as physiological stress responses, may exist (Zahodne et al., 2020). More research is therefore warranted to examine this aspect. Lastly, our findings are based on an American sample and may not be generalizable to other populations with different cultural influences. For example, given that Americans demonstrate greater levels of control beliefs than Asians, the beneficial role of sense of control may be more pronounced among Americans (Sastry & Ross, 1998). Moreover, given that our sample was predominantly White, our results may not be applicable to minority populations (e.g., non-Whites), who likely face greater levels of discrimination. Future research may seek to replicate our findings using diverse samples. Nonetheless, our results highlight the fact that perceptions of discrimination, even among members of privileged racial groups, can undermine control beliefs and impair EF.

Given that older adults are prone to experience discrimination and that control beliefs are malleable and relevant for cognitive outcomes (Lachman et al., 2011), our study has important implications for the development of interventions aimed at bolstering middle-

aged and older adults' sense of control and buffering cognitive impairment. Interventions should focus on helping older adults promote mastery (efficacy) and alleviate their perceptions of constraints to reduce cognitive decline arising from discriminatory experiences. For instance, older individuals' reappraisal of discriminatory experiences may confer benefits by minimizing attribution to discrimination (Ruggiero & Taylor, 1995) and thereby improving personal mastery and reducing perceptions of constraints.

Note

1. We used age as a covariate in all structural paths of the parallel mediation model rather than a moderator in a mediation model. This was done because age has been shown to be associated with cognitive performance, whereas little evidence suggests that age moderates the relation between sense of control and EF.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

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Data Availability Statement

The dataset used in our study is publicly available at https://www.icpsr.umich.edu/web/NACDA/studies/4652.

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Appendix

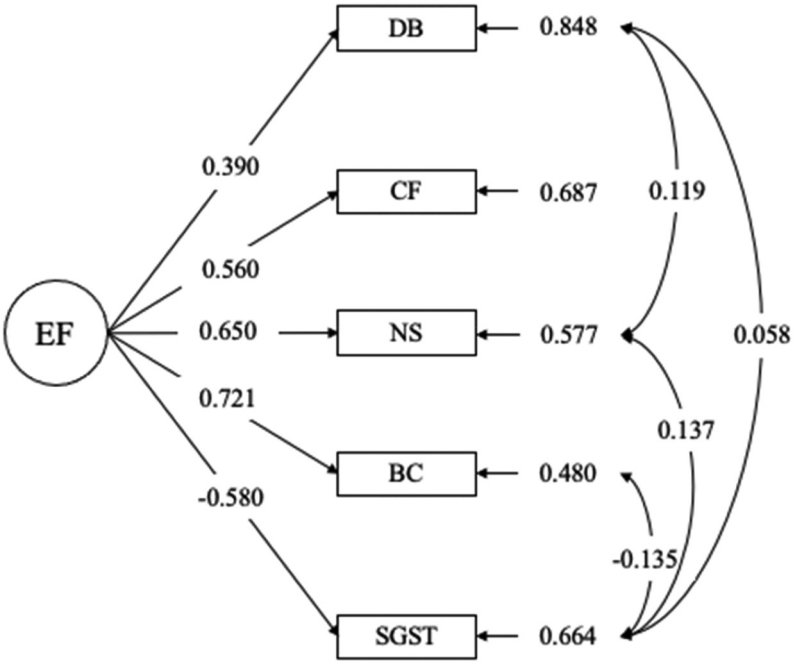

Figure A1. Individual measurement model of EF with standardized estimates. Circles represent latent variables and rectangles represent indicators (manifest variables). Values for long single-headed arrows signify factor loadings and for short single-headed arrows represent error variances. Values for curved, double-headed arrows indicate inter-factor correlations. DB = Digit Backward; CF = Category Fluency; BC = Backward Counting; NS = Number Series; SGST = Stop and Go Switch Task. All statistics are significant at the .05 level.