2022

RACIAL DISCRIMINATION AND CORE EXECUTIVE FUNCTIONS

Luke H. Keating

RACIAL DISCRIMINATION AND CORE EXECUTIVE FUNCTIONS

A thesis submitted in partial fulfillment
of the requirements for the degree of

MASTERS OF ARTS

to the faculty of the

DEPARTMENT OF PSYCHOLOGY

of

ST. JOHN'S COLLEGE OF LIBERAL ARTS AND SCIENCES

at

ST. JOHN'S UNIVERSITY
New York
by
Luke H. Keating

Date Submitted 4/22/2022 Date Approved 4/22/2022

Luke H. Keating

Elizabeth Brondolo

ABSTRACT

RACIAL DISCRIMINATION AND CORE EXECUTIVE FUNCTIONS

Luke H. Keating

Researchers have theorized that exposure to racial discrimination may impair executive functioning. The limited existing data broadly support this notion and suggest that discrimination may exert acute and persistent effects on executive functioning, potentially because of the cognitive demands associated with responding to discrimination. However, it is unclear if discrimination is differentially associated with different core executive functions. Further, the effects may vary depending on the timing of exposure, as recent or acute exposure to discrimination may operate on executive functioning through different mechanisms than exposure across the lifetime. The current study evaluates the relations of both recent and lifetime exposure to racial discrimination to three core executive functions (i.e., cognitive flexibility, inhibitory control and working memory) using a racially and ethnically diverse sample (n = 319). In fully adjusted models, recent discrimination was negatively associated with cognitive flexibility and working memory but not with inhibitory control. These data are consistent with the broader literature on acute stress effects on core executive functions and may have implications for understanding the effects of discrimination on health. Further research is warranted to understand the course and mechanisms of effects of lifetime and recent discrimination on core executive functions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Racial discrimination is a psychosocial stressor composed of prejudicial attitudes and discriminatory behaviors enacted on the basis of race or ethnicity (Brondolo et al., 2005). Racial discrimination is highly prevalent among members of racial/ethnic minority groups (Luo et al., 2012; Kessler et al., 1999). Discrimination has been implicated in a range of deleterious health behaviors and outcomes and is largely considered a determinant of health disparities (for review, see Paradies et al., 2015). However, the mechanisms linking discrimination to poor health remain unclear. One underexplored mechanism is executive functioning. Executive functioning has implications for health behavior as well as stress reactivity and recovery in the context of discrimination (Brondolo et al., 2018; Williams et al., 2017).

Executive Functions

Executive functions are top-down mental processes involved in the cognitive control of behavior above and beyond instinct and intuition (Diamond, 2013). Researchers have identified three core executive functions (i.e., cognitive flexibility, inhibitory control, and working memory) which differentially relate to higher-order cognitive abilities such as reasoning, planning, problem solving and organization (Miyake et al., 2000). Cognitive flexibility, also known as task switching or set shifting, involves the ability to switch perspectives and to change the way one thinks about problems, or other contextual, emotional, and behavioral information (Diamond, 2013). Inhibitory control refers to the capacity to inhibit thoughts, behaviors, and emotions in response to external and internal stimuli (Diamond, 2013). Working memory is the ability to maintain and manipulate information in conscious awareness (Diamond, 2013).

These core executive functions are vulnerable to acute and long-term stressors (Plieger et al., 2020), and there is evidence of differential effects of stress on specific core executive functions. For instance, a recent meta-analysis found that acute stressors were negatively associated with cognitive flexibility and working memory but not with inhibitory control (Shields et al., 2016). However, most studies employ a single measure of executive function, which may obscure effects on discrete, but interrelated, core executive functions (Miyake et al., 2000).

Discrimination and Executive Functioning

Exposure to racial discrimination can elicit effortful cognitive processing to evaluate the nature of the threat and identify and implement strategies for managing emotional and behavioral demands (Ozier et al., 2019). These cognitive demands may tax executive functioning. Specifically, processing acute discrimination-related threats may present attentional demands which restrict cognitive flexibility, limiting the individual's ability to regulate attention to threat. These demands may also occupy working memory capacity, making it more difficult for individuals to keep long-term health goals in mind for decision making. A social cognitive model of the effects of discrimination on health suggests that the effects of discrimination on executive functioning, and in particular on cognitive flexibility and working memory, may prolong stress effects and contribute to the health consequences of racial discrimination (Brondolo et al., 2018).

However, the link between discrimination and core executive functions has not been consistently demonstrated in either laboratory or survey studies. Specifically, researchers have evaluated the acute effects of discrimination on executive functioning using laboratory analogues of discrimination such as observations of racially prejudiced hiring

practices (Salvatore et al., 2007), exposure to negative assumptions about performance by same and other race examiners (Inzlicht et al., 2006; Thames et al., 2013), and interactions with a racially biased White confederate prior to cognitive testing (Murphy et al., 2013). Three studies in diverse samples found that exposure to laboratory analogues of discrimination was significantly negatively associated with inhibitory control as measured by Stroop tasks (Salvatore et al., 2007; Inzlicht et al., 2006; Murphy et al., 2013). One study found effects of subtle discrimination in a racially biased hiring condition on working memory (Ozier et al., 2019).

Other researchers have also examined the association of self-reported measures of discrimination experiences over the lifetime to executive functioning. One study reported negative effects of lifetime discrimination on global neuropsychological functioning including measures of inhibitory control and cognitive flexibility but did not assess effects on specific core executive function outcomes (Thames et al., 2013). Others have found negative effects of discrimination on executive functioning as indicated by measures of cognitive flexibility, reasoning/problem solving (Zahodne et al., 2020) and on processing speed (Barnes et al., 2012).

The studies reviewed above suggest that both acute and more sustained exposure to discrimination negatively impact core executive functions. However, limitations to the measurement of specific core executive functions obscures our understanding of which core executive functions may be particularly vulnerable to discrimination-related stress and therefore may require intervention. Understanding differential effects is crucial, as evidence suggests that impairments to different core executive functions may produce different downstream health effects and generate different responses to intervention

(Nguyen et al., 2019; Williams et al., 2017). For example, inhibitory control has been linked with failures to acutely regulate health behaviors including substance use; whereas working memory and cognitive flexibility have been linked to difficulties engaging in behaviors supportive of long-term health, including adhering to treatment regimens (Stiley et al., 2010).

There is evidence to suggest that acute stress effects on executive functions may resolve quickly, whereas long-term stress exposure may produce more sustained changes to underlying neuropsychological processes or structures (Busse et al., 2017). Discrimination is a multifaceted phenomenon, exerting both acute and chronic stress effects. The laboratory studies highlight acute effects of discrimination on executive functioning. However, it is difficult to determine if the responses to survey discrimination measures reflect relatively recent or more chronic exposure. Research evaluating the neuroendocrine effects of discrimination suggests that the consequences of discrimination as a stressor may depend on the timing of exposure (Adam et al., 2015). Therefore, to understand the effects of timing of discrimination on executive functioning, it will be useful to distinguish between recent and lifetime exposures. To our knowledge, no studies have examined relations of both recent and lifetime discrimination to all three core executive functions.

The current study addresses gaps in the existing literature by evaluating the potentially differential effects of discrimination (i.e., both recent and lifetime) on three different core executive functions: cognitive flexibility, working memory, and inhibitory control. Given the evidence of age-related changes to executive functioning, we examine the moderating effects of age on discrimination and core executive functions (Diamond,

2013). We also examine race (Black vs. others), ethnicity (Latino/a vs. others) and age as moderators, as evidence suggests there are race/ethnicity differences in exposure to discrimination (Luo et al., 2012; Kessler et al., 1999). Further, evidence suggests that depression, a well-established consequence of discrimination and a correlate of executive function, may partially explain effects of discrimination on executive functioning (Zahodne et al., 2020). As such, we include depression as a covariate in additional analyses.

METHOD

The current study recruited participants from two locations, utilizing the same measures and study procedures. Participants were students at a private university in the northeastern U.S. (College Sample) and urban community-dwelling adults recruited from a local hospital medical center, including patients and staff (Community Health Center Sample). Eligible participants in each study were 18 years of age or older and had the ability to read and respond to study measures in written English.

A total of 355 individuals volunteered for the studies (College Sample: n=203, 57.18%; Community Health Center Sample n=152, 42.82%). 36 participants were excluded due to missing data. The final analytic sample consisted of 319 individuals (89.8%) who completed demographic information for age, gender, and race, measures of lifetime and recent racial/ethnic discrimination, and all three core executive functioning measures. Participants excluded from analyses for missing data did not differ from the final analytic sample in recent or lifetime discrimination, educational level, or executive functioning. There was a significant difference in age between participants with missing data (M = 23.54; SD = 6.87) and those in the final analytic sample (M = 28.79; SD = 13.14; $F(1, 352) = 5.40$, $p = .02$). The full sample was racially and ethnically diverse and ranged in age from 18 to 85 years (M = 28.79, SD = 13.14) The majority of participants were women (63.32%). Sample characteristics are presented in Table 1.

Procedure

All participants were provided with informed consent and voluntarily agreed to participate. Participants completed a series of self-report measures including racial discrimination and socio-demographic information and were administered computerized

tests of core executive functions via the National Institutes of Health (NIH) Toolbox iPad application. Participants were given monetary compensation. The Institutional Review Boards (IRB) affiliated with St. John's University and Jamaica Hospital Medical Center approved the protocol.

Measures

Racial/Ethnic Discrimination

Data were collected on both lifetime and recent (in the past week) exposure to discrimination. Lifetime discrimination was measured using the Brief Perceived Ethnic Discrimination Questionnaire – Community Version (PEDQ-CV). The Brief PEDQ-CV is a 17-item scale assessing lifetime experiences of racial/ethnic discrimination in a social or interpersonal context (Brondolo et al., 2005). Respondents indicated how often they experienced specific instances of negative interpersonal treatment (e.g., "Because of your ethnicity/race, have others ignored you or not paid attention to you?"). Participants responded on a 5-point Likert scale, ranging from 1 (never) to 5 (very often). The Brief PEDQ-CV has been validated in Asian, American Indian/Alaskan Native, Latino/a and Black samples and has demonstrated adequate reliability and validity in both student and community samples (Brondolo et al., 2005; Blair et al, 2000). The scale exhibited good internal consistency in the full study sample (Cronbach's $\alpha = 0.90$).

Recent exposure to discrimination was assessed with the Brief PEDQ-CV Past-week discrimination scale, a 10-item scale that assesses experiences of social/interpersonal discrimination (e.g., "Because of your ethnicity/race, did someone say something mean or nasty to you?"). Participants responded on a 4-point scale including 0 (not at all), 1 (once per week), 2 (twice per week) and 3 (3 or more times per week). The scale

exhibited good internal consistency in our sample (Cronbach's α = .92). Full scale mean scores were used for both measures of discrimination in all analyses, with higher scores indicating greater experiences of discrimination.

Core Executive Functions

Core executive functions were assessed using three tests from the NIH Toolbox for Neurological and Behavioral Function – Cognition Battery (NIHTB-CB), a computerized cognitive testing platform (Zelazo et al., 2014). The NIHTB-CB has been validated for use in ages 3 – 85. All tests were administered via iPad in counterbalanced order and proctored by research assistants. Age-adjusted standard scores calculated based on the NIHTB-CB normative sample (M = 100; SD = 15) were used in all analyses (see Zelazo et al., 2014 for scoring details).

Cognitive Flexibility. To assess cognitive flexibility, participants were administered the Dimensional Change Card Sort (DCCS) test. Participants matched a series of bivalent test pictures according to changing dimensions (shape or color) (Zelazo et al., 2014). Participant's scores reflect the sum of accuracy and reaction time scores. Reaction time scores are only incorporated for participants achieving 80% or greater accuracy.

Inhibitory Control. The Flanker Inhibitory Control and Attention (FICA) test was used to measure inhibitory control. Participants were instructed to identify the direction (left or right) of a central arrow in a row of other arrows pointing in the same or different direction (Zelazo et al., 2014). Participant's scores reflect the sum of accuracy and reaction time scores. Reaction time scores are only incorporated for participants achieving 80% or greater accuracy.

Working Memory. The List Sorting Working Memory (LSWM) test was used to evaluate working memory. This task requires participants to sort a list of items (i.e., food or animals) in order from smallest to largest (Zelazo et al., 2014). Simultaneous auditory and visual presentation was used for all items. Scores on this test reflect the sum of items recalled correctly.

Covariates

We control for a range of sociodemographic characteristics linked to both discrimination and executive function. Participants completed a brief self-report demographic questionnaire to obtain information on gender, age, race/ethnicity, and highest level of education. Self-reported education level was coded at the degree level and included three groups: less than high school, high school diploma or equivalent, and four-year college graduate. Self-reported race/ethnicity was coded into five mutually exclusive groups: Asian, Black, Latino/a, White, and Other. The "Other" group consisted of participants who identified as any race/ethnicity other than the four prior groups and participants who identified more than one race/ethnicity. In analyses testing moderation by race, we adjust for minority group status (White vs. non-White). We also adjust for depression in additional analyses, as evidence suggests depressive symptoms may explain relations between discrimination and cognitive function (Zahodne et al., 2020). Depressive symptoms experienced in the past 2 weeks were assessed with the Center for Epidemiological Studies Depression Scale-Revised (CESD-R; Eaton et al., 2004). Two items related to suicidality were removed**.** Scale mean scores were used in all analyses (Cronbach's α = .94).

RESULTS

Preliminary Analyses

A series of ANOVAs were conducted to evaluate variations in core executive functioning measures and recent and lifetime discrimination by gender, race, education level and sample (college vs. community health center). Results of analyses of demographic variations are presented in Table 2. There was a significant effect of gender on working memory, with males scoring higher on the List Sorting Working Memory Test in our sample ($F(1, 317) = 5.19$, $p = .02$). No significant gender differences were observed for cognitive flexibility ($F(1, 317) = .07$, $p = .79$), inhibitory control ($F(1, 317) = 1.30$, $p = .26$), nor recent or lifetime discrimination (Lifetime Discrimination: ($F(1, 317) = 2.60$, $p = .11$); Recent Discrimination: ($F(1, 317) = 0.59$, $p = .44$)). There were significant race differences in cognitive flexibility ($F(4, 314)=7.00$, $p < .001$), inhibitory control ($F(4, 314) = 8.50$, $p < .001$), working memory ($F(4, 314)=3.32$, $p = .01$) as well as lifetime and Recent discrimination (Lifetime Discrimination: $F(4, 314) = 4.78$, $p < .001$; Recent Discrimination: $F(4, 314)= 3.55$, $p < .01$). Consistent with the broader literature on racial differences in reports of discrimination, Black participants reported the most lifetime and recent discrimination in our sample (Luo et al., 2012). There were significant effects of education level on all three core executive functioning measures (Cognitive Flexibility: $F(2, 313) = 3.89$, $p = .02$; Inhibitory Control: FICA: $F(2, 312) = 9.10$, $p < .001$; Working Memory: $F(2,312)=7.91$, $p < .001$) and on recent discrimination ($F(2, 309) = 4.70$, $p < .01$), but not on lifetime discrimination ($F(2, 309) = .06$, $p = .95$). Participants with higher levels of education performed better than those with lower levels of education on all three core executive functioning measures and reported less exposure

to recent discrimination. To evaluate whether this effect may be due to race differences in education level, a chi-square test of independence was conducted to examine the relationship between race and education level. No significant differences in education level by race were found X^2 (8, N = 312) = 14.33, p = .07). Finally, there was a significant effect of sample (college vs. community health center) on cognitive flexibility (F(1, 317) = 29.21, p <.001), inhibitory control (F(1, 312)=63.08, p<.001), working memory (F(1,312)=23.17, p < .001), and recent discrimination (F(1, 317) = 4.00, p < .05), but not on lifetime discrimination (F(1, 317) = .88, p = .35). Specifically, the community health center sample scored significantly lower on all core executive function tests and reported greater experiences of recent discrimination. Consequently, gender, age, race (black vs. other), education level (less than high school vs. all others, college graduate vs. all others) are included as covariates in subsequent analyses.

Sample Differences: Intraclass Correlations

The college and community health center samples significantly differed in scores on core executive functioning measures. We also examined intraclass correlations to determine the extent to which variability among core executive functions was clustered differentially within samples. ICC estimates and their 95% confidence intervals were calculated using a single-rating (i.e., subjects belong to only one dataset) one-way random effects model using PROC MIXED from SAS 9.4. Greater ICC estimates, in this case, reflect greater differences in variability across samples. An ICC value with 95% confidence intervals not including zero was interpreted as indication that participants should be nested within samples on a given measure. ICC was significantly different from zero for cognitive flexibility (0.1623; 95% CI [0.054, 0.268]), inhibitory control

(0.283; 95% CI [0.179, 0.381]), and working memory (0.120; 95% CI [0.011, 0.226). As such, in subsequent analyses the effects of discrimination on core executive functioning were tested in a series of mixed-model regression analyses using PROC MIXED (SAS 9.4) in which participants were nested within samples. To further evaluate whether effects were sensitive to data collection site, we also examined sample as a moderator of relations of discrimination to core executive function in final adjusted models. No significant interaction between lifetime or recent discrimination and sample was observed for the three core executive functioning outcomes.

Due to multi-site data collection, intraclass correlations (ICC) were examined to check for clustering in the data. Following results of ICC analyses, all subsequent analyses were conducted using Proc MIXED in SAS 9.4., treating the data as nested within samples (see Table 2).

Racial Discrimination and Executive Functioning

As shown in Table 2, in unadjusted models there was a significant negative association of recent discrimination to cognitive flexibility (β = -4.49, $t(316) = -2.60$, $p = .010$) and working memory (β = -2.75, $t(316) = -2.26$, $p = .024$), but not to inhibitory control (β = -1.58, $t(316) = -1.04$, $p = .297$). Though estimates were in the same direction as recent discrimination, no significant association of lifetime discrimination to any core executive function was found.

In adjusted models including all covariates, recent discrimination was significantly associated with cognitive flexibility (β = -3.61, $t(309) = -2.06$, $p = .041$). This relation remained significant when lifetime discrimination was added to the adjusted model (β = -4.46, $t(308) = -2.14$, $p = .033$) and when depression was also included (β = -

4.78, $t(306) = -2.19$, $p = .029$). Associations also remained significant in a smaller sample excluding White participants (n=42; $\beta = -3.89$, $t(268) = -2.00$, $p = .046$). The association of recent discrimination to working memory was also significant in the final adjusted model ($\beta = -2.51$, $t(309) = -2.02$, $p = .045$) but not when lifetime discrimination was added to the model ($\beta = -2.74$, $t(308) = -1.82$, $p = .070$).

Moderation Analyses

Zahodne and colleagues (2020) reported prospective associations of discrimination to executive function among older adults (50 years of age and older), but it is not known if these relations will be seen in younger adults. We found the interaction of age in years and recent discrimination was not significant for cognitive flexibility, inhibitory control, or working memory. Given limited power, we divided the sample at the median age (22 years) and found that in the older sample (=> 22 years) recent discrimination was significantly negatively associated with cognitive flexibility ($\beta = -5.42$, $t(147) = -2.11$, $p = .037$) and working memory ($\beta = -3.41$, $t(147) = -2.08$, $p = .039$), but not with inhibitory control, mirroring the overall pattern observed in the full sample.

Given that members of racial/ethnic minority groups face greater exposure to discrimination (Luo et al., 2012), we examined race/ethnicity differences in these effects in two analyses, the first contrasting Latino/a vs. all others and then Black vs. all others (Table 2) adjusting for all covariates. These are the largest groups in the sample. The interaction term between Latino/a vs. not and recent discrimination was significant ($\beta = -10.88$, $t(310) = -2.48$, $p = .014$; Figure 1). Recent discrimination was more strongly negatively associated with cognitive flexibility in Latino/a participants than in others. The

interaction term for Black vs. not and recent discrimination was not significant ($\beta = 3.14$, $t(308) = .87$, $p = .384$).

DISCUSSION

The current study examined relations of recent and lifetime racial discrimination with core executive functions (i.e., cognitive flexibility, inhibitory control, and working memory), as well as the moderating roles of age and race/ethnicity on the association between racial discrimination and three core executive functions. In fully adjusted models, recent discrimination was negatively associated with cognitive flexibility and working memory but not with inhibitory control. The associations of recent discrimination to cognitive flexibility persist independent of the influence of depressive symptoms or exposure to lifetime discrimination and were stronger for those who identified as Latino/a vs. those who did not identify as Latino/a. Associations of recent discrimination with working memory were no longer significant when lifetime discrimination was added to the model. Age did not moderate the association between recent discrimination and any outcome. However, in samples split by the median age, (22 years) analyses revealed negative associations of recent discrimination to cognitive flexibility and working memory were significant only in the older sample. Results support the notion that effects of discrimination on executive functioning may depend on age. Further, this difference may be explained by increasing vulnerability to stress-related changes to executive functioning with age, as studies examining trajectories of executive functioning have identified early adulthood as associated with the beginnings of plateau and decline (Ferguson et al., 2021).

A recent meta-analysis documented consistent adverse effects of acute stress on cognitive flexibility but did not find clear effects of acute stress on inhibitory control (Shields et al., 2016). The results of the current study are consistent with this pattern.

These may be a function of discrimination's effects on social cognition (Brondolo et al., 2018). Exposure to discrimination appears to influence expectations about social situations, with prior discrimination generating increased concerns about other race-related threats. Individuals may allocate cognitive resources to enable them to detect and respond to potential social threats (Lewis et al., 2015). However, the cognitive effort required to evaluate and respond to social threats may come at the expense of cognitive flexibility and working memory, making it more difficult to shift attention away from stressors and enable stress recovery and undermining the capacity to consciously maintain and evaluate long-term goals to inform decision making.

Contrary to our expectations, we did not find an association between lifetime discrimination and executive functioning. This is surprising as Zahodne and colleagues (2020) found that discrimination predicted executive functioning 2-4 years later, offering strong support for persistent effects of discrimination over time. One possible explanation is that lifetime and recent discrimination may operate through different mechanisms. Zahodne et al (2020) report the effect of discrimination on executive function was partially mediated by depression and vascular health, suggesting the possibility of additional mechanisms. It is possible that the effects of lifetime discrimination on executive functioning are moderated by other factors associated with physical health that we did not measure and were not seen in the sample of older adults in our study. Temporary but repeated effects of recent discrimination may produce compounding effects on executive function. Further longitudinal investigation is needed to understand the course and mechanisms of effects of lifetime and recent discrimination on executive functioning.

Moderator analyses revealed a stronger negative association between recent discrimination and cognitive flexibility in Latino/a participants compared with participants not identifying as Latino/a (Table 2). This finding may be explained by potentially compounding effects of negative race-related media communications with interpersonal discrimination. Data for the current study was collected from late 2016 to 2017, a time period marked by frequent negative media portrayals of Latino/a individuals (Hswen et al, 2020). There is evidence to suggest that observing discrimination also impacts mental health and executive functioning, exerting burdens similar to direct exposure (Hswen et al., 2020; Ozier et al., 2019). Though further research is needed, findings may be explained by additional influences on Latino/a participants in our sample, such as observing discrimination or negative race-related sentiment.

Limitations and Future Directions

The findings of the current study should be interpreted in the context of several limitations. All measures of discrimination were self-reported and therefore, are susceptible to recall bias. Future studies should conduct longitudinal investigations to understand the course and mechanisms of discrimination and executive functioning, as discrimination may exert repeated and/or persistent influence over time. Sample size prohibited more detailed comparisons among racial/ethnic groups in the moderation analyses.

Conclusion

Discrimination may impair core executive functions, but further work is warranted to understand the specific type and timing of exposures which influence core executive functions. The current study found that recent racial discrimination was

negatively associated with cognitive flexibility and working memory. This finding has important implications, as identifying core executive functions most readily affected by discrimination can help us design targeted interventions to support specific executive functions (Nguyen et al., 2019). Moreover, depletion of core executive functions secondary to discrimination may undermine coping, stress recovery, and health promoting behavior, contributing to health disparities.

Table 1

Sample Characteristics

Variables:	Full Sample (*n=319*)	Community Health Center Sample (*n=139*)	College Sample (*n=180*)
Age			
[M (SD) Range]	28.79 (13.14) Range: 18-85	40.01 (13.04) Range: 18-85	20.12 (1.57) Range: 18-28
Gender			
Female	*n* = 202; 63.32%	*n* = 94; 67.63%	*n* = 108; 60.00%
Male	*n* = 117; 36.68%	*n* = 45; 32.37%	*n* = 72; 40.00%
Race/Ethnicity			
Asian	*n* = 54; 16.93 %	*n* = 7; 5.04%	*n* = 47; 26.11%
Black	*n* = 111; 34.80%	*n* = 53; 38.13%	*n* = 58; 32.22%
Latino/a	*n* = 82; 25.71%	*n* = 52; 37.41%	*n* = 30; 16.67%
White	*n* = 42; 13.17%	*n* = 9; 6.47%	*n* = 33; 18.33%
Other	*n* = 30; 9.40%	*n* =18; 12.95%	*n* = 12; 6.67%
Education Level			
Less than high school	*n* = 18; 5.77%	*n* = 18; 13.43%	*n* = 0; 0%
High school or some college	*n* = 243; 77.88%	*n* = 85; 63.43%	*n* = 158; 88.76%
College or higher	*n* = 51; 16.35%	*n* = 31; 22.13%	*n* = 20; 11.24%
Discrimination			
Lifetime Discrimination	1.73 (0.61)	1.70 (0.62)	1.76 (0.61)
Recent Discrimination	0.48 (0.64)	0.57 (0.72)	0.42 (0.58)
Executive Functioning			
Dimensional Change Card Sort (DCCS)	102.60 (20.73)	95.75 (22.47)	107.88 (17.61)
Flanker Inhibitory Control & Attention (FICA)	95.93 (18.88)	87.28 (17.77)	102.61 (16.94)
List Sorting Working Memory (LSWM)	91.78 (14.48)	87.63 (14.07)	94.98 (14.01)

†N's may not always add up to total sample N due to missing data.

Table 2

Socio-Demographic Comparisons

Variables	Lifetime Discrimination M (SD)	Recent Discrimination M (SD)	Cognitive Flexibility (DCCS) M (SD)	Working Memory (LSWM) M (SD)	Inhibitory Control (FICA) M (SD)
Gender					
Male	1.80 (.66)	0.52 (.64)	103.00 (20.48)	94.19 (14.50)	97.51 (19.18)
Female	1.69 (.58)	0.46 (.64)	102.37 (20.93)	90.38 (14.32)	95.01 (18.69)
Race/Ethnicity					
Asian	1.68 (.49)	.31 (.54)	110.31 (15.20)	94.29 (14.20)	106.94 (16.44)
Black	1.86 (.57)	.56 (.67)	98.81 (22.11)	90.57 (15.12)	93.33 (19.31)
Latino/a	1.63 (.63)	.45 (.56)	100.90 (20.89)	89.72 (13.55)	93.88 (18.09)
White	1.49 (.61)	.35 (.62)	112.21 (16.26)	97.90 (13.42)	99.62 (17.65)
Other	1.97 (0.78)	.77 (.83)	93.90 (21.42)	88.73 (14.26)	86.17 (16.21)
Education Level					
Less than high school	1.76 (.63)	.92 (.95)	89.39 (23.63)	78.78 (15.93)	77.94 (15.12)
High school/Some college	1.75 (.61)	.48 (.62)	103.86 (20.35)	92.68 (14.18)	97.39 (18.68)
College or Higher	1.72 (.65)	.39 (.59)	103.10 (19.10)	91.20 (13.44)	96.02 (17.63)
Sample					
Community Health Center Sample	1.71 (.62)	.58 (.72)	96.05 (22.20)	87.32 (14.05)	87.23 (17.52)
College Sample	1.77 (.61)	.43 (.58)	108.06 (17.61)	94.88 (13.98)	102.67 (17.01)

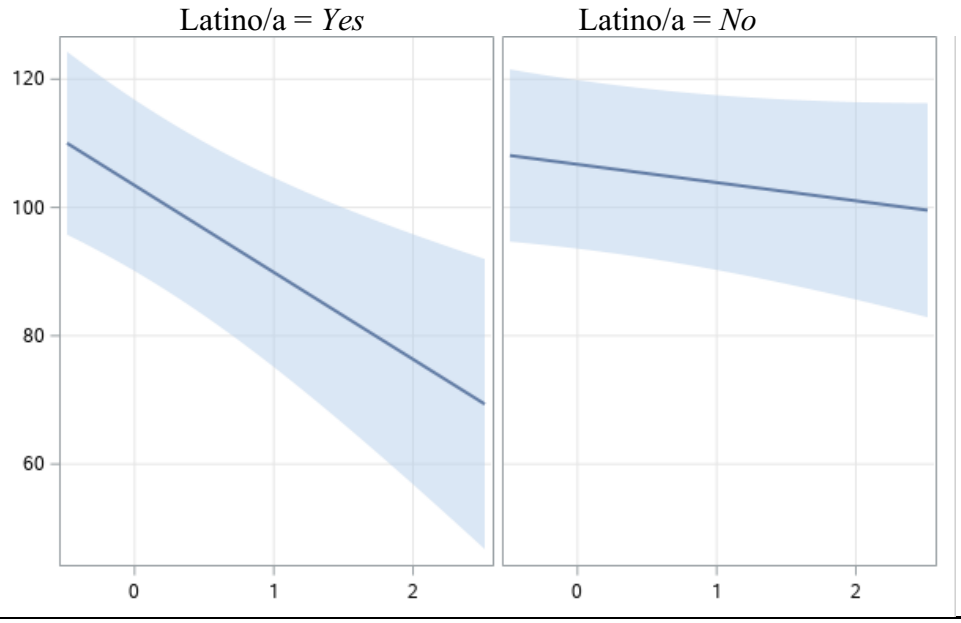
Different subscripts within columns reflect significant differences between groups ($p<.05$).

Table 3
Mixed-Model Regression Analyses

	Unadjusted Models			**Adjusted Models**		
	β	***SE***	***t***	**β**	***SE***	***t***
Cognitive Flexibility (DCCS)						
Past-Week Discrimination	**-3.61****	1.76	-2.06	**-3.61***	1.76	-2.06
Lifetime Discrimination	-2.02	1.82	-1.11	-0.94	1.89	-0.50
Working Memory (LSWM)						
Past-Week Discrimination	**-2.75***	1.22	-2.26	**-2.51***	1.24	-2.02
Lifetime Discrimination	-1.29	1.28	-1.01	-0.72	1.29	-0.56
Inhibitory Control (FICA)						
Past-Week Discrimination	-1.58	1.52	-1.13	-0.66	1.55	-0.43
Lifetime Discrimination	-2.06	1.58	-1.31	-1.76	1.65	-1.07
Moderation Analyses: Race/Ethnicity						
Interaction of Past-Week Discrimination and Latino/a vs. Other: Cognitive Flexibility				**-10.88*****	4.39	-2.48
Interaction of Past-Week Discrimination and Black vs. Other: Cognitive Flexibility				4.37	3.55	1.23
Moderation Analyses: Age						
Interaction of Past-Week Discrimination and Age: Cognitive Flexibility				-0.19	0.13	-1.40
Interaction of Past-Week Discrimination and Age: Working Memory				0.02	0.10	0.21
Interaction of Past-Week Discrimination and Age: Working Memory				-0.12	0.12	-0.97

Figure 1

Moderation by Race/Ethnicity - Latino/a



X axis = Recent Discrimination; Y axis = Cognitive Flexibility (DCCS)

REFERENCES

Adam, E. K., Heissel, J. A., Zeiders, K. H., Richeson, J. A., Ross, E. C., Ehrlich, K. B., Levy, D. J., Kemeny, M., Brodish, A. B., Malanchuk, O., Peck, S. C., Fuller-Rowell, T. E., & Eccles, J. S. (2015). Developmental histories of perceived racial discrimination and diurnal cortisol profiles in adulthood: A 20-year prospective study. Psychoneuroendocrinology, 62, 279–291. https://doi.org/10.1016/j.psyneuen.2015.08.018

Barnes, L. L., Lewis, T. T., Begeny, C. T., Yu, L., Bennett, D. A., & Wilson, R. S. (2012). Perceived discrimination and cognition in older African Americans. Journal of the International Neuropsychological Society: JINS, 18(5), 856.

Blair, I. V., Danyluck, C., Judd, C. M., Manson, S. M., Laudenslager, M. L., Daugherty, S. L., & Brondolo, E. (2020). Validation of the Brief Perceived Ethnic Discrimination Questionnaire–Community Version in American Indians. Cultural Diversity and Ethnic Minority Psychology.

Brondolo, E., Blair, I. V., & Kaur, A. (2018). Biopsychosocial mechanisms linking discrimination to health: A focus on social cognition.

Brondolo, E., Kelly, K. P., Coakley, V., Gordon, T., Thompson, S., Levy, E., & Contrada, R. J. (2005). The perceived ethnic discrimination questionnaire: development and preliminary validation of a community version 1. Journal of applied social psychology, 35(2), 335-365.

Busse, D., Yim, I. S., Campos, B., & Marshburn, C. K. (2017). Discrimination and the HPA axis: current evidence and future directions. Journal of Behavioral Medicine, 40(4), 539-552.

Diamond A. (2013). Executive functions. *Annual review of psychology*, *64*, 135–168.

Eaton, W. W., Smith, C., Ybarra, M., Muntaner, C., & Tien, A. (2004). Center for Epidemiologic Studies Depression Scale: review and revision (CESD and CESD-R).

Ferguson, H. J., Brunsdon, V. E., & Bradford, E. E. (2021). The developmental trajectories of executive function from adolescence to old age. Scientific reports, 11(1), 1-17.

Hswen, Y., Qin, Q., Williams, D. R., Viswanath, K., Subramanian, S. V., & Brownstein, J. S. (2020). Online negative sentiment towards Mexicans and Hispanics and impact on mental well-being: A time-series analysis of social media data during the 2016 United States presidential election. Heliyon, 6(9), e04910.

Inzlicht, M., Mckay, L., Aronson, J. (2006). Stigma as Ego Depletion. Psychological Science, 17(3), 262-269.

Kessler, R. C., Mickelson, K. D., & Williams, D. R. (1999). The Prevalence, Distribution, and Mental Health Correlates of Perceived Discrimination in the United States. Journal of Health and Social Behavior, 40(3), 208. doi:10.2307/2676349

Lewis, T. T., Cogburn, C. D., & Williams, D. R. (2015). Self-reported experiences of discrimination and health: scientific advances, ongoing controversies, and emerging issues. Annual review of clinical psychology, 11, 407-440.

Luo, Y., Xu, J., Granberg, E., & Wentworth, W. M. (2012). A longitudinal study of social status, perceived discrimination, and physical and emotional health among older adults. Research on Aging, 34(3), 275-301.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. Cognitive Psychology, 41, 49–100.

Murphy, M. C., Richeson, J. A., Shelton, J. N., Rheinschmidt, M. L., & Bergsieker, H. B. (2013). Cognitive costs of contemporary prejudice. Group Processes & Intergroup Relations, 16(5), 560-571.

Nguyen, L., Murphy, K., & Andrews, G. (2019). Cognitive and neural plasticity in old age: A systematic review of evidence from executive functions cognitive training. Ageing research reviews, 53, 100912.

Ozier, E. M., Taylor, V. J., & Murphy, M. C. (2019). The Cognitive Effects of Experiencing and Observing Subtle Racial Discrimination. Journal of Social Issues.

Plieger, T., & Reuter, M. (2020). Stress & executive functioning: a review considering moderating factors. Neurobiology of Learning and Memory, 173, 107254.

Salvatore, J., & Shelton, J. N. (2007). Cognitive Costs of Exposure to Racial Prejudice. Psychological Science, 18(9), 810–815.

Shields, G. S., Sazma, M. A., & Yonelinas, A. P. (2016). The effects of acute stress on core executive functions: A meta-analysis and comparison with cortisol. Neuroscience & Biobehavioral Reviews, 68, 651-668.

Stilley, C. S., Bender, C. M., Dunbar-Jacob, J., Sereika, S., & Ryan, C. M. (2010). The impact of cognitive function on medication management: three studies. Health Psychology, 29(1)

Thames, A. D., Hinkin, C. H., Byrd, D. A., Bilder, R. M., Duff, K. J., Mindt, M. R., ... & Streiff, V. (2013). Effects of stereotype threat, perceived discrimination, and examiner race on neuropsychological performance: simple as black and white? Journal of the International Neuropsychological Society: JINS, 19(5), 583.

Williams, P. G., Tinajero, R., & Suchy, Y. (2017). Executive functioning and health. Oxford Handbooks Online.

Zahodne, L. B., Morris, E. P., Sharifian, N., Zaheed, A. B., Kraal, A. Z., & Sol, K. (2020). Everyday discrimination and subsequent cognitive abilities across five domains. Neuropsychology, 34(7), 783.

Zelazo, P. D., Anderson, J. E., Richler, J., Wallner-Allen, K., Beaumont, J. L., & Weintraub, S. (2014). II. NIH Toolbox Cognition Battery (CB): Measuring executive function and attention. Monographs of the Society for Research in Child Development, 78(4), 16

Vita

Name	*Luke H. Keating*
Baccalaureate Degree	*Bachelor of Arts*, *St. John's University, Jamaica, NY* *Major:Psychology*
Date Graduated	*December, 2016*