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Abstract

Racial discrimination contributes to stress-related health disparities among African Americans, but less is known about the acute effects of racial exclusion on the hypo-pituitary-adrenocortical response and psychological mediators. Participants were 276 Black/African American emerging-adults (54% female; M_{age} = 21.74, *SD* = 2.21) who were randomly assigned to be excluded or included by White peers via the game Cyberball. Racial exclusion (vs. inclusion) predicted: greater negative affect ($F(1, 276) = 104.885$, $p < .0001$), lower perceived control ($F(1, 276) = 205.523$, $p < .0001$), and greater cortisol release ($F(1, 274) = 4.575$, $p = .033$). Racial exclusion's impact on cortisol release was mediated by lower perceived control (95% CI: .027, .112), but not negative affect (-.041, .013). These findings suggest that racial exclusion contributes to acute cortisol release, and that reduced perceived control is a consequence of racial discrimination that has important implications for the health of those who experience discrimination.

Keywords: Racial discrimination, exclusion, cortisol, negative affect, perceived control, Cyberball

Racial Exclusion Causes Acute Cortisol Release among Emerging-Adult African Americans: The Role of Reduced Perceived Control

There are vast racial health disparities for illness and mortality for Blacks (or African Americans[1]) in the United States, with Blacks experiencing disproportionate disease burden compared to Whites (National Center for Health Statistics, 2016). These disparities are particularly evident for stress-related illnesses (e.g., heart disease, stroke; American Psychological Association Working Group on Stress and Health Disparities, 2017; National Center for Health Statistics, 2016). According to the weathering perspective (Geronimus, 1992), disparities emerge "upstream" in stress-related subclinical health indicators (e.g., cardiovascular intima media thickness, Peterson, Matthews, Derby, Bromberger, & Thurston, 2016; diurnal cortisol slope, Peterson et al., 2017). Nationally representative samples of generally healthy adults demonstrate that Blacks have higher allostatic load compared to Whites, and these disparities are already present in emerging adulthood (Beckie, 2012; Geronimus, Hicken, Keene, & Bound, 2006). Collectively, morbidity and subclinical racial disparities persist even when controlling for socioeconomic status (Geronimus et al., 2006; Williams, Priest, & Anderson, 2016).

The social experience of race in America is an important risk-factor for disproportionate stress-related illness among Blacks, and a higher proportion of Black adults report experiencing racial discrimination compared to other racial/ethnic groups (Borrell et al., 2010). Racial discrimination presents unique challenges for Blacks during emerging adulthood (Hope, Hoggard, & Thomas, 2015). Black and African American college students, in particular, report

[1] When discussing past research, we typically use the racial or ethnic identity term that was used by study authors. By switching between African American and Black, we do not mean to imply that these terms are interchangeable as there is variation in identity (Thompson & Akbar, 2003).

greater experienced discrimination compared to other racial and ethnic groups (Gomez, Miranda, & Polanco, 2011; Tropp, Hawi, Van Laar, & Levin, 2012). Of various forms of racial discrimination, social exclusion is the most frequently reported by Blacks (Brondolo et al., 2011). For example, over 86% of African American college students reported *being ignored, overlooked, or not given service* over the course of college (Sellers & Shelton, 2003). Termed *race-related exclusion,* Brondolo and colleagues demonstrated that this form of racial discrimination contributes uniquely to lower self-rated health via increases in state negative affect (i.e., depression, anxiety, and cynical hostility, Brondolo et al., 2011).

Racial discrimination against Blacks is increasing online (Williams & Medlock, 2017); by adolescence, 32% of African American youth report an online experience of racial discrimination ranging from microaggressions, to exclusion, to hate speech (Tynes, Lozada, Smith, & Stewart, 2018; Tynes, Umana-Taylor, Rose, Lin, & Anderson, 2012). However, more research exploring the impact of online racial discrimination is needed in developmental periods other than adolescence (Lewis, Cogburn, & Williams, 2015). More generally, lab studies have demonstrated that online social exclusion elicits negative emotions both when hypothetically excluded by friends (Covert & Stefanone, 2018) and when excluded by confederate strangers (Gross, 2009). Extensive research using the ostracism paradigm Cyberball demonstrates that online exclusion results in negative emotions (Williams, 2009).

Racial Discrimination and the Hypothalamic-pituitary-adrenocortical Response

Perceived racial discrimination is associated with poorer health, including heightened physiological stress response (Paradies et al., 2015; Pascoe & Smart Richman, 2009; Williams & Mohammed, 2009). One pathway through which racial discrimination may impact physiological health outcomes is activation of the hypothalamic-pituitary-adrenocortical axis (Harrell et al.,

2011; Lockwood, Marsland, Matthews, & Gianaros, 2018). Precedent from the stress literature indicates that social stressors, in particular social exclusion, activate a host of neurobiological changes, preparing an individual to adapt to threat (Dickerson & Zoccola, 2013). Hypothalamic-pituitary-adrenocortical axis activation manifests in increased output of cortisol, a hormone secreted by the adrenal cortex. The acute cortisol stress-response influences cardiovascular, inflammatory, and immune physiological responses to efficiently react to an immediate stressor (Mills & Ziegler, 2008; Tsigos & Chrousos, 2002). While acutely adaptive, chronic dysregulation of diurnal cortisol has been linked to morbidity (Adam et al., 2017) and increased risk of all-cause mortality (deaths primarily due to cardiovascular causes, Kumari, Shipley, Stafford, & Kivimaki, 2011).

Racial discrimination relates prospectively to hypothalamic-pituitary-adrenocortical axis dysregulation (Busse, Yim, Campos, & Marshburn, 2017; Korous, Causadias, & Casper, 2017; Lockwood et al., 2018). Higher racial discrimination across adolescent development is associated with higher allostatic load and flatter cortisol slope for Black adults (Adam et al., 2015; Brody et al., 2014). Racial discrimination and cortisol are also positively related among emerging-adult African Americans cross-sectionally (Jackson, Shestov, & Saadatmand, 2017). In sum, research has demonstrated that social exclusion and perceived racial discrimination associate with hypo-pituitary-adrenocortical axis dysregulation. Although cross-sectional and longitudinal findings suggest a directional association between racial discrimination and cortisol dynamics, very little is known about whether racial exclusion *causes* cortisol release. Researchers have identified a need for experimental manipulations of discrimination to causally assess its impact on cortisol (Busse et al., 2017; Lockwood et al., 2018).

The Effects of Social Exclusion and Racial Discrimination on Cortisol Release in the Lab

Several previous studies have demonstrated that social exclusion results in an automatic stress response (Eisenberger, Lieberman, & Williams, 2003; Williams, 2007), activating cortisol release (for a review, see Dickerson & Zoccola, 2013). Exclusion manipulations that are *uncontrollable* typically demonstrate more robust cortisol release (Dickerson & Zoccola, 2013). One experimental paradigm that invokes uncontrollable social exclusion online is Cyberball. Cyberball was initially developed to investigate online ostracism and involves an online game of catch where the participant, believing themselves to be playing with other participants over a web-interface, are either excluded or included via preprogrammed tossing responses by "other players" (Williams & Jarvis, 2006). More recent adaptations allow researchers to invoke appearance-based attributions for exclusion by uploading photos of the "other players" along with the participant's photo for the "other players" to "see." Cyberball has been used in this way to examine the effects of acute discrimination (via racial exclusion) on risky health cognitions in Black samples (Stock, Peterson, Gibbons, & Gerrard, 2013; Stock, Peterson, Molloy, & Lambert, 2017), but we are unaware of any research that used Cyberball to examine the effects of racial exclusion (i.e., participants are excluded by confederate players of a different race) on cortisol release.

A separate, but related collection of studies has explored discrimination's influence on cortisol release in the laboratory. For racial discrimination, acute manipulations usually employ *explicit* racial or ethnic discrimination (Busse et al., 2017; Korous et al., 2017). For example, in a study of Latina/o emerging-adults, participants engaged in the Trier Social Stress Test and gave speeches to White confederates describing why they would be good candidates for a job (Huynh, Huynh, & Stein, 2017). The participants randomly assigned to hear the confederates make a negative, discriminatory remark about a Latino classmate (discrimination condition) had greater

cortisol release than participants randomly assigned to hear the confederates discuss a classmate in a neutral manner (control condition, Huynh et al., 2017). A meta-analysis of similar experiments revealed that lab-manipulated explicit racial or ethnic discrimination related to cortisol release with a large overall effect size, but none of the studies investigated an exclusively Black sample (Korous et al., 2017).

Exposure to vicarious racism outside the lab elicited a reactive cortisol profile; lab-based cortisol stress responses were more pronounced among African American college students after widespread news of a racist campus incident was nationally publicized compared to students who participated in the study prior to the scandal (Smart Richman & Jonassaint, 2008). Collectively, experimental (Korous et al., 2017) and historical (Smart Richman & Jonassaint, 2008) research on discrimination suggests that explicit racial discrimination impacts cortisol release. However, no research has explicitly examined how racial exclusion relates to acute cortisol reactivity among Blacks. Further experimental work is needed to directly test whether racial exclusion (i.e., White-perpetrated exclusion versus inclusion) causes a cortisol response and what psychological factors drive this relationship.

Potential Psychological Mediators of Racial Exclusion and Cortisol Release

Lockwood and colleagues (2018) have proposed a conceptual model where psychosocial factors, such as distress or negative affect, mediate the impact of discrimination on the hypo-pituitary-adrenocortical axis. Based on substantial longitudinal research, Lockwood and colleagues (2018) issued a call to increase research experimentally investigating the mediators through which discrimination impacts the acute hypo-pituitary-adrenocortical response in efforts to both enhance understanding of *how* discrimination influences health outcomes and to better target potential interventions. Two mediating processes that have been studied more extensively

in the relationship between discrimination and risky health behavior include increases in negative affect and reduced perceived control (Gibbons & Stock, 2018), and emerging theoretical perspective argues that social cognitions should be investigated as potential mediators to the stress-response that results from discrimination, in addition to affect (Brondolo, Blair, & Kaur, 2018).

Negative affect. Social exclusion results in heightened feelings of negative affect (Blackhart, Nelson, Knowles, & Baumeister, 2009), including increases in state sadness and anger for participants excluded in the Cyberball paradigm (Williams, 2009). The multimodal model of social exclusion explores commonalities across forms of rejection, including social exclusion and racial discrimination, in that they lead to negative affect, but posits that social exclusion based on identifiable group membership (e.g., racial discrimination) is more likely to result in feelings of anger compared to other forms of social exclusion (Smart Richman & Leary, 2009). Cross-sectional and longitudinal studies with large samples demonstrate that racial discrimination is related to psychological distress among Black Americans (e.g., Broman, Mavaddat, & Hsu, 2000; Brown et al., 2000) as well as depressive symptoms (Kogan, Yu, Allen, & Brody, 2015) and anger among African American adolescents (Gibbons et al., 2012). Similarly, studies have shown that perceived racial discrimination is positively associated with both trait (Brondolo et al., 2008; Hatzenbuehler, Corbin, & Fromme, 2011) and state measures of negative affect including daily-diary ratings in multiethnic adult (Brondolo et al., 2008; Broudy et al., 2007) and emerging-adult African American (Peterson, Joseph, Gordon, & Kamarck, 2019) samples.

To our knowledge, only three studies have examined the relationships between perceived discrimination, negative affect, and cortisol dynamics. Negative affect was associated with

increased levels of cortisol among adolescents and this relationship was stronger for adolescents who reported greater (vs. lower) perceived discrimination (Doane & Zeiders, 2014). Greater perceived discrimination and anger partially accounted for greater allostatic load (with cortisol as a biomarker) among African Americans compared to White Americans (Tomfohr, Pung, & Dimsdale, 2016). Lastly, greater perceived discrimination associated with greater anxiety and, in turn, greater total cortisol concentration among emerging-adult African Americans (Lee et al., 2018), but the relationship between racial exclusion, negative affect, and cortisol release have not been explored experimentally.

Perceived control. Recent theoretical perspective on racial discrimination points to social cognitive factors, such as depleted feelings of control or mastery, as an important, yet understudied, mediating process linking racial discrimination and negative health outcomes (Brondolo et al., 2018; Broman et al., 2000; Williams & Mohammed, 2009). Racial discrimination may have a particular deleterious effect on perceived control among Blacks in the United States (Broman et al., 2000; Brondolo et al., 2018; Williams & Mohammed, 2009). Perceived control refers to the belief that one has power over their internal states and behavior and can influence their environment to bring about desired outcomes (Wallston, Wallston, Smith, & Dobbins, 1987). Social exclusion threatens perceived control, considered a fundamental human need (Williams, 2007; Williams & Nida, 2011). Several studies have found that general experiences of discrimination (Jang, Chiriboga, Kim, & Rhew, 2010; Jang, Chiriboga, & Small, 2008) and racially-driven discrimination (Moradi & Hasan, 2004; Moradi & Risco, 2006) are associated with lower perceptions of control. Discrimination was associated with reduced self-control cross-sectionally among African American male adolescents (Kogan et al., 2015) and

prospectively over the course of 8 years among African American children transitioning to older adolescence (Gibbons et al., 2012).

Experimental research examining racial exclusion dovetails these findings, as research from the present dataset demonstrated that acute racial exclusion resulted in reduced perceived control (Stock et al., 2017). This has also been replicated in the momentary level using ecological momentary assessment. Discrimination experienced in a daily-life moments associated with reduced momentary psychosocial resources, including state control, in a sample of emerging-adult African Americans (Peterson, Joseph, et al., 2019). In terms of cortisol, lower trait perceived control and mastery is related to flatter (blunted) diurnal cortisol decline (Cohen et al., 2006). Social-evaluative manipulations that involve uncontrollable features are associated with the greatest cortisol release (Dickerson & Kemeny, 2004), but no research that we are aware of has explored the relation between racial exclusion, perceived control, and cortisol release.

The Present Study

Taken together, research indicates that discrimination may result in dysregulation of cortisol over time (e.g., Adam et al., 2015), but little research has explored this relationship causally. Additionally, it is important to investigate the psychological factors that may mediate this relationship (Lockwood et al., 2018). We examined whether inclusion or exclusion by Whites via Cyberball influenced cortisol release among Black emerging-adults. We hypothesized that racial exclusion would result in greater cortisol release, negative affect, and lower perceived control, and explored whether negative affect or perceived control mediated any relationship between racial exclusion and cortisol release.

Method

Participants

Participants were recruited throughout the Washington, D.C. metropolitan area via online and paper flier advertisements; they were told the study concerned the relations among health, stress, personality, and the social environment. Three hundred individuals met the criteria for participation (self-identified as African American or Black, ages 18 to 25) and enrolled in the study. Eleven individuals did not accurately complete each phase of the study to allow for examination of the Cyberball manipulation on the dependent variables (e.g., participant began the Cyberball phase of the protocol before the experimenter explained the game). Of the remaining 289 participants, 13 were not included due to calculation issues with cortisol (e.g., 2 participants produced too little saliva to perform the immunoassay, 3 participants were not included due to outlier cortisol readings greater than 3 standard deviations above the mean [> 3.7 ug/dL]). The remaining 276 emerging-adults (54% female; M_{age} = 21.74, *SD* = 2.21) comprise the study sample.

Procedure

Following a screening call, participants were scheduled for laboratory appointments. To minimize the effect of circadian fluctuations on salivary cortisol levels, appointments were scheduled between 12pm and 6pm and participants were instructed to refrain from smoking and tobacco, alcohol, caffeine, and moderate and vigorous exercise the day of their appointment and to refrain from all eating and drinking (besides water) an hour before their appointment.

Informed consent was obtained and then participants engaged in a 15-minute rest period, after which baseline cortisol levels were measured. Salivary cortisol samples were obtained because levels measured in saliva closely match the amount of free cortisol in blood, yet allow for samples to be collected repeatedly, in a convenient, non-invasive manner (Dickerson & Kemeny, 2004; Riad-Fahmy, Read, & Walker, 1983). To collect the saliva sample, participants

were instructed to place an oral swab underneath their tongue for 90 seconds, while being timed by the research assistant (Beltzer et al., 2010). This method follows past research demonstrating that optimal cortisol detection occurs in the saliva in the sublingual gland area under the tongue (for a review, see Granger, Fortunato, Beltzer, & Virag, 2012). After the sample was collected, participants placed the swab in a marked tube, and the sample was immediately placed in a freezer set to -20°C.

Next participants filled out a survey on the computer, via Medialab (Jarvis, 2008), to measure demographic variables, cortisol control variables, as well as additional measures intended for a separate study. Participants then played a modified version of Cyberball (Stock, Gibbons, Walsh, & Gerrard, 2011). The research assistant took a photograph of the participant, who was led to believe that the image would be uploaded onto the game for the "other players" to see. Participants were shown bogus photos of the "other players" who were all White same-gender 18 to 25 year-olds. Participants were randomly assigned to be included or excluded during the game. Included participants (n = 134) received the ball 25% of the time; in the racial exclusion condition (n = 142), participants were tossed the ball twice at the beginning of the game and never again for the remainder of the game.

Research assistants obtained a second cortisol sample 15 minutes after the participant completed the Cyberball game (Adam, Hoyt, & Granger, 2011). Participants then completed measures on perceived control and negative affect as well as manipulation checks. Finally, participants were debriefed and paid $50 for their time.

Measures

Pre-manipulation measures.

Demographics. Participants reported their: gender (0 = *male*, 1 = *female*), age, relationship status (1 - 8 scale, verbally anchored as: 1 = *no relationship*, 3 = *minimal commitment*, 5 = *some commitment*, 7 = *very strong commitment*, 8 = *married*), and if they were currently enrolled in school (0 = *no*, 1 = *yes*).

Cortisol controls. Participants were asked whether they had eaten or drunk anything other than water in the past hour, consumed caffeine or alcohol, or used tobacco, or engaged in moderate or high intensity exercise that day. Participants were also asked whether they themselves were currently using hormonal contraception or pregnant. All participant responses were coded as 0 and 1, with 1 indicating the presence of a "yes" response.

Post-manipulation measures.

Negative affect. Participants responded to 14 items assessing negative affect after the game (e.g., "I felt angry" and "I felt sad," Williams, 2009). Participants responded on a scale of 1 = *not at all* to 5 = *extremely*; items factored together and were reliable ($\alpha = .96$) and were averaged together to create a construct with higher numbers indicative of greater negative affect.

Perceived control. Participants indicated how in control they felt during the game using five items (e.g., "I felt powerful," Williams, 2009). Participants responded on a scale from 1 = *not at all* to 5 = *extremely*. The five items factored together with high reliability ($\alpha = .82$) and were averaged to create a construct with higher numbers representing greater perceived control.

Cortisol analysis. Salivary cortisol samples were sent, on dry ice, to Salimetrics© for analysis. All saliva samples were stored at -20°C until assayed. An enzyme immunoassay method was used to determine pre- and post-manipulation salivary cortisol levels. This method was chosen because it used a chemical matrix which accommodated the use of saliva. Saliva was thawed, vortexed, and centrifuged for 15 minutes. Once analyzed, Salimetrics© returned the raw

data, including pre-manipulation cortisol level and post-manipulation cortisol level (ug/dL). Pre-manipulation and post-manipulation cortisol values were standardized (z-scored) so they could be compared. Cortisol response was calculated by subtracting pre-manipulation cortisol levels from post-manipulation levels, higher numbers indicate more pronounced cortisol release (Jamieson, Koslov, Nock, & Mendes, 2013; Townsend, Eliezer, Major, & Mendes, 2014).

Manipulation checks. To examine if the Cyberball manipulation resulted in feelings of *perceived discrimination,* participants were asked: "To what extent do you feel your inclusion or exclusion was due to your…race?"; an additional item was: "To what extent do you feel you were being discriminated against based on your race?" (1 = *not at all* to 7 = *very much*); these items were averaged (r = .83, p < .001; Stock et al., 2011).

Results

Means and Correlations

Table 1 presents the means, standard deviations, and correlations for the primary measures. The majority of participants were enrolled in school (59.4%). 39.1% were not in a relationship. The bivariate relationships among primary measures were assessed using Pearson's correlation (Table 1). Female participants reported lower perceived control during the Cyberball game (r = -.14, p = .02). Younger participants reported lower perceived control (r = .12, p = .043) and higher perceived discrimination (r = -.13, p = .031). Participants in more serious relationships tended to have a more pronounced cortisol release (r =.14, p = .023). Perceived discrimination was significantly associated with higher negative affect (r = .61, p < .001) and lower perceived control (r = -.51, p < .001), but not cortisol release (p = .37).[2] Negative affect and perceived control were inversely correlated (r = -.64, p < .001).

[2] The null correlation between discrimination and cortisol release was somewhat surprising, but these results included both conditions. Disaggregating the sample by condition, the null result persisted within both the inclusion (p = .621) and the

Manipulation Check and Randomization Check

To examine whether Cyberball elicited racially-attributed exclusion, an ANOVA was run examining the main effect of condition (0 = inclusion, 1 = exclusion). Excluded participants reported greater discrimination (M = 4.440, SE = .148) than included participants (M = 2.239, SE = .153; $F(1, 276) = 107.051$, $p < .001$, $\eta_p^2 = .281$; Stock et al., 2011, 2013).[3] Randomization effects for pre-manipulation cortisol did not emerge between participants who ended up being assigned to the inclusion and exclusion condition (p = .866).

Statistical Analysis

A series of Bonferroni-adjusted GLM ANCOVAs were conducted to examine the impact of racial exclusion on perceived control, negative affect, and cortisol response. Putative demographic controls were examined, and gender, age, and relationship status were included in the final analyses because they associated with dependent variables at the $p < .10$ level (see Table 1).[4] Cortisol response analysis controlled for additional factors known to influence cortisol (see pre-manipulation measures).

Effects of Racial Exclusion

Negative affect. Gender, age, and relationship status were not significantly associated with negative affect (ps > .177). Excluded participants reported more negative affect (M = 2.538,

exclusion (p = .758) condition. However, among the subsample of participants who acknowledged experiencing some discrimination (at least a "3" on the scale of perceived discrimination) the relation between perceived discrimination and cortisol release was marginally significant such that greater perceived discrimination trended with greater cortisol release (r = .16, p = .06).

[3] The functional results for the manipulation check were the same when controlling for gender and age ($p < .001$).

[4] Although school enrollment did not emerge as a putative demographic control, the main analyses examining the effect of racial inclusion/exclusion condition on dependent variables were reanalyzed adding school enrollment as a control variable. Results were functionally the same (i.e., significance and direction of significant relationships) for all analyses (negative mood, perceived control, and cortisol release), so the results presented here do not include school enrollment as a control variable.

SE = .072) than included participants (*M* = 1.476, SE = .074; *F*(1, 276) = 104.885, *p* < .0001, η_p^2 = .279).[5]

Perceived control. Females reported less perceived control than males (*b* = -.252, *t* = -2.827, *p* = .005); age and relationship status did not emerge as significantly associated with perceived control (*p*s > .181). In a similar pattern to negative affect, excluded participants reported less control (*M* = 1.759, *SE* = .060) than included participants (*M* = 3.004, *SE* = .062; *F*(1, 276) = 205.523, *p* < .0001, η_p^2 = .431).

Cortisol release. Eating or drinking other than water in the past hour, along with the day's caffeine use, alcohol use, tobacco use, and moderate or intense exercise, and current contraceptive use and pregnancy status were controlled for in addition to gender, age, and relationship status. Tobacco use that day (0 = *no use*, 1 = *use*) was associated with a blunted cortisol response (*b* = -.161, *t* = -2.133, *p* = .034). For demographic variables, a more pronounced cortisol response was significantly related to being in a more committed relationship (*b* = .015, *t* = 2.391, *p* = .018), but was not significantly related to either age (*p* = .117) or gender (*p* = .947). As hypothesized, excluded participants had greater cortisol output (*M* = .012, *SE* = .020) than included participants (*M* = -.050, SE = .021; *F*(1, 274) = 4.575, *p* = .033, η_p^2 = .017).[6] [7]

Mediation

To examine whether the significant effect of racial exclusion on cortisol release was mediated by negative affect or perceived control, a bootstrap test of multiple mediation (Preacher

[5] Negative mood analyses were also conducted separately for emotions related to anger (angry, upset, mad, tense) and sadness (hopeless, sad, helpless). Results were functionally the same (i.e., significance and direction of significant relationships). The similar results along with the single factor for the negative mood item indicate that anger and sadness are not distinct constructs. Therefore, the composite negative mood item results were reported here.

[6] Due to the high number of cortisol-related controls, the analysis was reexamined eliminating all cortisol controls except for tobacco use. The functional results (i.e., significance and direction of significant relationships) were the same for both analyses. Therefore, the results using all controls were reported here.

[7] The three main analyses (GLM ANCOVAS) examining negative affect, perceived control, and cortisol release were reexamined including a gender interaction term (gender X exclusion condition) and no evidence of gender moderation emerged across the three analyses (*p*s > .10).

& Hayes, 2008) using the PROCESS macro in SPSS (Hayes, 2012; Model 4) was conducted. Both of the potential mediators were examined together in the same model and both direct and indirect effects were examined. Gender, age, relationship status, and cortisol controls (eating or drinking other than water in the hour prior to the appointment, day's caffeine use, alcohol use, tobacco use, and moderate or intense exercise, and current contraceptive use and pregnancy status) were included as covariates. Results from the bootstrapping procedure using 1000 resamples revealed that, as expected, exclusion predicted lower perceived control and greater negative affect (*p*s < .001; see Figure 1). Only perceived control was a significant predictor of cortisol response (t = -2.25; CI = -.09, -.01; p < .03). In addition, the bias-corrected 95% CI for the indirect effect of perceived control on cortisol response did not contain zero (.027, .112). No indirect effect of negative affect was found (-.041, .013). Thus, the relation between racial exclusion and cortisol release was mediated only by reduced perceived control.

Table 1

Means, Standard Deviations, and Correlations for Primary Study Variables

	1	2	3	4	5	6	7	8
1. Gender	--							
2. Age	-.16**	--						
3. Relationship status	.16*	.09	--					
4. Condition	.02	-.09	-.04	--				
5. Perceived discrimination	.09	-.13*	-.01	.53***	--			
6. Negative affect	.06	-.02	.06	.53***	.58***	--		
7. Perceived control	-.14*	.12*	.07	-.66***	-.51***	-.59***	--	
8. Cortisol difference score	.003	.10	.14*	.13*	.06	.08	-.16**	-
M	-	21.74	3.55	-	3.37	2.02	2.36	-.02
SD	-	2.21	2.46	-	2.10	1.00	.96	.24
Observed Min	-	18	1	-	1.00	1.00	1.00	-2.84
Observed Max	-	25	8	-	7.00	5.00	5.00	.27

***** $p < .05$ ** $p < .01$ *** $p < .001$

Table note. gender (0 = *male*, 1 = *female*); currently enrolled in school (0 = *no*, 1 = *yes*); condition (0 = *inclusion*, 1 = *exclusion*)

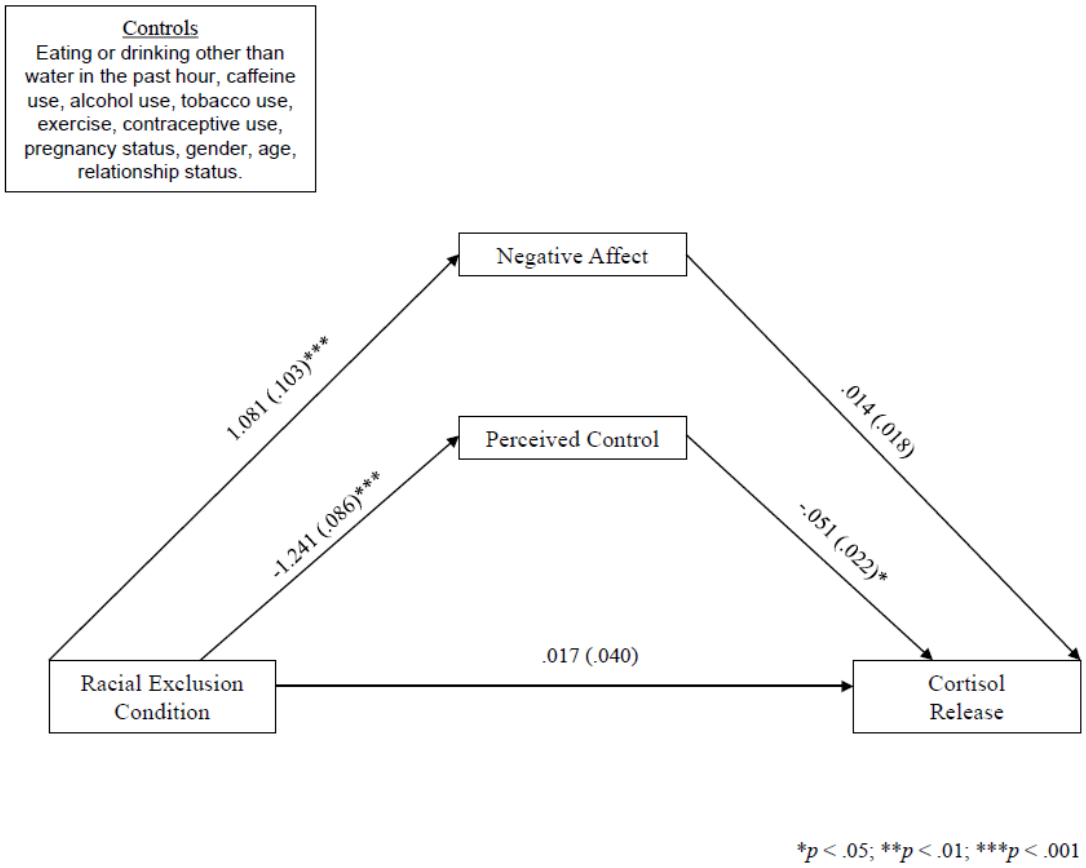

Figure 1. Perceived control, but not negative affect, mediates the relationship between racial exclusion and cortisol release.

Discussion

The results of the present study show that emerging-adult Blacks experienced greater cortisol release after racial exclusion (perceived as racial discrimination) compared to inclusion. Racial exclusion was attributed to discrimination and resulted in greater negative affect and lower perceived control. These results were present when taking age, gender, school status, and relationship status into account. To our knowledge, this is the first study that experimentally examined the influence of White-perpetrated racial exclusion on cortisol release among Black participants. Additionally, results revealed that *reduced perceived control,* but not increased negative affect, mediated the relation between experiencing racial exclusion and cortisol release.

Racial Exclusion is Associated with Cortisol Release

Both social exclusion and racial discrimination activate a host of neurobiological changes, influencing the hypothalamic-pituitary-adrenocortical axis and preparing an individual to adapt to threat (Dickerson & Zoccola, 2013; Korous et al., 2017). The present results extend this research in two ways. First, previous research indicates that racial discrimination is associated with dysregulation of the hypothalamic-pituitary-adrenocortical axis over time (Busse et al., 2017; Lockwood et al., 2018). Among African American older adolescents and emerging-adults, research studies have demonstrated cross-sectional (Jackson et al., 2017) and longitudinal (Adam et al., 2015) relations between perceived discrimination and cortisol indicators. The present results provide further *causal* evidence that racial exclusion can *lead to* acute hypothalamic-pituitary-adrenocortical axis effects among emerging-adult Blacks.

Second, *explicit* discrimination associated with a large effect in acute cortisol release across four studies of racial minorities (Korous et al., 2017). The results from the present study parallel and extend these findings, demonstrating that cortisol release occurs due to another form

of discrimination, non-verbal racial exclusion online. Importantly, the present results demonstrate that racial discrimination need not be verbal, chronic, nor in-person, to impact the hypothalamic-pituitary-adrenocortical axis response.

The role of negative affect and perceived control. The present results also add to the research on psychological responses to racial exclusion. Racial exclusion was associated with greater negative affect among Blacks compared to inclusion, which parallels earlier research (Broman et al., 2000; Brown et al., 2000; Gibbons et al., 2012; Kogan et al., 2015), but demonstrates this relationship experimentally in an emerging-adult Black sample. While there is extensive research on increased negative affect due to discrimination, there is less empirical research on the relationship between Blacks' experiences of discrimination and perceived control. Cross-sectional studies have shown that greater discrimination is associated with lower perceptions of control (Jang et al., 2010, 2008; Moradi & Risco, 2006) and a handful of studies have demonstrated similar effects for racial discrimination in exclusively Black samples (Broman et al., 2000; Gibbons et al., 2012). Along with our former publication using this sample (Stock et al., 2017), the present results are some of the first that provide experimental evidence that discrimination against Blacks results in reduced perceived control. More research should include feelings of control, in addition to negative affect, as a psychological consequence of racial discrimination in efforts to better understand whether different forms of discrimination (e.g., institutional versus interpersonal) are more or less likely to deplete perceived control.

This is the first study to examine both negative affect and perceived control as mediators between discrimination and cortisol response and only perceived control led to cortisol release. Past correlational research demonstrates that negative affect mediates the relation between perceived race-based social exclusion and self-rated health (Brondolo et al., 2011) and both

negative affect and depleted perceived control mediate the relation between discrimination and substance use (Gibbons et al., 2012). While both negative affect and reduced perceived control are painful experiences, perceived control is considered a fundamental human need and may be more likely to invoke concerns that lead to hypo-pituitary-adrenocortical response, an evolutionary neurobiological sensitivity to *threat* of self-preservation, safety, and goal attainment (Broman et al., 2000; Brondolo et al., 2018; Dickerson & Kemeny, 2004; Williams & Mohammed, 2009). Research on diurnal cortisol typically includes negative affect and depression (e.g., Adam et al., 2017; Miller et al., 2016), but the few studies that capture positive wellbeing, such as trait control, show that it is associated with healthier cortisol rhythms (Cohen et al., 2006; Miller et al., 2016). The present results highlight the importance of reduced perceived control as a health risk pathway due to discrimination against Blacks and are important in the greater research conversation surrounding wellbeing, including autonomy and mastery, as essential to healthy neuroendocrine functioning (Steptoe, 2019).

Limitations

Although a strength of the present study was comparing resting cortisol and cortisol response to the Cyberball stressor, the cortisol sampling is still limited. For example, collecting two cortisol measurements prevents observations of rate of recovery after exposure to the stressor and the length of time that cortisol levels remained elevated is unknown. Further investigation using area-under-the-curve methods to capture sustained reactivity or delayed recovery period following the discriminatory experience would provide insight into the potential long-term consequences of discrimination on hypo-pituitary-adrenocortical axis function and recovery (see Helpman, Penso, Zagoory-Sharon, Feldman, & Gilboa-Schechtman, 2017; Park, Flores, Aschbacher, & Mendes, 2018). Blunted cortisol responses are evident among individuals

who have faced longitudinal trauma (e.g., war survivors; Miller, Chen, & Zhou, 2007). Future research could expand this inquiry to research on racial discrimination and investigate whether racial trauma (e.g., racial violence; see Williams, Metzger, Leins, & DeLapp, 2018) results in blunted cortisol response to acute racial exclusion.

This study examined racial exclusion and, like previous research using this experimental paradigm, participants attributed the exclusion to racial discrimination (Stock et al., 2011, 2013), showing the effects were driven by discrimination rather than ostracism alone. However, without a same-race condition, we are unable to experimentally compare the effects of same versus other-race exclusion directly, which is a direction for future research. One study among Black and White participants investigated same versus cross-race rejection in an online negative feedback paradigm (Jamieson et al., 2013). Although cross-race rejection elicited cortisol release over baseline levels, results indicated greater cortisol release for same-race compared to cross-race rejection and these effects were significant for both Black and White participants (Jamieson et al., 2013).

Future Directions and Implications

Although this is the first study examining cortisol response following racial discrimination operationalized using Cyberball, several studies have examined the effects of Cyberball-based exclusion on cortisol response (Dickerson & Zoccola, 2013), and there are personality constructs relevant to both social exclusion and discrimination that would warrant further study as potential moderators. Among African Americans, racial identity is associated with lower depression and a greater sense of control (mastery) in a nationally representative sample (Hughes, Kiecolt, Keith, & Demo, 2015) and can buffer discrimination's association with alcohol risk cognitions (Stock et al., 2011), cardiovascular reactivity (Neblett & Roberts, 2013),

and cortisol response (Lucas et al., 2017). Additionally, social and/or emotional support may also have protective, buffering effects against racial discrimination (Brody et al., 2014; Clark, 2006). Personality characteristics could exacerbate the cortisol response, such as the need to belong (Beekman et al., 2016). For African American college students, high race-based rejection sensitivity predicted greater negative emotional responses in reaction to racial discrimination (mediated through intrusive thoughts), but race-based rejection sensitivity has not been studied for perceived control and cortisol release (Henson, Derlega, Pearson, Ferrer, & Holmes, 2013). Additionally, perceptions of process and personal justice may interact with perceived control in ways that either exacerbate or buffer cortisol response to racial exclusion among African Americans (Lucas et al., 2016).

Beyond individual differences, the impact of discrimination on the hypo-pituitary-adrenocortical axis may vary based on an individual's identity. Race represents one dimension of social identity that may be subject to discrimination, but people's social identities are multidimensional and can contain various dimensions of advantage (e.g., Black male) and disadvantage (e.g., Black female; Bowleg, 2008; Lewis & Grzanka, 2016). Research on intersectionality, or the idea that social identities based on race/ethnicity, gender identity, and sexual attraction among others are interdependent and not mutually exclusive, stresses the importance of investigating the intersection between multiple attributes of discrimination (Bowleg, 2008; Lewis & Grzanka, 2016). Although the present design attempted to isolate racial exclusion by both controlling for self-reported gender and assigning participants to same-sex Cyberball conditions, future research should assess potential differences between single and multiple forms of discrimination. This would allow for a more nuanced understanding of discrimination against people with multiple marginalized social identities especially considering

that discrimination experiences can carry attributional ambiguity if there is no contextual salience of one specific social status (Garnett et al., 2014).

The finding that depleted perceived control mediates the relationship between racial exclusion and cortisol release, although preliminary, provide food for thought for research applications. Research suggests that among African American high school students, those who reported greater control over discriminatory experiences also reported greater social support seeking and problem-focused coping and that approach-oriented coping could potentially replenish feelings of depleted control due to discrimination (Scott & House, 2005). Adding a Cyberball condition with an explicit exit icon would provide an opportunity to test variations in control experimentally. Among racial minority college students, confronting discrimination was related cross-sectionally to greater mental wellbeing, mediated through increases in autonomy (Sanchez, Himmelstein, Young, Albuja, & Garcia, 2016). Higher anger expression after experiencing social rejection from a White confederate was associated with faster cortisol reactivity recovery among African American adults with lower background discrimination (Park et al., 2018). Identifying active coping strategies that enhance or replenish perceived control may potentially alleviate some of the physiological strain that results from discrimination. However, expressing anger and exercising confrontation within discriminatory institutions can also result in sanctions against those who speak up (e.g., Kaiser & Miller, 2001; Kaiser & Miller, 2003). Confronting and dismantling institutional discrimination is an essential step in earning trust of marginalized groups and affirming agency in pursuing justice against discrimination.

Conclusion

Health disparities contribute to substantial loss of life for Black Americans via stress-related illnesses, with weathering already present for Blacks in emerging adulthood (Geronimus

et al., 2006). Discrimination is a common experience for among Black emerging-adults (Hope et al., 2015), is increasing online (Tynes et al., 2012), and contributes to disparities via dysregulation of the hypo-pituitary adrenocortical axis (Lockwood et al., 2018); however, less is known about the psychological mediators that contribute to this process. The present results indicate that a short experience of racial exclusion is related to greater cortisol release among emerging-adult Blacks, along with greater negative affect and lower perceived control when compared to inclusion. The cortisol response was driven by reduced perceived control. These results provide experimental and physiological evidence that extend theoretical research on the arresting and dehumanizing consequences of racial discrimination in degrading a sense of mastery or control (Broman et al., 2000; Brondolo et al., 2018; Williams & Mohammed, 2009). Societal and interpersonal interventions are needed to dismantle the perpetration and proliferation of racial discrimination and eliminate racial health disparities. Enhancing perceived control is one psychosocial resource with potential to alleviate the impact of discrimination and empower Black youth as they emerge into adulthood.

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