

# Do Positive Psychological Factors Equally Predict Resistance to Upper Respiratory Infections in African and European Americans?

Cameron R. Wiley<sup>1</sup>, Kennedy M. Blevins<sup>1</sup>, Sheldon Cohen<sup>2</sup> ,  
and Sarah D. Pressman<sup>1</sup> 

<sup>1</sup>Department of Psychological Science, University of California, Irvine, and <sup>2</sup>Department of Psychology, Carnegie Mellon University

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## Abstract

Research has consistently shown that positive psychological constructs are linked to better physical health, but few studies have examined the role that race plays in this connection. We explored whether positive self-evaluations were equally protective against upper respiratory infection for 271 African American adults and 700 European American adults in a series of virus-exposure studies. Participants were assessed at baseline for psychological functioning and physical health, quarantined and exposed experimentally to a respiratory virus, and then monitored for infection and symptoms. Regression analyses revealed significant interactions between race and multiple positive psychological factors; several factors that were helpful to European Americans were unhelpful or even harmful to African Americans. Building on past work showing cross-cultural variation in the health correlates of affect, this study provides evidence that the health benefits of positive psychological constructs may not be universal and points to the need to explore factors that underpin these observed differential patterns.

## Keywords

cross-cultural differences, emotions, health, happiness

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There has been increasing interest in understanding the psychological factors that protect people from illness. For example, positive emotional style (i.e., higher average levels of positive affect) has been linked to benefits ranging from fewer injuries to increased longevity (e.g., Pressman & Cohen, 2005). Relevant to the COVID-19 pandemic, higher levels of positive emotional style have been linked to fewer illness symptoms and reduced risk of developing illness following experimental exposure to upper respiratory viruses (e.g., Cohen et al., 2003, 2006). Beyond positive emotional style, other positive self-evaluations, including self-esteem (Antonucci & Jackson, 1983), self-acceptance (Chamberlain & Haaga, 2001), and positive self-assessments of health (e.g., Cohen et al., 2015), have also been tied to better health. The salubrious effects of positive self-assessments are

promising, especially given their breadth and many conceptual replications. One important limitation, however, is that these studies tend to overlook the role that racial and cultural differences play in the associations between positive factors and health. This is especially important as we struggle to understand why racial minorities bear the brunt of the COVID-19 burden (Hooper et al., 2020; Karaca-Mandic et al., 2020) and to make sense of long-standing evidence of poorer health in minorities, especially African Americans (National Center for Health Statistics, 2016).

## Corresponding Author:

Cameron R. Wiley, University of California, Irvine, Department of Psychological Science  
Email: wileycr@uci.edu

Recent research has indeed suggested that culture plays an important role in moderating the relation between positive psychological factors and health (Miyamoto & Ryff, 2011; Pressman & Cross, 2018). Although there is little work on positive factors, evidence from negative-emotion studies shows that health correlates differ on the basis of country of origin, race, and/or ethnicity (Consedine et al., 2002). For example, African Americans tend to report higher trait negative emotion than European Americans (Consedine & Magai, 2002), and this higher negative emotion (e.g., anger) has been associated with better health (Consedine et al., 2005) in Black ethnic groups (e.g., African Americans, English Caribs, Haitians) but with poorer health in European Americans. Similarly, negative affect does not predict chronic health conditions (e.g., arthritis, hypertension) in African Americans, as it typically does in European Americans (Consedine et al., 2002). These differences are likely related to differences in the cultural socialization and valuation of emotions (Consedine et al., 2002, 2012; Kitayama et al., 2015; Luong et al., 2016), which may result in downstream differences in psychophysiological regulation, reactivity, and health (e.g., Mauss & Butler, 2010).

Studies specifically examining African Americans and positive traits have found that African Americans report higher positivity (Lankarani & Assari, 2017), self-esteem (Twenge & Crocker, 2002), and optimism (Hernandez et al., 2015) than European Americans. Given the typical health-protective effects of positivity, it is perplexing that African Americans have such disproportionate rates of ill health. One potential explanation is that racial socialization of African Americans has encouraged self-regulation of negative states (e.g., Mattis et al., 2016) to the point that African Americans are desensitized to and underreport negative emotions (e.g., Consedine & Magai, 2002) but then also overreport positive emotional style and other positive traits because of social pressures. Consistent with this, other studies have found that, compared with European Americans, African Americans have greater positive facial expressions in response to positive stimuli but also fewer negative facial expressions in response to negative stimuli (Vrana & Rollock, 2002). African Americans also tend to score higher than European Americans on social-desirability measures, suggesting that they may consciously and deliberately misrepresent what they feel in order to present themselves in a more positive light (Consedine et al., 2012; Klassen et al., 1975). A similar argument may be made for other positive traits. That is, the self-reporting of high levels of self-esteem and good health in African Americans may have more to do with socialization and external pressure and less to do with

### Statement of Relevance

Positive psychological factors have been shown to have favorable effects on physical health, including increased resistance to infectious illness. However, the bulk of this work has used European American samples or ignored possible race interactions, potentially limiting the value of these findings. This is salient given the large disparities in pandemic infectious-illness outcomes across race—for example, between African American adults and European American adults. The current study found that whereas positive factors were associated with reduced illness after experimental virus exposure for European Americans, positive self-assessments for African Americans were not only unhelpful but also, in some cases, associated with an increased risk of developing upper respiratory infections. These findings suggest that the benefits of positive psychological constructs may not generalize across races, which could be because proposed measures do not properly index these factors in certain groups or because of a limited understanding of the psychophysiological mechanisms underlying their health effects.

internal differences, perhaps resulting in fewer physical benefits.

Past research also shows that not all emotions are experienced equally across cultures (Eid & Diener, 2001). The emotion-regulation perspective suggests that African Americans report less negative emotion because they do not consciously experience the same emotions as European Americans. Because of cultural values and socialization practices regarding emotion, minorities may repress the expression of negative emotion, allowing physiological arousal to exist without the accompanying psychological experience (Consedine et al., 2012). Although positive emotional style has not been specifically studied, African Americans may regulate their emotions in a manner that overemphasizes positive emotions because of cultural norms around the value of those emotions, allowing them to consciously experience or report high positive emotion without the concomitant physiological benefits.

Adding to past work on cultural variations in emotion–health connections, the current study examined whether positive self-evaluations, typically tied to better physical functioning, yield benefits for African Americans in a similar manner as for European Americans. Given current pandemic-related racial disparities, we

were especially interested in infectious-illness outcomes and therefore analyzed data from The Common Cold Project (Carnegie Mellon University, 2022a). In this series of studies, healthy volunteers self-reported positive emotional styles, self-esteem and acceptance, and self-reported health. These variables were of interest given past ties to infectious illness and other wellness outcomes. Self-esteem and acceptance were of particular interest given their known ties to health as well as to the experience of racism in the United States (e.g., Johnson, 2020). Participants were next exposed to a common cold or flu virus and followed in quarantine to observe the development of objective clinical illness. Previous analyses of these data have found that higher positive emotional style is associated with lower levels of objective illness (Cohen et al., 2003, 2006). Here, we tested across multiple studies whether this is true in both African Americans and European Americans and further explored whether other typically health-protective positive factors helped both groups equally. To compare these results with those of earlier studies that focused on the role of race in the impact of negative emotions and health, we also tested the interactions of race and both negative emotional style and stress.

## Method

### Participants

Participants were drawn from four studies that were part of The Common Cold Project: the Pittsburgh Mind-Body Center (PMBC) Study and Pittsburgh Cold Studies 1 to 3 (PCS1, PCS2, and PCS3). The current analyses specifically focused on healthy adults between the ages of 18 and 55 years (271 African Americans and 700 European Americans) recruited from the greater Pittsburgh, Pennsylvania, region.<sup>1</sup> Candidates underwent a physical examination and had their medical history evaluated by a study physician prior to participation. Exclusion criteria included current pregnancy, history of chronic medical or psychiatric illness, regularly taking most prescription medications, treatment with steroids or immunomodulating agents in the previous 3 months, a history of nasal or otologic surgery, and abnormal blood or urine findings from a laboratory test. Antibody levels for the challenge viruses included in the studies were also collected from the blood samples. Candidates were also excluded if they displayed symptoms of an upper respiratory infection during the 24 hr prior to exposure to the virus. Other trial-specific exclusion criteria are described in previous publications on these studies (Cohen et al., 2003, 2006). Both protocols were approved by the institutional review boards at Carnegie Mellon University and the University of Pittsburgh. All participants provided written informed

consent and received an honorarium (\$800 to \$1,000 depending on the study). Participants with relevant measures of positive psychological factors were included in the analyses. Different studies used different measures, which resulted in different sample sizes for various analyses (e.g., self-esteem and self-acceptance were assessed only in the PMBC Study). That said, in light of the power demands associated with the binary outcome variable of a diagnosis of upper respiratory infection, we aggregated across data sets and reported specific sample sizes for each analysis. The total sample across all four studies was primarily composed of participants who self-identified as European American ( $n_s = 224$  in PCS1, 226 in PCS2, 108 in PMBC, and 142 in PCS3). A smaller but sizable proportion of participants self-identified as African American ( $n_s = 42$  in PCS1, 99 in PCS2, 72 in PMBC, and 58 in PCS3).

### Procedures

Candidate participants who passed the medical screening (i.e., medical history, medication check, and collection and analysis of blood) to determine “good general health” returned to the clinic within 6 weeks (for a full list of procedures, questionnaires, and data, see <https://www.cmu.edu/common-cold-project/about/index.html>). During that session, participants completed pre-viral-challenge questionnaires, including assessments that provided psychological measures relevant to the current study (i.e., positive and negative emotional style, self-acceptance, self-esteem, self-reported health, and perceived stress). Participants were also interviewed by phone on three evenings per week for 2 weeks during the month before quarantine and on the first evening (before viral challenge) of quarantine. Assessments of daily affect collected on the phone were used to calculate positive emotional style and negative emotional style (see below).

Participants were then isolated in a local hotel for 6 days. On Day 0 (prior to the viral challenge), an examination was conducted to exclude people with active infections and to collect pre-viral-challenge levels of objective markers of illness (e.g., nasal mucociliary-clearance function and mucus excretion) as well as general symptoms. At the end of that day, participants were inoculated with nasal drops that contained 100 to 300 tissue-culture infective doses (TCIDs) of a respiratory virus known to cause upper respiratory infection (collected via the TCID<sub>50</sub> assay). PCS1 used two different viruses to evaluate the generalizability of effects: Rhinovirus 39 ( $n = 147$ ) and Rhinovirus 21 ( $n = 129$ ). PCS2 used Rhinovirus 39 ( $n = 228$ ) and Rhinovirus 23 ( $n = 106$ ). In the PMBC Study, both Rhinovirus 39 and influenza A were used, and in PCS3, only Rhinovirus 39 was used. On each of the 5

quarantine days, participants were assessed for objective markers of illness, and a nasal-wash sample was collected for virus culture. Roughly 28 days after virus exposure, participants returned for another blood collection, used to verify infection by serology. The investigators were blind to all psychological and biological measures throughout the trial.

## Measures

**Positive and negative emotional style.** Emotional style was assessed using select subscales derived from a factor analysis of affect items from the Profile of Mood States (Usala & Hertzog, 1989). Emotion data were collected via nightly phone interviews on each of the 12 days prior to the participant's hotel stay, as well as on the first day of their stay (the day prior to receiving the virus). For every time point for each of the 13 days, participants filled out a questionnaire that assessed eight factors with three to four emotion adjectives each: anxiety (on edge, nervous, tense), depression (unhappy, depressed, sad), hostility (hostile, angry, resentful), fear (fearful, frightened, afraid), fatigue (sluggish, tired, fatigued, sleepy), well-being (happy, pleased, cheerful), vigor (full of pep, energetic, lively), and calm (at ease, calm, relaxed). Each item was rated on a scale from 0 (*not at all accurate*) to 4 (*extremely accurate*) according to how much that trait reflected how the participant felt at that moment.

Both the total scales and subscales for positive emotional style and negative emotional style have strong reliability and validity, as reported in previous articles using the current data set as well as under the Measures section of The Common Cold Project website (Carnegie Mellon University, 2022b). The Cronbach's  $\alpha$  for both positive emotional style and negative emotional style was roughly .89, whereas Cronbach's  $\alpha$ s for the well-being, vigor, and calm subscales ranged from .78 to .87. Positive emotional style and negative emotional style were calculated by averaging daily negative- and positive-affect scores across all 13 days.<sup>2</sup>

**Self-esteem and self-acceptance.** Self-esteem was measured using two different scales in two of the studies. In the PMBC Study, self-esteem was assessed via the four-item version of the Rosenberg Self-Esteem Scale (Krause, 1995; Rosenberg, 1989), which is designed to measure an individual's global self-worth by asking four positively worded questions that were pulled from the original 10-item scale. An example item is "I am able to do things as well as most other people." Responses are scored on a Likert-type scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher scores indicate greater levels of self-esteem. In the PCS3, self-esteem was assessed via the self-acceptance subscale of a modified 39-item version of

the Psychological Well-Being Scale (Ryff, 1989). Individuals who score high on self-acceptance possess a positive attitude toward the self, feel positive about their past, and accept their good and bad qualities. An example of an item from the self-acceptance subscale is as follows: "In general, I feel confident and positive about myself." Items are scored on a Likert-type scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). We also examined self-acceptance separately because of the slight difference in concept from esteem. Self-esteem is presented as a  $z$  score in the final analyses to account for measurement differences across studies.

**Self-reported health.** Subjective health was assessed via the Short Form Health Survey (Ware & Sherbourne, 1992), which is designed to measure an individual's quality of life and general health across eight domains, such as general health perceptions, general mental health, and bodily pain. For the current study, perceived health was measured using a single item from the general-health-perceptions domain: "In general, would you say your health is . . .," which is scored on a Likert-type scale ranging from 1 (*excellent*) to 5 (*poor*). To make the interpretation of the interaction results more consistent with the other analyses, we reverse-coded this variable so that the lowest state of subjective health (*poor*) would be coded with the lowest value (1) and the highest state of subjective health (*excellent*) would be coded with the highest value (5).

**Psychological stress.** Psychological stress was assessed via the 10-item version of the Perceived Stress Scale (Cohen et al., 1983), which is designed to measure an individual's appraisal of stressful situations and the degree to which they find them unpredictable, uncontrollable, or overloading. Example items are "In the last month, how often have you been able to control irritations in your life?" and "In the last month, how often have you found that you could not cope with all the things that you had to do?" All items are scored on a Likert-type scale ranging from 0 (*never*) to 4 (*very often*). Higher scores indicate greater levels of stress.

**Disease outcome.** The outcome for this study was clinically verified colds, which is a combination of infection and objective signs of clinical illness. *Infection* is defined as evidence of virus replication. When an upper respiratory virus replicates, evidence of the virus can be found in nasal-secretion samples. Samples were collected daily via a saline solution wash of the nose. These were frozen and later cultured for the specific challenge virus using standard techniques (Gwaltney et al., 1989). Infection was operationalized as the presence of challenge virus in any of the 5 postchallenge days or a fourfold (or greater)



rise in virus-specific serum neutralizing antibody from previrus exposure to 28 days after exposure. The presence of a virus indicates that the virus is replicating. An increase in virus-specific antibody occurs in response to viral replication and is an indirect marker of infection.

Objective signs of illness were assessed with two objective markers of upper respiratory illness: nasal mucus excretion and nasal mucociliary clearance. The first, mucus excretion, was assessed by collecting used tissues from participants in sealed plastic bags. Total mucus excretion was calculated by weighing the bags and then subtracting the weight of the tissue and bag. Clearance function was assessed as the amount of time required for a dyed and sweetened solution administered in the nostrils to be tasted by the participant (Doyle et al., 1988). These values were all baseline adjusted (baseline subtracted) for values taken the day before the viral challenge. Negative adjusted scores were assigned a value of zero. Average nasal clearance function was calculated by taking the mean adjusted scores across the 5 postchallenge days, and total mucus weight was calculated by summing values across the 5 postchallenge days. Objective presence of clinical illness was diagnosed if participants were (a) infected with the target virus and (b) had either a total baseline-adjusted 5-day mucus weight of at least 10 g or a baseline-adjusted mucociliary-clearance time of 7 min or longer (Cohen et al., 1997).

### **Demographics and standard control variables**

Covariates were selected from past publications (e.g., Cohen et al., 2003, 2006; Miller et al., 2016) of the cold-study data that have selected variables with significant and/or theoretical ties to upper respiratory infection. Participants self-reported their age, sex, race, and adult socioeconomic status (as measured by educational attainment in years), and additional covariates included body mass index, season of the year (fall, winter, spring, summer), perceived stress, baseline immunity to the specific challenge virus (i.e., neutralizing specific antibody titer as assessed from a blood sample collected days prior to the exposure to the virus), and the relevant challenge virus for the study trial. These variables were included in all models that were adjusted for covariates. Additional demographic variables included for descriptive purposes were household income, subjective socioeconomic score, and marital status.

### **Data analysis**

Analyses were conducted using SPSS (Version 25). Differences in continuous variables of interest across race

were first examined using an independent-samples *t* test in which age, subjective socioeconomic status, body mass index, prechallenge antibody titer, positive emotional style, negative emotional style, perceived stress, self-esteem, and self-acceptance were the dependent variables and race (European American, African American) was the independent variable. Differences in nominal variables of interest across race were examined using a  $\chi^2$  test in which sex, objective cold status, and marital status were the dependent variables and race was the independent variable. Differences in ordinal variables of interest were examined using a Mann-Whitney *U* test in which education level, household income, and self-reported health score were the dependent variables and race was the independent variable. For *p* values from all group comparison analyses, see Table 1.

A series of hierarchical regressions was conducted to determine main and interaction effects. Objective colds were first predicted from the main effects of covariates in the first step (which included the main effect of race), followed by the psychological variables of interest in the second step (e.g., positive emotional style). Colds were then predicted from the interaction effects between race and each variable of interest using logistic regression. Race was dummy coded as 0 (European American) and 1 (African American), and positive emotional style, negative emotional style, perceived stress, self-acceptance, and self-reported health were all mean centered before being included in regression models as part of their respective interaction terms. Self-esteem was *z*-scored in the original data set and thus was not standardized further. Regression coefficients, standard errors, 95% bootstrapped confidence intervals (CIs; 1,000 samples), and *p* values are reported. Results of the regression analyses can be found in Table 2.

## **Results**

### **Sample description**

Descriptive statistics separated by race can be found in Table 1. The average age of African Americans (33 years) was higher than that of European Americans (30 years), whereas the gender splits for both racial groups were nearly equal (approximately 50% female). Roughly 40% of African Americans had a high school education or lower compared with only 20% of European Americans, whereas 27% of European Americans had at least a 4-year college degree compared with only 8% of African Americans. Nearly 84% of African Americans had a household income of \$30,000 or less compared with 62% of European Americans; the \$20,000 to \$29,999 income range had the highest percentage of European Americans (20%), whereas the \$5,000 to

**Table 1.** Descriptive Statistics for Demographic, Virological, and Psychological Variables by Race

Variable	European American			African American			<i>p</i>
	<i>N</i> (%)	<i>M</i>	<i>SD</i>	<i>N</i> (%)	<i>M</i>	<i>SD</i>	
Age (years)	700	29.94	10.69	271	33.39	9.33	.001
Sex	700			271			.366
Male	339 (48.4)			140 (51.7)			
Female	361 (51.6)			131 (48.3)			
Education level	700			271			
High school or lower	145 (20.7)			109 (40.2)			< .001
< 2 years of college	202 (28.9)			98 (36.2)			
> 2 years of college/associate's degree	166 (23.7)			43 (15.9)			
4-year college degree or higher	187 (26.7)			21 (7.7)			
Household income	248			129			< .001
Less than \$5,000	34 (13.7)			30 (23.3)			
\$5,000–\$9,999	32 (12.9)			31 (24.0)			
\$10,000–\$14,999	37 (14.9)			24 (18.6)			
\$15,000–\$20,000	27 (10.9)			12 (9.3)			
\$20,000–\$29,999	50 (20.2)			11 (8.5)			
\$30,000–\$39,999	29 (11.7)			10 (7.8)			
\$40,000–\$49,999	10 (4.0)			4 (3.1)			
\$50,000–\$59,999	14 (5.6)			3 (2.3)			
\$60,000–\$74,999	4 (1.6)			2 (1.6)			
\$75,000–\$99,999	6 (2.4)			1 (0.8)			
\$100,000–\$124,999	2 (0.8)			0			
\$125,000–\$149,999	2 (0.4)			0			
\$150,000 or more	1 (0.8)			1 (0.8)			
Subjective socioeconomic status	474	4.47	1.82	228	4.18	1.89	.981
1–3	160 (33.8)			86 (37.7)			
4–6	246 (51.8)			119 (52.2)			
7–9	68 (14.4)			23 (10.1)			
Marital status	700			271			< .001
Currently married or living together	182 (26.0)			65 (24.0)			
Never married	398 (56.9)			141 (52.0)			
Separated	19 (2.7)			31 (11.4)			
Divorced	96 (13.7)			31 (11.4)			
Widowed	5 (0.7)			3 (1.1)			
Body mass index	698	26.17	5.70	271	28.72	6.85	< .001
Prechallenge virus-specific antibody titer	699	4.97	5.77	271	5.96	5.88	.13
Objective criteria for cold	700			268			.726
Met	475			185			
Not met	225			83			
Positive emotional style	476	14.06	4.13	227	15.04	4.88	.001
Negative emotional style	476	2.94	2.66	227	2.76	2.78	.717
Perceived Stress Scale score	700	14.12	6.49	271	13.82	6.08	.178
Self-esteem score <sup>a</sup>	475	−0.052	1.01	226	0.178	0.944	.338
Ryff Self-Acceptance subscale score	367	39.19	7.62	155	40.41	6.68	.04
Self-reported health score <sup>b</sup>	250	3.94	0.72	130	3.92	0.694	.394

Note: Each *p* value was taken from the results of an independent-samples *t* test, a Mann-Whitney *U* test, or a  $\chi^2$  test, depending on the scaling of the variable.

<sup>a</sup>This variable was *z*-scored in the original data set. <sup>b</sup>This variable, which was measured on the 36-item Short Form Health Survey, was reverse coded.

**Table 2.** Main and Interaction Effects of Psychological Variables and Race on Objective Cold Status, Bootstrapped and Adjusted for Covariates

Variable	<i>b</i> ( <i>SE</i> )	Odds ratio <sup>a</sup>	95% CI	<i>p</i>
Positive emotional style	<b>-0.07 (0.024)</b>	0.94	[-0.12, -0.02]	.04
Positive Emotional Style × Race	<b>0.09 (0.044)</b>	1.08	[0.003, 0.17]	.04
Negative emotional style	-0.04 (-0.002)	0.96	[-0.12, 0.03]	.28
Negative Emotional Style × Race	-0.01 (0.078)	0.98	[-0.18, 0.14]	.81
Perceived stress <sup>b</sup>	0.01 (0.012)	1.01	[-0.01, 0.03]	.36
Perceived Stress × Race	0.003 (0.028)	1.00	[-0.06, 0.06]	.92
Self-esteem	0.15 (0.12)	1.17	[-0.08, 0.38]	.16
Self-Esteem × Race	<b>0.58 (0.207)</b>	1.82	[0.18, 1.04]	< .01
Self-acceptance	0.03 (0.019)	1.03	[-0.01, 0.07]	.13
Self-Acceptance × Race	<b>0.09 (0.036)</b>	1.09	[0.03, 0.17]	< .01
Self-reported health <sup>c</sup>	<b>0.20 (0.180)</b>	0.61	[-0.89, -0.17]	< .01
Self-Reported Health × Race	<b>0.66 (0.367)</b>	0.52	[0.012, 1.43]	.05

Note: Boldface indicates significant coefficients.

<sup>a</sup>Odds ratios were obtained from nonbootstrapped results. <sup>b</sup>This analysis did not include perceived stress as a covariate given that it was used as a predictor. <sup>c</sup>This variable was reverse coded.

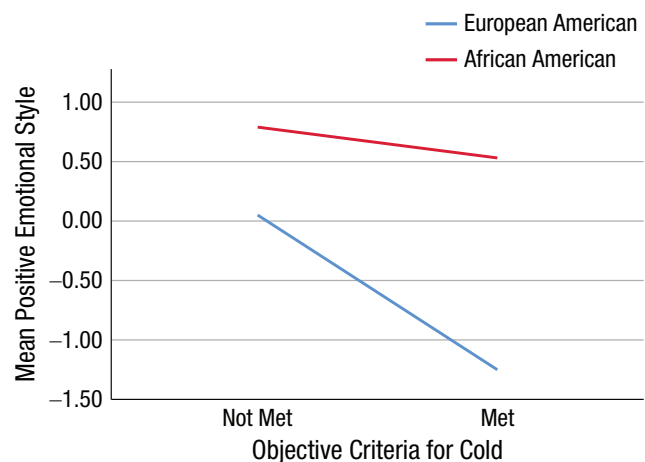
\$9,999 income range had the highest percentage of African Americans (24%). Marital status was largely equal between African Americans and European Americans for the two most common status options (“currently married/living together” or “never married”).

### ***Do protective psychological factors equally predict upper respiratory infections across European American and African American populations?***

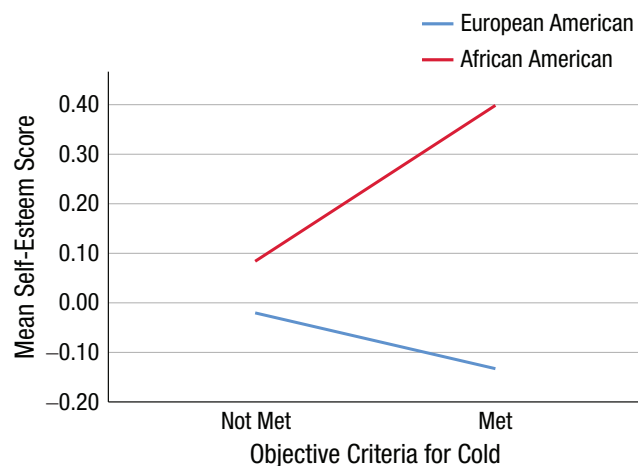
In the overall sample, the main effect of positive emotional style on objective colds was significant after analyses included all covariates, indicating that positive emotional style was protective against getting a cold ( $b = -0.06$ , 95% CI =  $[-0.11, -0.02]$ ,  $p = .004$ ). When examining the interaction between race and positive emotional style, we found a significant effect ( $b = 0.08$ , 95% CI =  $[-0.008, 0.163]$ ,  $p = .05$ ); for the African American sample, there was a 0.08 greater incidence of objective colds compared with the European American sample when positive emotional style was held constant. That is, there was a near flat slope of positive emotional style for African Americans when analyses compared those who did or did not get a cold, but for European Americans, there was a steep decline in the likelihood of getting sick for those higher in positive emotional style. For a depiction of this interaction, see Figure 1.

The main effect of self-esteem on objective colds was not significant when analyses included all covariates, indicating that self-esteem was not protective against getting a cold in the full sample ( $b = 0.15$ , 95% CI =  $[-0.08, 0.38]$ ,  $p = .16$ ). When examining the

interaction between race and self-esteem, we found a significant effect ( $b = 0.58$ , 95% CI =  $[0.18, 1.04]$ ,  $p < .01$ ); for the African American sample, there was a 0.58 greater incidence of objective colds compared with the European American sample when self-acceptance was held constant. That is, there was a steep incline in the likelihood of getting sick for African Americans who were higher in self-esteem, whereas for European Americans, there was a steep decline in the likelihood of getting sick for those higher in self-esteem. For a depiction of this interaction, see Figure 2. As with self-esteem, the main effect of self-acceptance on objective colds was not significant after analyses included all covariates, indicating that self-acceptance was not protective against getting a cold ( $b = 0.027$ , 95% CI =  $[-0.01,$



**Fig. 1.** Mean positive emotional style as a function of objective cold status, separately for European American and African American participants ( $N = 698$ ).



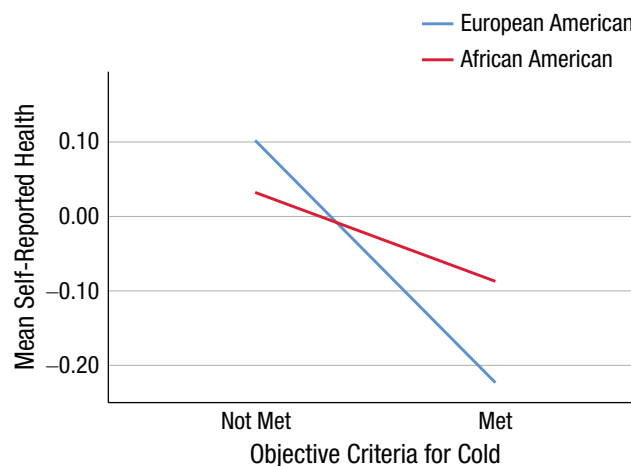
**Fig. 2.** Mean self-esteem (z-scored) as a function of objective cold status, separately for European American and African American participants ( $N = 696$ ).

0.07],  $p = .13$ ). However, when examining the interaction between race and self-acceptance, we found a significant effect ( $b = 0.089$ , 95% CI = [0.03, 0.17],  $p < .001$ ); for the African American sample, there was a 0.09 greater incidence of objective colds, compared with the European American sample, when self-acceptance was held constant.<sup>3</sup>

Lastly, the main effect of self-reported health on objective colds was significant when analyses included all covariates, indicating that self-reported health was protective against getting a cold ( $b = 0.195$ , 95% CI = [-0.89, -0.17],  $p = .006$ ). When examining the interaction between race and self-reported health, we found a significant effect ( $b = 0.66$ , 95% CI = [0.012, 1.43],  $p = .049$ ); for the African American sample, there was a 0.66 higher incidence of objective colds compared with the European American sample when self-reported health was held constant. For a depiction of this interaction, see Figure 3.

### ***Do typically harmful psychosocial factors equally predict upper respiratory infections across European American and African American populations?***

In the overall sample, the main effect of negative emotional style on objective colds was not significant after analyses included all covariates, indicating that negative emotional style was not a significant predictor of getting a cold ( $b = -0.02$ , 95% CI = [-0.09, 0.04],  $p = .59$ ), as has been shown in past studies (Cohen et al., 1993, 2003). When examining the interaction between race and negative emotional style, we did not find a significant effect ( $b = -0.02$ , 95% CI = [-0.17, 0.13],  $p = .81$ ). For a depiction of the mean responses as a comparison



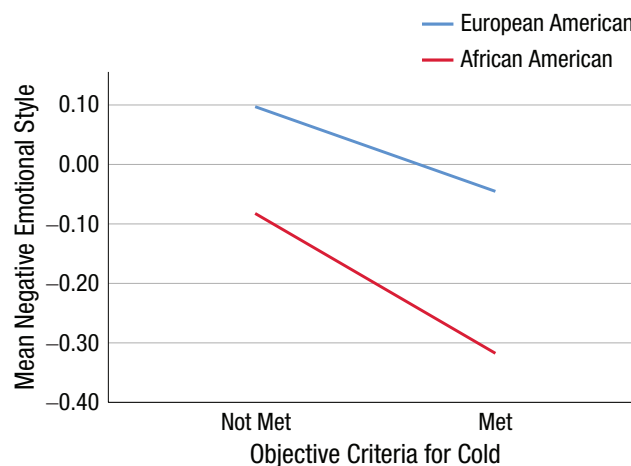
**Fig. 3.** Mean self-reported health as a function of objective cold status, separately for European American and African American participants ( $N = 375$ ).

with the interaction of positive emotional style and race in Figure 1, see Figure 4.

Additionally, the main effect of perceived stress on objective colds was not significant when analyses included all covariates, indicating that perceived stress was not a significant predictor of getting a cold in this population subset ( $b = 0.01$ , 95% CI = [-0.01, 0.03],  $p = .37$ ). When examining the interaction between race and perceived stress, we also failed to find a significant effect ( $b = 0.003$ , 95% CI = [-0.06, 0.06],  $p = .92$ ).

### ***Post hoc analyses: probing interaction effects of race and subscales of positive emotional style***

To further probe the nature of the interaction between race and positive emotional style, we conducted post



**Fig. 4.** Mean negative emotional style as a function of objective cold status, separately for European American and African American participants ( $N = 698$ ).



hoc analyses that examined the interaction between race and each of the subscales of positive emotional style (i.e., calm, vigor, and well-being) to determine whether our initial results were driven by a particular class of emotionality. When examining the interaction between race and the calm subscale, we found a significant effect ( $b = 0.28$ , 95% CI = [0.05, 0.53],  $p = .015$ ); for the African American sample, there was a 0.28 greater incidence of objective colds compared with the European American sample when the calm-subscale score was held constant. This interaction had a near identical pattern to that of the Positive Emotional Style  $\times$  Race interaction represented in Figure 1. When examining the interaction between race and vigor, we did not find a significant effect ( $b = 0.18$ , 95% CI = [-0.04, 0.37],  $p = .088$ ) nor did we find a significant effect when we examined the interaction with well-being ( $b = 0.14$ , 95% CI = [-0.11, 0.40],  $p = .224$ ).

## Discussion

Using a viral-challenge paradigm with an objective assessment of disease susceptibility, we found evidence that several positive factors (positive emotional style, calm, self-esteem, self-acceptance, and self-reported health) considered to be health protective were typically tied to better infectious-illness outcomes for European Americans but were unhelpful or harmful to African Americans, even with African Americans who reported higher levels of positive emotional style, self-esteem, and self-acceptance. Although previous studies have found differences in links between positive psychological factors and health on the basis of different sociodemographic factors (e.g., Keyes, 2002), few have looked explicitly at African Americans, and none have used an experimental virus-exposure paradigm. These findings are especially critical and timely given the potent interest in creating positive psychology-oriented interventions to improve health outcomes for a wide range of illnesses and groups (Ghosh & Deb, 2017) as well as the continued disproportionate negative impact of COVID-19 on African Americans (Hooper et al., 2020).

So why, despite vast amounts of evidence on the benefits of positive emotional style for health (e.g., Pressman et al., 2019), is positive emotional style not helpful for African Americans? First, self-reported positivity in African Americans may not reflect emotion in the same way that it does in European Americans but, rather, may serve as a by-product of emotional suppression or the desire to present themselves in a way that fits cultural pressures (Woods-Giscombé, 2010). This is supported by evidence that the race of the other individuals present influences emotion self-reports (Vrana & Rollock, 2002). Given the harmful effects of long-term

emotional suppression (Roberts et al., 2008), this may explain the observed ill-health findings. Norms and stereotypes may also encourage African Americans to self-report high levels of health and assuredness. For example, John Henryism is a predisposition prevalent in African American men that is characterized by excessively and actively coping with stress (James, 1994). Although seemingly positive, John Henryism is tied to worse physiological functioning (James, 1994) and lower happiness (Angner et al., 2011), despite higher self-reported health (Bonham et al., 2004). Related to this is the superwoman schema, which posits that African American women are naturally strong and resilient (Woods-Giscombé, 2010). Like John Henryism, some aspects of this positive schema are not protective (Allen et al., 2019). Thus, as in the current study, these seemingly positive self-perceptions in African Americans are not necessarily tied to good health.

There are two distinct emotional factors potentially at work here: emotional expression and experienced affect. Although these factors are correlated, they differ in their health mechanisms and influences (Consedine et al., 2014). Whereas differences in expression are likely related to differences in social desirability among minority groups, emotion-regulation theory posits that differences in trait negative affect also play a role. For instance, reports of lower anger by minority women were theorized to be related to socialization, motivating them to create more restrictive patterns of emotional experience and expression (Consedine et al., 2012). Therefore, African Americans may be exhibiting similar patterns of emotion regulation to minimize being labeled as threatening or unfriendly (Mattis et al., 2016). African Americans may also report more positive emotion because it is valued and/or expected on the basis of societal norms. If it is also the case that negativity is being repressed, this may be one reason that we do not see the health benefits of positive emotional style for African Americans. This is consistent with our post hoc finding of calm being helpful for European Americans but not African Americans because calm in African Americans may be the result of suppression rather than true low arousal. Future research should explore plausible mechanisms relevant to these norms (e.g., active coping, emotional suppression) to better understand how these factors relate to disparities in the benefits of positive psychological factors.

Positive emotion and self-concepts may also be necessary in African Americans as a coping response to high levels of discrimination and threat. If so, African Americans may need even more positivity for resulting health benefits, perhaps because of the greater allostatic load and chronic stress experienced by many African Americans (Allen et al., 2019). Whereas severe

and/or chronic stress could limit the buffering effects of positive feelings (Pressman & Cohen, 2005), positive emotional style has been tied to better health to a greater extent in the poorest (vs. richest) countries on the planet (Pressman et al., 2014), making this unlikely. Further, although there was no evidence of stress playing a role in our findings, we were not able to assess discrimination or race-related stress. There were also no interactions between negative emotional style and race, which is consistent with the results of past studies indicating a lack of variance in negative emotional style across race (Consedine et al., 2006) and showing that negative emotional style does not predict objective infectious illness (Cohen et al., 2006). Future studies should explore multiple types of stress (e.g., discrimination) as well as a range of affect measures (e.g., inhibition, expression), including positive self-evaluations relevant to African American well-being (e.g., spirituality, racial identity; Mattis et al., 2016).

Although the current study used a strong research design and a large, open data set, it had limitations. Some analyses may have been underpowered because of the disparity in the size of the racial groups. Whereas other studies using these data have had comparable sample-size issues and still found intriguing results (e.g., Miller et al., 2016), future work should replicate our findings with larger samples for each ethnic group. Next, because cold-study participants tend to be lower in socioeconomic status than the population as a whole, our results have generalizability limitations. However, socioeconomic status was controlled in all models and was not associated with variables of interest. Also limiting generalizability is the exclusion of individuals with chronic health conditions, but it is worth noting that chronic illness is rare in our population (average age = 30 years). Further, variations in chronic conditions by race typically appear later in life (e.g., age 40 years and older; Golden et al., 2019; Mozaffarian et al., 2016; Quiñones et al., 2019), making this potential confound less of a concern. Lastly, the use of rhinoviruses and influenza virus may limit our ability to relate these findings to the current coronavirus pandemic (for a thorough discussion of this issue, see Cohen, 2021).

Our findings highlight the necessity to explore interactions between positive psychological constructs and race rather than simply controlling for race. They also echo past concerns for the presence of “skin-deep resilience” in African Americans of low social standing (Miller et al., 2016). Understanding this phenomenon is especially critical given growing attempts to improve physical health by manipulating these positive variables (e.g., Bassett et al., 2021). Whereas the mechanisms underlying why African Americans do not benefit from positive self-evaluations are unclear, our findings emphasize the need to discover what factors confer

resilience to our most at-risk populations and further support the notion that what is beneficial for European American health may not apply to everyone.

## Transparency

*Action Editor:* Paul Jose

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## Author Contributions

S. Cohen designed the study, and S. Cohen and S. D. Pressman collected the data. C. R. Wiley analyzed and interpreted the data under the supervision of S. D. Pressman and S. Cohen; S. D. Pressman and K. M. Blevins conducted the preliminary analyses. All the authors contributed to the manuscript and approved the final manuscript for submission.

## Declaration of Conflicting Interests


The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

## Open Practices

All data and materials have been made publicly available via The Common Cold Project website and can be accessed at <https://www.cmu.edu/common-cold-project/about/index.html>. The design and analysis plans for the present study were not preregistered.

## ORCID iDs

Sheldon Cohen  <https://orcid.org/0000-0003-2248-4600>

Sarah D. Pressman  <https://orcid.org/0000-0003-1576-6466>

## Notes

1. No other racial group had a sufficiently large sample size to serve as a comparison group. For more information, see <https://www.cmu.edu/common-cold-project/about/index.html>.
2. Previous analyses of the current data (e.g., Cohen et al., 2003, 2006) have found that the assessment of positive emotional style used in this study not only is highly correlated with more traditional one-time assessments of positive emotionality but also has been shown to be more strongly associated with infection-related outcomes. Additionally, our decision to record and examine multiple assessments was to maximize the accuracy of affect, and several studies have highlighted the value of repeated assessments for this purpose (i.e., Shiffman et al., 2008; Smyth & Stone, 2003). Reviews by Pressman and Cohen (2005) and other researchers have also shown that, as they theorized, longitudinal measures of affect are more critical for health outcomes than any single day, further supporting the study's design of emotion-data collection.
3. The interaction between self-acceptance and race on colds looked nearly identical to that of self-esteem (shown in Fig. 2). This is not surprising given the high correlation between these positive constructs ( $r = .89$ ) and that acceptance was included in the measurement of self-esteem in one study.

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