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# Written Disclosure of Experiences With Racial Discrimination and Antibody Response to an Influenza Vaccine

**Cinnamon Stetler, Edith Chen, and Gregory E. Miller**

*This study examined whether Blacks who wrote about their experiences with racial discrimination in a laboratory-based disclosure intervention would show greater levels of antibody production in response to an influenza vaccine compared with Blacks who wrote about a neutral topic. Forty-seven participants were randomized to write about their thoughts and feelings around their experiences with racism, or to write about their schedule for the week. Participants wrote on the same topic during each of three 20-min sessions. Blood was drawn prior to the intervention and at 1 and 3 months postvaccination to assess antibody production. Participants in the racism disclosure group produced significantly less antibodies to 2 of 3 viral strains. Post hoc analysis suggests that participants who were unsure about whether their events were due to racism or due to other factors had reduced levels of antibody to 1 viral strain. The attributional ambiguity sometimes associated with racism may inhibit the benefits of disclosure interventions for these types of stressors.*

*Key words: racism, stress, antibody, vaccine, influenza*

There are vast racial differences in morbidity and mortality rates in the United States. Blacks live an average of 6.1 years fewer than Whites, and experience much higher rates of diseases such as diabetes, hypertension, cancer, and pneumonia than their White counterparts (Williams & Collins, 1995). A 2001 study reported that infectious diseases account for nearly 10% of the difference in mortality rates between Blacks and Whites (Richardus & Kunst, 2001). The higher rates of infectious diseases among Blacks are of particular concern, as many of these conditions are readily treatable or preventable. Although effective antibiotics and vaccines exist, a recent study suggests that their benefits have not been equally distributed across racial groups. In a study of Medicare recipients, rates of vaccination were approximately 50% for Whites but only 30% for Blacks (Gornick et al., 1996). In a recent paper, Blacks were over 20% less likely to receive an influenza vaccination than Whites, whether they had Medicare or fee-for-service coverage (Schneider, Cleary, Zaslavsky, & Epstein, 2001). There is also evidence to suggest that vaccinations are differentially effective in Blacks and Whites (Breiman et al., 2000; Granoff et al., 1984). One study in an HIV+ sample found that Blacks were three times as likely as Whites to develop pneumonia after receiving a vaccine (Breiman, et al., 2000), yet another study suggested that Black, but not White, children who possess a certain genetic allotype may respond better to Haemophilus influenzae type b vaccine (Granoff et al., 1984).

Researchers have argued that experiences with racism and discrimination, via their effects as chronic stressors, may contribute to the higher rates of morbidity and mortality among Blacks in the United States (Clark, Anderson, Clark, & Williams, 1999). Williams, Yu, and Jackson (1997) showed that race-related stress such as perceived discrimination was associated with more self-reported ill health and days spent in bed in a sample of urban Blacks. Although racism and immune response have not been examined, studies have shown that exposure to other forms of chronic stress is associated with decrements in several measures of immune response (see Herbert & Cohen, 1993; Segerstrom & Miller, 2004, for a review), and increased susceptibility to infectious disease (Cohen, Tyrrell, & Smith, 1991; Leserman et al., 1999). Chronic stress has also been linked to reduced antibody response (e.g., Vedhara et al., 1999).

Given that chronic stress has a negative impact on the immune system's ability to function properly (see Cohen, Miller, & Rabin, 2001, for a review), an intervention designed to decrease levels of stress may help

Cinnamon Stetler, Edith Chen, and Gregory E. Miller, University of British Columbia, Vancouver, Canada.

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Correspondence should be sent to Cinnamon Stetler, University of British Columbia, Department of Psychology, 2136 West Mall, Vancouver, BC V6T 1Z4, Canada. E-mail: cstetler@psych.ubc.ca

to boost the immune system's response to a vaccination. One way that distress can be ameliorated is to instruct participants to write about stressful events during a brief laboratory session. Several studies have shown psychological and physiological benefits from this type of disclosure intervention (Miller & Cohen, 2001; Smyth, 1998), and a few researchers have looked specifically at immune outcomes. Esterling, Antoni, Fletcher, Margulies, and Schneiderman (1994) reported that participants who wrote about or discussed stressful events from their past had better immunologic control of a latent virus than participants randomly assigned to deal with nonstressful topics. Petrie, Booth, Pennebaker, Davison, and Thomas (1995) found that medical students assigned to write about stressful events from their past produced more antibodies in response to a Hepatitis B vaccine than students assigned to write about trivial topics.

Theorists have argued that expressive writing confers these physiological benefits by facilitating the cognitive processing of the stressful event (Pennebaker, 1989; Pennebaker & Keough, 1999). More specifically, writing is thought to facilitate the consolidation of a coherent narrative about the event (Smyth, 1998). This narrative provides the writer with a better understanding of what caused the event to occur and what it means for his or her future, both of which are considered essential milestones in the coping process (Taylor, 1983). Interestingly, it seems that making a causal attribution at all, whether or not this attribution is accurate, is central to adaptive coping (Taylor, 1983). This narrative may also provide the writer with a sense of closure about the stressor. Putting adverse events such as this in the past is known to facilitate psychological adjustment (Ross & Wilson, 2002) and may thus have beneficial physiological effects.

Though racism continues to impact the well being of African Americans (Clark et al., 1999), there has been little effort to examine its biological consequences. The goal of this study was to test the efficacy of a disclosure intervention, aimed at processing experiences of discrimination, on the immune system's response to a routine influenza vaccination. We hypothesized that African American participants who were randomized to write about racial discrimination would produce greater levels of antibody in response to the influenza vaccine than would African American participants who were assigned to write about neutral topics.

## Methods

### Participants

Participants were recruited by flyers posted around the university's campuses. Interested participants contacted the study office and underwent a telephone screening interview. Those who were over 18 years old and in good medical health were invited to participate. Good health was defined as having no history of chronic illness that affected the immune system, no current infectious diseases or upper respiratory symptoms, and no current or recent use of medications that affect the immune system. Participants were paid incrementally as they completed each phase of the study (writing, vaccination, 1 and 3 month follow-up) for a total of $100. Forty-seven participants ($M$ age = 27.46, $SD$ = 10.3) completed the entire study. The total sample consisted of 43 women and 5 men; 46 participants self-identified as African American, 2 as biracial or multiracial.

### Procedure

Participants attended a total of three lab sessions prior to receiving the influenza vaccination. During the first lab session, participants completed a demographics questionnaire and baseline measures of mood and stress. They also had blood drawn via antecubital venipuncture to assess baseline levels of antibodies to the vaccine's components. Next they were randomly assigned to write about their experiences with racism, prejudice, and discrimination (experimental group) or about their schedule for the week (control group) by drawing an envelope from a box. Participants were then seated at a table in a quiet room and given general instructions verbally by the experimenter, who was blind to group assignment. Participants were told to write continuously for 20 min on the topic described in envelope's instructions, without regard for spelling, syntax, or grammar. They were told that the content of their writing would be kept confidential at all times. After 20 min, the experimenter returned to the room and directed the participant to place his or her writing in an envelope, seal it, and deposit it in a secure box. Participants then returned to the lab approximately 5–7 days later for a second writing session, during which they wrote for 20 min about the same topic. The procedure was then repeated 5–7 days later during a third writing session.

Participants in the experimental condition were asked to write about a time when they experienced discrimination due to their race. They were asked to be very detailed about the experiences and the circumstances around it, and to explore their deepest thoughts and feelings in connection with the experiences. They were especially encouraged to write about those thoughts or feelings they had not previously shared with anyone else. During the second and third writing sessions, participants were given similar instructions and the option of continuing to write about the same experience or to detail another incidence of discrimination.

Participants in the control condition were asked to write about their schedule for the up-coming week. They were asked to be as detailed as possible and account for as much time as possible, but to avoid writing about feelings related to the schedule. They were instructed to write in prose form to avoid a "time-table" response.

At the completion of the third and final writing session, participants were directed to obtain a flu shot within one week through either student/employee health or their personal physician. In instances where the experimenter could not witness the administration of the flu shot, participants obtained the signature of the vaccine administrator and returned the signed, dated piece of paper to the experimenter. Administration of the flu shot was verified for 44 of 48 participants. The remaining four participants were excluded from the follow-up portion of the study.

Approximately 30 days from the day of the flu shot, participants returned to the lab for the first follow-up session. During this session, participants completed questionnaires about mood, perceived stress, and health practices. A blood sample was then drawn to assess antibody levels. Participants also returned approximately 60 days later (90 days from flu shot) and underwent a similar follow-up procedure. A 1-week window was allowed for scheduling purposes at each follow-up time point. The Institutional Review Board of Washington University approved this protocol.

### Antibody Response to Vaccination

Hemagglutination inhibition assays (HIA) were used to determine titer of antibodies to each of three strains of the influenza vaccine: A/New Caledonia (H1N1), A/Moscow (H3N2) and B/Sichuan. These assays were performed at the federally funded Center for Vaccine Development at St. Louis University. Under normal circumstances, the influenza virus will cause red blood cells to clump together (agglutinate). This clumping process is blocked if enough specific antibodies are present, providing a method to quantify the volume of antibodies that a person has produced. To perform this assay, serum is serially diluted with saline and then added to a red blood cell preparation that contains influenza. HIA determines the highest dilution at which the participant's serum prevents the clumping of red blood cells. The reciprocal of the level at which this inhibition occurs is interpreted as the titer of antibody present in the serum. Thus, higher values indicate a greater level of antibody production. Because the serum dilutions were increased geometrically (1:2, 1:4, 1:8), a log base 2 transformation was needed to normalize the distribution. A slope value was calculated for each strain by regressing the antibody level on to time since vaccine (baseline, one month, and three months). These slope values served as the dependent variable for most analyses. Greater slope values indicate greater levels of antibody production and maintenance and imply a healthier immune response to the vaccine.

### Psychosocial Indicators

**Perceived stress.** Participants completed the 10-item Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) at baseline and during each follow-up visit. This scale requires participants to rate how frequently they have felt that life is overwhelming, unpredictable, and uncontrollable in the past month. Average Cronbach's alpha across all three administrations was .90.

**Mood state.** Participants completed a brief, 25-item version of the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971; Usala & Hertzog, 1989) to assess positive and negative affect. This questionnaire was completed immediately before and after each of the three writing sessions to assess state affect, and at baseline, 1-month, and 3-month follow-ups to assess positive and negative affect over the past month. The positive affect scale consisted of 9 items (e.g., happy, calm, lively); the negative affect scale consisted of 16 items (e.g., hostile, sad, nervous, tired). Participants were asked to rank on a 5-point scale how intensely they felt these emotions (currently) or how often they experienced these emotions (during the previous month). Higher scores indicate greater intensity or prevalence of the emotion. The average internal consistency for the state affect measures was $\alpha = .91$ for positive affect, and $\alpha = .86$ for negative affect. The average internal consistency for the monthly affect ratings was $\alpha = .92$ for positive affect, and $\alpha = .89$ for negative affect.

### Essay Coding Procedure

To better understand the cognitive and emotional processes the writing procedure evoked, we had trained judges read each essay about racism and rate the author's explanatory certainty (two items) and feelings of closure (two items) about the event. Two coders rated all essays and made ratings on a 5-point scale. In cases where they disagreed by more than 2 points, disputes were resolved through a consensus meeting. Independent of this consensus, the average intercoder correlation across the four items and three essays for all participants was $r = .68$ ($p < .001$, $N = 26$).

### Explanatory Certainty

Though the participants in the experimental group were instructed to write about a time when they experi-

enced racism or discrimination, the events they described proved to be causally complex. Some of the participants clearly attributed the event to racism and others saw racism as one of many possible factors at work. To understand whether participants had formed definitive explanations about the causes of their experience, we had judges rate the extent to which they (a) attributed the event described to the racism or prejudice of another party, and (b) attributed the event described to factors other than racism (e.g., his or her own behavior, other characteristics of the situation). These items were rated on a scale ranging from 1 (*not at all*) to 5 (*very much*). As expected, responses to these items were highly inversely correlated, $r = -.77$. To form a measure of explanatory certainty, we then subtracted scores on the second item from scores on the first item. This yielded an index where higher scores (for example, a 5 on the first item and a 1 on the second for a total score of 4) indicate more explanatory certainty (the essayist clearly attributes the event to racism/discrimination) and lower scores (a 3 on both items for a total score of 0) indicate less explanatory certainty (the essayist is making multiple attributions for the event or makes no attributions at all). The average explanatory certainty score was 2.49 ± 1.21, indicating that despite the instructions, most participants did not make a clear attribution to racism in their essays.

### Feelings of Closure

To assess the extent to which participants achieved a sense of closure during the writing intervention, we asked judges to rate the degree to which the essay's author (a) viewed racism as an ongoing, permanent condition (something they face or might potentially face most days); and (b) viewed their experience of racial prejudice as in the past, an isolated event, and/or not likely to happen again (not something they face or expect to face most days). The ratings for each item were made on a scale ranging from 1 (*not at all*) to 5 (*very much*). The second item was reverse-scored to facilitate interpretation of summary scores. For example, an essay would receive a high score on the second item if it included sentences like "Racism hasn't been a big part of my life"; "I can only remember this happening a few times in my whole life"; "Racism was more of a problem 30 years ago than it is today"; etc. An essay would receive a high score on the first item if it included sentences like "Every time I go to this neighborhood, something always happens"; "Racism is everywhere in our world"; "Hardly a day goes by when I don't feel discriminated against in some way." Because the ratings for these items were highly inversely correlated ($r = -.95$), they were summed to create a feelings of closure measure related to racism. The average closure score was 7.2 ± 1.87.

**Table 1.** *Demographic and Health Characteristics*

| Measure | Racism Disclosure | *SD* | Control | *SD* |
|---|---|---|---|---|
| *N* | 26 | | 22 | |
| Age (years) | 27.4 | 11.3 | 27.6 | 9.3 |
| Gender (% women) | 92.3 | | 86.4 | |
| Education (years post-secondary) | 2.3 | 2.0 | 2.4 | 1.4 |
| Income (US dollars/year) | $47,800 | | $34,500 | |
| Oral contraceptive use (# yes) | 4 | | 2 | |
| Daily smoker (# yes) | 1 | | 2 | |
| Number of drinks/week | 3.1 | 5.3 | 3.8 | 8.7 |

## Results

Table 1 displays the characteristics of the sample. Twenty-six participants were randomized to the disclosure of racism condition, 22 to the control condition. The two groups did not differ on age, $t(46) = .08$, *ns*; income, $t(42) = -1.77$, $p = .09$; years of education, $t(46) = .11$, *ns*; amount of alcohol consumed per week, $t = 1.1$, *ns*; or number taking oral contraceptives, $\chi^2 = .43$, *ns*. Only three participants (two in control group) reported that they were regular smokers, that is, smoked at least one cigarette, cigar, or pipe a day. The pattern of results was not altered when these three participants were excluded from the analyses. Neither oral contraceptives, alcohol intake, income, nor years of education were significantly associated with antibody responses (*p's* > .34). Though the groups were equivalent in terms of age, this variable was significantly and inversely related to antibody response (*r*s range from –.37 to –.49; average $r = -.44$, $p < .01$). Therefore, we included age as a covariate in subsequent analyses.

### Antibody Response to Vaccine

The vast majority of participants had been previously exposed to one or more vaccine components, as indicated by a titer ≥ 2 (Cox et al., 2002). Prior to vaccination, 67% ($N = 34$) of the participants had titers to the New Caledonia strain, 96% ($N = 49$) had titers to the Moscow strain, and 94% ($N = 48$) had titers to the Sichuan strain. Those participants who had prevaccination antibody titers to any of the three strains were evenly distributed across the groups, $\chi^2 = 2.7$, *ns*. Note that even with previous exposure to a strain, there can be variability in immune response to a new vaccination. Four participants had maximum titers (1,024) to one of the strains prior to receiving the vaccine, 2 participants from each group. The results reported here include these four participants; however, the overall pattern of results was the same when they were excluded from analyses. Retaining these participants is a conservative

approach given that doing so decreases the variance in antibody slope, making group differences harder to detect.

The majority of participants also showed a response to the vaccination. To evaluate adequacy of antibody response, virologists can use two different standards: whether there has been a four-fold increase in titer levels and whether titers reach a level that is considered adequate protection from infection (usually 40 or greater; Cox et al., 2002). If the first standard is applied, 60% of participants showed a four-fold increase in their New Caledonia titers, 50% showed an increase in their Moscow titers, and 48% showed an increase in their Sichuan titers. If the adequate protection standard is applied, 60% of participants' titers to the New Caledonia strain reached a level of at least 40, 73% to the Moscow strain, and 77% to the Sichuan B strain.

### Short-Term Effects on Mood

Participants completed mood ratings immediately before and after each writing session. Given the nature of topics participants were directed to write about, we expected different patterns of emotional response in the groups. Change scores (post–pre) averaged across the three writing sessions for positive, $t(46) = -2.02$, $p = .05$, and negative mood, $t(46) = 1.94$, $p < .06$, differed by condition. Participants in the control group were more positive (–.53 ± 2.14 vs. –2.62 ± 4.46) and less negative (–1.63 ± 3.35 vs. .99 ± 5.5) after writing than participants in the racism disclosure group. Change in affect did not account for a significant amount of variance in antibody response.

### Longer Term Effects on Mood

We predicted that participants in the racism disclosure group would experience less perceived stress and negative affect, and more positive affect, compared to the control group at 1 month and 3 months postvaccine. Separate 2 (Group) × 3 (Time) repeated measures ANOVAs were run for each of these variables. The only significant effects that emerged were main effects for Time on negative affect, $F(2, 80) = 3.57$, $p < .04$, and perceived stress $F(2, 80) = 5.56$, $p < .01$, indicating a decline in negative affect and perceived stress from baseline to the last follow-up visit. The groups did not differ on these variables at baseline. No Group effects or Group × Time interactions were statistically significant. Unexpectedly, the groups did not differ on positive or negative affect or perceived stress throughout the follow-up period.

### Disclosure and Antibody Response to Vaccine

The influenza vaccine consists of three different strains of virus. Table 3 displays the geometric means and standard errors for each strain by group at each time point. We calculated a slope variable for each strain by regressing the log-transformed antibody values on time (0, 1, and 3 months). These slope values were the dependent variables for hierarchical regression. Baseline values for the respective virus and participant age were entered in the first step. Group was entered in the second step. Recall that we also con-

**Table 2.** *Means, Standard Deviations, and Inter-Rater Correlations for Post Hoc Coding of Essays*

| | Rater 1 | | Rater 2 | | |
|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | Inter-Rater Correlation[a] |
| Closure item 1 | 3.65 | .95 | 4.05 | 1.06 | .73 |
| Closure item 2 | 3.56 | .94 | 4.45 | .93 | .66 |
| Explanatory certainty item 1 | 4.12 | .71 | 4.08 | .77 | .69 |
| Explanatory certainty item 2 | 4.19 | .69 | 4.46 | .61 | .63 |

*Note*. Closure item 1 = the extent to which the author views racial prejudice as an ongoing, permanent condition. Closure item 2 = the extent to which the author views racial prejudice as in the past, isolated, and not likely to happen again. Explanatory Certainty item 1 = the extent to which the author attributes the event(s) to racism or prejudice. Explanatory Certainty item 2 = the extent to which the author attributes the event described to his/her own traits or behavior as an individual.

[a]$N = 26$, $p < .001$.

**Table 3.** *Geometric Mean and Standard Error Antibody Titers for Each Strain by Group and Time*

| | Baseline | | | | 1 Month | | | | 3 Months | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Disclosure | | Control | | Disclosure | | Control | | Disclosure | | Control | |
| Location | *M* | *SE* | *M* | *SE* | *M* | *SE* | *M* | *SE* | *M* | *SE* | *M* | *SE* |
| New Caledonia | 3.7 | .51 | 2.44 | .43 | 6.51 | .5 | 6.88 | .57 | 5.85 | .49 | 6.19 | .66 |
| Moscow | 4.9 | .37 | 4.9 | .4 | 7.23 | .3 | 7.61 | .43 | 6.86 | .28 | 7.38 | .46 |
| Sichuan | 4.74 | .47 | 4.96 | .37 | 7.2 | .37 | 7.0 | .42 | 7.02 | .38 | 6.81 | .43 |

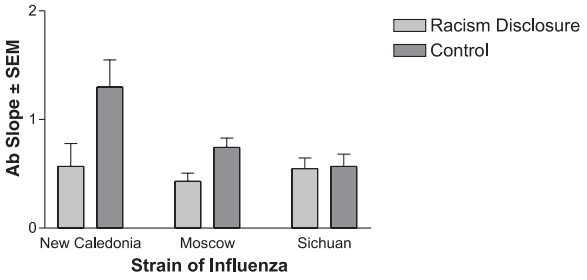


**Figure 1. Adjusted mean antibody slope (± *SE*) for three strains of influenza virus by group.**

trolled for age because it was negatively associated with antibody levels (*r's* range from –.41 to –.51, all *p's* < .007).

For the New Caledonia strain, group accounted for approximately 8% more variance in slope above and beyond baseline levels and age (Table 4). Racism disclosure participantss had a mean slope (adjusted for age) of .57 (± .21); controls averaged 1.30 (± .25; Figure 1). This suggests that racism disclosure participants produced antibodies at approximately half the rate that control participants did. The unexpected pattern of findings extended to the Moscow strain as well. Group accounted for approximately 7% more variance in slope beyond baseline levels and age (Table 4), such that racism disclosure participants (average slope = .43 ± .08) produced antibodies at only 60% the rate of control participants (average slope = .74 ± .09; Figure 1). For the Sichuan strain, Group did not explain any more variance in slope beyond baseline levels and age ($\Delta F$ = .02, *ns*). Racism disclosure participants had an average slope of .55 (± .10), and control participants averaged .57 (± .11). Given that greater slope values indicate higher levels of antibody production postvaccination, participants who wrote about their experiences with racial discrimination had a diminished response to the vaccine, compared to control participants, for two of the three influenza strains.

## Essay Content and Antibody Response

To better understand why writing about racism diminished antibody responses to the vaccination, we examined how the writing exercise may have modified participants' feelings of closure about racist events, and attributions for their occurrence. Table 2 displays the means, standard deviation, *N*, and inter-rater correlations for each of the four coded items. Hierarchical linear regressions were performed just on the data from the participants in the racism disclosure group, this time entering the essay variables in the second step instead of the group variable. For the New Caledonia strain only, explanatory certainty and feelings of closure accounted for an additional 16% of the variance in slope, beyond age and baseline levels (Table 5). Explanatory certainty proved to be a significant predictor of antibody slope (ß = .49, $p < .03$), but feelings of closure did not (ß = –.15, *ns*). To the extent that participants lacked a clear explanation for the event described in their essays, they showed a weaker antibody response to this strain of the vaccine. In other words, to the extent that participants were able to definitely attribute their experience to racism, they showed a greater antibody response. The essay variables did not account for a significant amount of variance in the response slope of the other two vaccine strains (*p*s >.22).

**Table 4.** *Written Disclosure of Experiences With Racism Predicts Antibody Response to New Caledonia and Moscow Strains*

| Predictor | B | *SE* B | β | *t* | *p* < |
|---|---|---|---|---|---|
| For New Caledonia | | | | | |
| STEP 1 | | | | | |
| Baseline ab | –.18 | .07 | –.37 | –2.75 | .01 |
| Age | –.004 | .02 | –.35 | –2.58 | .02 |
| STEP 2 | | | | | |
| Group | –.73 | .33 | –.29 | –2.2 | .04 |
| For Moscow Strain | | | | | |
| STEP 1 | | | | | |
| Baseline ab | –.17 | .03 | –.53 | –4.97 | .001 |
| Age | –.002 | .01 | –.46 | –4.23 | .001 |
| STEP 2 | | | | | |
| Group | –.32 | .12 | –.27 | –2.7 | .01 |

*Note.* B = unstandardized regression coefficient; *SE* B = Standard error of regression coefficient; β = standardized regression coefficient. For Step 1 of New Caledonia equation: Cumulative $R^2$ = .27, $\Delta R^2$ = .27, $p < .001$; for Step 2: Cumulative $R^2$ = .35, $\Delta R^2$ = .08, $p <$ .04; For Step 1 of Moscow equation: Cumulative $R^2$ = .73, $\Delta R^2$ = .53, $p < .001$; for Step 2: Cumulative $R^2$ = .78, $\Delta R^2$ = .07, $p < .01$.

**Table 5.** *Explanatory Certainty Predicts Antibody Response to New Caledonia Strain*

| Predictor | B | *SE* B | β | *t* | *p* < |
|---|---|---|---|---|---|
| STEP 1 | | | | | |
| Baseline ab | –.12 | .04 | –.50 | –2.89 | .01 |
| Age | –.002 | .01 | –.36 | –2.06 | .05 |
| STEP 2 | | | | | |
| Explanatory certainty | .48 | .20 | .49 | 2.37 | .03 |
| Feelings of closure | –.05 | .07 | –.15 | –.73 | *ns* |

*Note*. B = unstandardized regression coefficient; *SE* B = Standard error of regression coefficient; β = standardized regression coefficient. For Step 1 of equation: Cumulative $R^2$ = .35, $\Delta R^2$ = .35, $p <$ .01; for Step 2: Cumulative $R^2$ = .49, $\Delta R^2$ = .16, $p$ = .06.

## Discussion

This study examined whether a written disclosure intervention, intended to reduce stress around events related to racism and discrimination, would improve antibody response to an influenza vaccine. Our results indicated that, contrary to predictions, participants who received the intervention did not show an

improved antibody response. In fact, they showed worse antibody response than the control group; in the case of the New Caledonia strain, the response slope was reduced by half, and for the Moscow strain, by more than 40%. We also predicted that participants in the racism disclosure group would show increased positive affect or decreased negative affect or perceived stress compared to the control group. No such group differences were found. In an effort to explore the reasons behind these unexpected results, we coded the racism disclosure essays post hoc for constructs that the disclosure and coping literatures have discussed as important in the face of stressful events, such as achieving a sense of closure, and developing explanations or causal attributions. Results of these analyses indicated that participants in the racism disclosure group who did not clearly tie the negative event to racism or discrimination, and thus did not make clear causal attributions in their essays, tended to have a worse antibody response. Though this study has several important limitations, the findings may shed light on the mechanisms by which disclosure interventions operate by illustrating a circumstance when such interventions are not as beneficial as previously observed.

Other studies have found both psychosocial and physiological benefits with disclosure interventions, though none have examined this effect in a minority population or using discrimination as the disclosure topic. It may be that the discrimination faced by Blacks differs in important ways from the stressors addressed in other disclosure intervention studies. Unlike other studies, whose participants address stressors that have largely occurred in the past in some time-limited fashion, racism is an ongoing and ubiquitous presence in modern society. In addition, racism often emerges in very subtle, indirect ways, now that overt displays of racism are no longer tolerated by mainstream society. These veiled yet pervasive stressors, such as racism, may promote rumination and/or vigilance rather than the formation of a coherent narrative. To the extent that participants in the racism disclosure group were unable to construct a narrative, this may explain why the group differences in antibody response were in an unexpected direction (Song, 2001). Furthermore, recent findings by Major, Kaiser, and McCoy (2003) suggested that attributing negative outcomes to the prejudice of others may have a protective effect on one's self-esteem and level of depression. This implies that interventions such as the one in this study may benefit participants in the racism disclosure group only to the extent that those participants attribute the event to racism. Our results also suggest that the benefits of attributing events to others' prejudice may extend beyond psychological outcomes to immunological ones as well.

The literature has shown that successful coping (and improved health outcomes) frequently involves finding personal meaning in one's experience (Affleck, Tennen, Croog, & Levine, 1987; Bower, Kemeny, Taylor, & Fahey, 1998). One component of finding meaning is making an attribution as to the event's cause (Taylor, 1983). Attributional ambiguity has been associated with poorer psychological outcomes such as self-esteem, motivation, or life satisfaction (Crocker, Voelkl, Testa, & Major, 1991; Major & Crocker, 1993; Schneider, Hitlan, & Radhakrishnan, 2000). One study found that participants who perceived themselves as excluded by peers, but did not attribute it to racism reported more illness symptoms than those who perceived themselves to be excluded because of racism (Schneider, Hitlan, & Radhakrishnan, 2000). The authors explain that the ambiguity surrounding why they had been excluded may have deleterious effects on well being. If the participants in our study faced similar situations, in which the real cause of an event was unclear but racism was suspected, this uncertainty may have been exacerbated by the disclosure intervention for some participants. Statements such as "Because I am uncertain about his reasoning, this situation still bothers me" and "When I was a senior in high school and I got into Princeton and Duke I wondered if I was actually good enough or did they just want another Black girl for their statistics" indicate that participants in our study faced ambiguity as well. The difficulty some participants had in arriving at a clear decision regarding the cause of the stressful event may have led them to produce less antibodies in response to the vaccine.

This study also has important limitations, and their impact on the nature of the results should be addressed. First, the sample size was small, thus increasing the possibility that these findings are due to chance. Though the direction of the difference was not as predicted, significant differences in antibody slope were found for two of three vaccine strains, suggesting that the study was powerful enough to detect such effects. It is unclear why differences were not detected in all three influenza strains used in the vaccine. Baseline titers or variance in baseline titers were not significantly higher or lower for the strains that did show effects (New Caledonia and Moscow) compared to the strain for which there were no significant effects (Sichuan). A greater amount of variance was found for the slope of the antibody response to the New Caledonia strain, compared to the other two strains. Thus, differences in variance may explain the New Caledonia findings, but they would not explain why an effect emerged for Moscow but not Sichuan. Thus, differences in baseline titers or variance in baseline titers or slope do not seem to be responsible for the lack of effects across all three strains. Effects in some, but not all, vaccine strains has been found in other studies (Miller, Cohen, Pressman, Barkin, Rabin, & Treanor, 2004; Vedhara et al., 1999).

Another important issue is that the primary experimenters in this study were White. This may have fostered some amount of distrust in the participants, who may have been less willing to fully disclose during the writing intervention, thereby reducing its efficacy. Future studies may want to ensure that the experimenter and participants have the same racial background, or they may want to test this question empirically.

Written disclosure of stressful life events has been shown to have both psychological and physiological benefits. However, such benefits may not be without their limitations. Inasmuch as disclosure is thought to induce the cognitive processing of an event such that a meaningful narrative is formed, that cognitive processing may not be useful for all types of people or events. Coping with certain types of ongoing but ambiguous stressors, such as racism and discrimination, may not be enhanced by the intense examination of these interventions. Cognitive processing may not be beneficial in the face of ambiguous events, or for people who tend not to make causal attributions but instead tend to ruminate over events. The benefits of disclosing may be strengthened if individuals are specifically instructed to arrive at some causal factor for the stressful event. The results of this study suggest that for African Americans, the biological effects of the stress of experiencing racism or discrimination can be alleviated best when clear attributions are made.

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