Article

Minority Stress, Emotion Regulation, and Executive Function: An Experimental Investigation of Gay and Lesbian Adults

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Abstract

Minority stress is associated with emotional, cognitive, and health consequences for sexual minority individuals. Mechanisms remain poorly understood. Theory and preliminary evidence suggests that stress associated with minority identity results in negative emotions and attempts at suppression, which may contribute to depletion of executive function. This study was an experimental investigation of gay and lesbian adults ($N = 141$). Participants engaged in a stressful interpersonal task with a confederate with anti-gay or pro-gay attitudes. We examined how condition affected executive function, along with potential mediators (state anger, anxiety, expressive suppression). Contrary to hypotheses, participants in the anti-gay condition showed better postmanipulation cognitive performance than the pro-gay condition. This effect was partially mediated by anger. Participants in the anti-gay condition reported greater attempts at suppression, but this variable did not emerge as a mediator. This study was the first to experimentally manipulate exposure to anti-gay attitudes and measure effects on executive function.

Keywords

minority stress, gay and lesbian, executive function, expressive suppression

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Discrimination and Minority Stress

Although attitudes toward lesbian, gay, and bisexual (LGB) individuals have improved significantly over the past few decades (Twenge, Sherman, & Wells, 2016), continued social prejudice and discrimination remain problematic for LGB people. According to law enforcement statistics, 17.7% of the 6,121 hate crime victims in the United States in 2016 were targeted based on their perceived sexual orientation (Federal Bureau of Investigation, U.S. Department of Justice, 2017). A meta-analysis demonstrated that LGB individuals are more likely to experience a variety of forms of harassment and victimization than heterosexual individuals. Approximately 56% of LGB people reported verbal harassment, 50% sexual harassment, and 44% discrimination (Katz-Wise & Hyde, 2012).

Minority stress theory (Meyer, 1995, 2003) proposes that the stress associated with these discrimination experiences, chronic expectations of rejection, internalized homophobia, and concealment of sexual orientation negatively impact mental health. Other authors have proposed mechanisms for these effects, including difficulties with emotion regulation, stressors in interpersonal relationships, and negative thought patterns (Hatzenbuehler, 2009). Elaboration of this theory suggests that the effects of minority stress extend to health behaviors and physical health as well (Lick, Durso, & Johnson, 2013). Indeed, LGB adults evidence disparities in health risk behaviors, mental health, and physical health, compared with heterosexual individuals, and minority stress experiences are a significant contributing factor (see Institute of Medicine, 2011, for a thorough review).

Executive Function (EF) and Self-Regulation

The specific cognitive and emotional mechanisms linking minority stress to health risk behaviors require additional consideration and empirical testing. One possibility is that minority stress leads to poorer EF, which may be responsible

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for some of the health disparities documented. EF has been conceptualized as the "set of higher-order neurocognitive processes that allow higher organisms to make choices and to engage in purposeful, goal-directed, and future-oriented behavior" (Suchy, 2009; also see Suchy, 2015, for a review). EF has been increasingly recognized in the behavioral medicine literature (see Williams & Thayer, 2009) as an important contributor to enacting healthy behaviors (e.g., diet and exercise; Gettens & Gorin, 2017, adherence to medical regimens; Suchy et al., 2016) and avoiding unhealthy behaviors (e.g., alcohol and substance misuse; Blume & Marlatt, 2009). EF also appears to be sensitive to the effects of acute and chronic stress (Shields, Sazma, & Yonelinas, 2016), pain (Nes, Roach, & Segerstrom, 2009), poor sleep (Nilsson et al., 2005; Wilckens, Woo, Kirk, Erickson, & Wheeler, 2014), or the suppression of emotion (Franchow & Suchy, 2015, 2017). Together, these findings suggest that minority stress might tax EF in a manner that increases health risks.

Theoretical and empirical research from the social psychological literature on the association between stress and self-regulation additionally informs this idea. Self-regulation refers to "the capacity to exert control over cognition, emotion, behavior, and physiology" (Nes et al., 2009). Cognitive and affective self-regulation are central to everyday function (McClelland, Cameron Ponitz, Messersmith, & Tominey, 2010), including enactment of health behaviors (i.e., maintaining a healthy diet or refraining from use of alcohol and tobacco; Hagger & Chatzisarantis, 2017). Moreover, cognitive and emotional function is susceptible to dysregulation from various forms of stressors (for a review, see Lupien, McEwen, Gunnar, & Heim, 2009). EF is thought to reflect the *capacity* for self-regulation, and "state reductions" in EF in response to stress may explain failure in the ability to regulate effectively across domains (Hofmann, Schmeichel, & Baddeley, 2012). Many of the empirical designs that researchers have used to explore the effects of discrimination-related stress on self-regulation actually employ tests used more commonly by neuropsychologists to assess EF (e.g., the Stroop; Inzlicht, McKay, & Aronson, 2006; Salvatore & Shelton, 2007).

Associations Between Minority Stress and EF

No studies we could identify have tested the possibility that exposure to anti-gay attitudes impacts LGB individuals' neurocognitive or EF. However, some research has explored the possibility that other manifestations of stigma might tax cognitive and emotional resources. For example, Inzlicht and colleagues (2006) told African American participants that the Stroop test (a test commonly used as an index of EF) was an intelligence test (thereby drawing attention to negative stereotypes about African Americans and intelligence). These authors found that those participants performed more slowly than African American individuals who were not told it was an intelligence test, and more slowly than White participants in either condition. A related study found that merely being exposed to the idea that members of your group are discriminated against could impact Stroop performance (Salvatore & Shelton, 2007). A multistudy investigation by Baumeister, DeWall, Ciarocco, and Twenge (2005) showed that both experiencing rejection and expecting future rejection impairs self-regulation across a variety of domains (i.e., consumption of healthy beverage, restraint from unhealthy food, persistence at frustrating puzzle, performance on dichotic listening task). It is reasonable to suspect that these findings might extend to LGB individuals in minority stress situations. Critcher and Ferguson (2014) experimentally manipulated whether heterosexual participants were instructed to conceal their sexual orientation in an interview task and demonstrated adverse effects on self-regulatory domains (i.e., complex thinking, inhibition/restraint, and physical endurance).

Mechanisms—Emotion and Expressive Suppression

Another relatively unstudied question is *how* minority stress might tax cognitive and self-regulatory resources. One plausible mechanism is that encountering prejudice elicits an emotional response (e.g., anxiety, anger) and active attempts to regulate or suppress expression of those emotions. These emotional responses might then be linked to cognitive or self-regulatory function. Individuals exposed to interpersonal rejection generally (Richman & Leary, 2009) and discrimination in particular (Schmitt, Brancsombe, Postmes, & Garcia, 2014) experience a range of negative emotions, including frustration, anxiety, and sadness. Qualitative work has demonstrated that LGB individuals report utilization of varied emotion regulation strategies in response to minority stress (McDavitt et al., 2008). Quantitative work has shown that LGB individuals report greater rumination and difficulties in identifying their emotions compared with heterosexual individuals (Hatzenbuehler, McLaughlin, & Nolen-Hoeksema, 2008) and that minority stress experiences predict increased expressive suppression and rumination (Hatzenbuehler, Dovidio, Nolen-Hoeksema, & Phills, 2009; Hatzenbuehler, Nolen-Hoeksema, & Dovidio, 2009). These studies additionally demonstrated negative consequences of these emotion regulation attempts for mental health of sexual minority individuals.

Relatedly, a theoretical model proposing mechanisms for stereotype threat effects suggested that both the experience of negative emotions as part of the stress response and the attempt to suppress these emotions account for poorer performance (Schmader, Johns, & Forbes, 2008). Johns, Inzlicht, and Schmader (2008) found experimental evidence that stereotype threat causes individuals to intentionally suppress emotion (in this case, anxiety). This effortful regulation is responsible for poorer performance on tasks related to EF. If merely activating stereotypes has the potential to cause individuals to suppress emotion, it is likely that more explicit

exposure to discrimination or anti-gay attitudes could have similar effects. Research in the stress literature (e.g., Lazarus, 1991) has found that experiences perceived as outside of one's control (like those that characterize minority stress) often result in expressive suppression as an emotion-focused strategy. Controllable situations may elicit more approach-oriented responses (e.g., attempting to confront the stressor).

A growing body of research suggests that experiencing negative emotions and suppressing their expression contributes to problems in verbal and working memory (Richards & Gross, 2000; Schmeichel, 2007), EF (Franchow & Suchy, 2015, 2017; Niermeyer, Franchow, & Suchy, 2016), and self-regulation (Baumeister, Schmeichel, & Vohs, 2007). Researchers have instructed participants to suppress their emotional responses (usually to emotional videos) and found that they are subsequently dysregulated (e.g., Muraven, Tice, & Baumeister, 1998). Recent studies in the neuropsychological literature have similarly demonstrated that the amount of recent expressive suppression reported by participants was associated with performance on a battery measuring multiple facets of EF (Franchow & Suchy, 2015; Niermeyer et al., 2016).

Summary

Minority stress is the prevailing explanation for health disparities between LGB and heterosexual individuals. However, our present understanding of how that might occur is very limited. One plausible route involves the potential for minority stress experiences to lead to a range of negative emotional reactions and attempts to regulate or suppress those reactions, thereby resulting in state decrements in EF. Williams and Thayer (2009) noted that poor EF predicts a variety of medical conditions, including "obesity, diabetes, hypertension and vascular disease, lung disease, and HIV/AIDS." These medical conditions have in common behavioral and lifestyle influences that rely on one's higher-level ability to regulate across domains. Understanding these effects and the underlying cognitive and emotional mechanisms is important for developing prevention and intervention efforts and targeting these efforts to specific high-risk groups.

Present Study and Hypotheses

The primary purpose of this study was to examine the association between encountering social prejudice and EF performance. A secondary aim was to test potential mediators of that effect (state anger, anxiety, expressive suppression). We used an experimental paradigm in which LGB participants engaged in a stressful interpersonal task and manipulated additional exposure to anti-gay attitudes. Emotion, expressive suppression, and cognition were assessed both before and after the experimental manipulation. Importantly, performance on EF tasks relies not only on EF capacity but also on lower order component processes (CP) such as speed of processing, visual perception, and motor and verbal output (Lezak, Howieson, Bigler, & Tranel, 2013; Suchy, 2015; Suchy, Niermeyer, & Ziemnik, 2017). For that reason, we additionally explored whether observed effects were unique to EF or also involved CP. Our hypotheses were as follows:

1. **Hypothesis 1:** Participants exposed to anti-gay attitudes will exhibit poorer performance on the posttask cognitive tests, compared with participants interacting with a pro-gay confederate, relative to baseline performance. We will examine performance on tests of both higher-order (EF) and lower-order (CP) processes to determine whether the effect of our manipulation was unique to EF.
2. **Hypothesis 2:** State anger, anxiety, and expressive suppression, will mediate the association between exposure to anti-gay attitudes and cognitive performance. Specifically, participants in the anti-gay condition will report increased anger, anxiety, and expressive suppression during the task, compared with participants in the pro-gay condition. These mechanisms will be partially responsible for the observed associations between exposure to anti-gay attitudes and EF. We will again examine whether effects are uniquely executive with control for lower-order CP scores in these analyses.

Method

Participants

Participants ($N = 150$) were recruited from an existing list of LGB individuals who indicated an interest in research participation at the local LGB pride festival, as well as targeted Facebook advertising. Participants were eligible for the study if they were between the ages of 18 and 60 years and self-identified as lesbian or gay. If participants identified as queer or bisexual, they were asked follow-up screening questions regarding sex of recent dating partners and attraction patterns. Participants were eligible if they indicated recent dating partners of the same sex and primary same-sex attraction patterns, regardless of identity. The first nine participants were regarded as pilot cases while we tested and refined aspects of the manipulation, resulting in 141 participants who were run through the final protocol. Seven participants in the sample were found to have a scaled score below 4 on at least one of the subtests of our neuropsychological battery. These cases were removed from analyses because they were unusually low for a nonclinical sample, and likely reflected either problems with test administration, a lack of effort during testing, or cognitive impairment. An additional seven participants were removed from analyses because they endorsed significant suspicion about the

Table 1. Participant Demographic and Baseline Descriptives by Experimental Condition.

	Anti-gay condition (n = 65)	Pro-gay condition (n = 62)	Group difference (p)
Age	24.88 (6.00)	27.09 (7.85)	.08
Education Scale	3.40 (0.93)	3.53 (0.78)	.39
Personal Income Scale	3.22 (2.05)	3.52 (1.85)	.38
"Outness" Scale	4.34 (1.02)	4.44 (0.93)	.58
Race/ethnicity (% White)	86	81	.41
Sex (% male)	43	52	.34
Executive function baseline	11.54 (1.59)	11.12 (1.59)	.14
Component process baseline	10.85 (1.76)	10.58 (1.52)	.37
Information (WAIS-IV)	13.32 (2.96)	12.77 (2.91)	.30
State anger baseline	1.54 (0.53)	1.52 (0.31)	.77
State anxiety baseline	1.99 (0.66)	1.99 (0.51)	.99

Note. Values displayed in this table are mean (standard deviation) for each continuous variable by condition. Values are displayed as relevant percentages for categorical variables. The t tests were run to investigate differences in each variable by condition and p values are presented. WAIS-IV = Wechsler Adult Intelligence Scale–Fourth Edition.

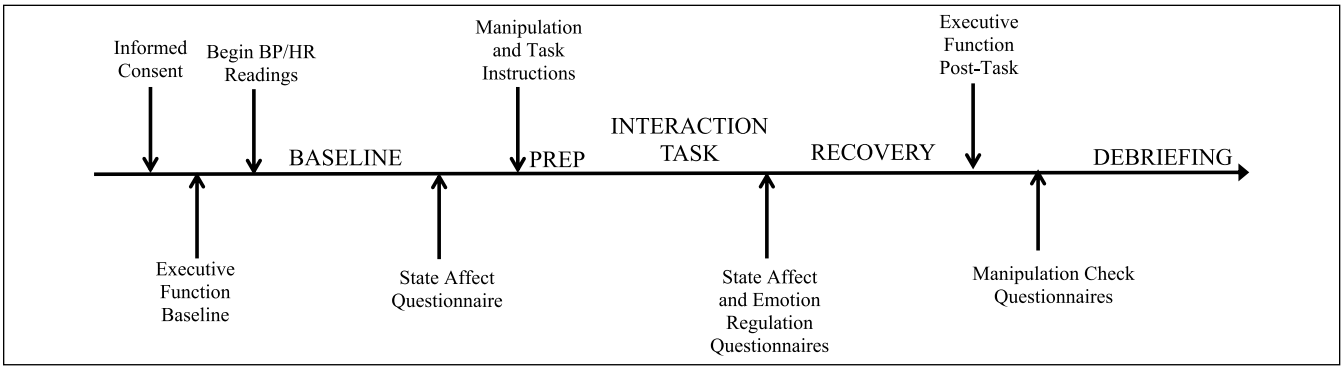

Figure 1. Study protocol.
Note. This figure illustrates the order of lab study procedures. BP = blood pressure; HR = heart rate.

manipulation prior to debriefing. This resulted in a final analytic sample of 127 participants. A priori power analysis demonstrated a required sample size of 98 participants to achieve effect size of .25 with alpha of .05 and power of .80 for the main analyses of interest.

The mean age of the analytic sample was 26 years (SD = 7; range = 18-58 years). Participants were 84% European American, 6% Hispanic/Latino, 6% Asian/Pacific Islander, and 4% African American or "other" category. For highest education level completed, 9% of the sample reported high school graduate, 47% some college or technical school degree, 30% college degree, and 13% professional or graduate degree. Modal personal income was between US$16,000 and US$25,000 annually. The relatively low socioeconomic position of this sample was likely due to the younger age of participants, including college students. Participant differences by randomized condition were assessed and results presented in Table 1. Condition was not associated with demographics, participant "outness" about sexual orientation, or baseline emotion or cognition measures.

Procedure

The institutional review board (IRB) of the participating institution approved all study procedures. Participants were led to believe through email and telephone exchanges that they were eligible to participate in two separate studies: (a) an online survey about their experiences as a gay or lesbian adult and (b) a lab-based experiment about the health effects of diverse participant interactions that did not specify inclusion or exclusion criteria based on sexual orientation. The online questionnaire took approximately 30 to 45 min to complete and included questions on sociodemographic information, sexual attraction, identity development, risk behaviors, minority stress experiences, and mental health. Responses to the online survey were linked to the lab-based data via a unique number assigned to each participant.

Participants were scheduled for a laboratory session after completing online questionnaires. Figure 1 provides a schematic diagram of lab study procedures. The order of procedure and wording of the script were adapted from previous research within this lab (Cundiff, Smith, Baron, & Uchino, 2016). Research assistants were blind to participant condition. When

participants arrived, they were told that their interaction partner would be arriving in the next few minutes and would be directed to a separate lab room. Participants were informed that the purpose of the study was to examine how diverse individuals interact and evaluate one another in interview situations, and how those interactions affect health. After informed consent, participants completed the baseline cognitive tests. Other study aims (not reported here) involved assessment of cardiovascular responses, so electrodes and a blood pressure cuff were placed on participants. They then completed a 10-min, minimally engaging, baseline task. Participants then completed the measure of baseline state affect.

Participants were provided with verbal information about the evaluative task in which the interviewer would evaluate the interviewee based on his or her intelligence, competence, and likeability. They were told to disclose as much or little personal information about themselves as they would like. Participants were led to believe that they were interacting with a participant in another room through microphone and speaker so that "how attractive, unattractive, or similar to you the other person is doesn't affect how you interact with them or how you react to them in terms of heart rate and blood pressure." They were led to believe they would meet the other participant at the end of the study. Participants next drew a slip of paper out of a cup that resulted in all participants being "randomly assigned" to the role of interviewee. The research assistant left the room at this point, presumably to inform the other participant about their role.

Prejudice manipulation. The research assistant provided the participant with a "Q&A" form and indicated it was completed by the interviewer/other participant. They were prompted to "look it over to know a little more about" their interviewer. The handwriting was gender-matched to the participant, based on data suggesting that participants are capable of reliably identifying sex differences in handwriting (Beech & Mackintosh, 2005). One of the "Q&A" questions asked, "What are two political issues that you are passionate about? What is your position on these issues and why?" Exposure to anti-gay attitudes was manipulated by varying responses to the question. Participants in the anti-gay condition believed their interview partner responded as follows: "As a straight person, I hope that increased support for gay marriage does not lead to more rights in other areas for gay people, such as teaching in schools. It's not a healthy lifestyle that we want to promote." Pro-gay condition: "Even though I'm straight, I hope that increased support for gay marriage leads to more rights in other areas for gay people, such as teaching in schools. It's good to promote diversity." The remaining questions and answers intentionally covered neutral topics (e.g., hobbies, places to travel, pets) and were identical across conditions. The experiences of participants in each condition were identical (e.g., participants in each condition heard an identical recording of the confederate interviewer). We opted to manipulate prejudicial attitudes of the interaction partner, rather than direct exposure to discrimination. We believed this would increase the external validity to the everyday lives of sexual minority men and women, who regularly encounter individuals with anti-gay attitudes and situations in which the threat of discrimination is ambiguous or subtle.

Interview task. The interview task was adapted from Critcher and Ferguson's (2014) research, and from previous studies in our lab with a similar paradigm. A recording led participants through the task instructions and the interview task. Participants were reminded of their role (always interviewee), the evaluative nature of the task, and the "rules" of the interaction. Participants were provided in advance with a series of four questions: (a) Tell me about your daily schedule. Which parts do you choose and which parts do you have to do? What do the choices you make tell you about yourself as a person? (b) Think of your ideal dating partner. In what sorts of domains do you think that you would want the two of you to be similar? In what sorts of ways do you think it would benefit you to be different? (c) As you look into the future, how much of a challenge do you think it will be to strike a balance between your work life and your relationship life? (d) Would you be open to adopting children? Why or why not? The prerecorded confederate asked each question in turn and allowed participants 90 s to speak in response. Each response was followed by 90 s of silence, during which time they were told the interviewer was rating their responses and that they could begin contemplating their answer to the next question. The voice of the prerecorded confederate was gender-matched to the participant.

Study personnel then gave participants another set of questionnaires, including assessments of state affect during the task, stressfulness of the task, and emotion regulation. These questionnaires were given immediately after the interaction task so that they could answer most accurately about state affect and emotion regulation during the task itself. Participants then completed the posttask cognitive battery. Finally, participants completed manipulation check items. They were then questioned verbally to assess the success of study deception and thoroughly debriefed before leaving the lab.

Measures

Demographics. Participants were asked demographic questions on the online questionnaire about their age, race/ethnicity, gender, sexual orientation, income, education level, and religion.

State affect. Participants completed 12 items adapted from the State-Trait Personality Inventory (Spielberger, 1980) and commonly used in this lab to measure state anxiety and anger (citation redacted for blind review). This measure is sensitive to experimental manipulations (Nealey-Moore, Smith, Uchino, Hawkins, & Olson-Cerny, 2007). The response scale

ranged from 1 = *not at all* to 5 = *extremely.* Participants completed these measures at baseline (Cronbach's α for anger = .72, anxiety = .81) and after the stressor task (α for anger = .88, anxiety = .85).

Expressive suppression. Expressive suppression was measured by the Emotion Regulation Questionnaire (Gross & John, 2003) four-item subscale for suppression. The response scale ranged from 1 = *not at all* to 5 = *extremely*. The scale has been shown to have good psychometric properties and has been adapted to a state (rather than trait) version (Butler, Lee, & Gross, 2007; Kashdan & Steger, 2006) for experimental studies. This version asked participants to respond regarding efforts to suppress emotion expression during the experimental task. An example item is "I controlled my emotions during the task by not expressing them." Cronbach's alpha was .73.

Cognitive testing. A composite of several tests from the Delis–Kaplan Executive Function System battery (D-KEFS; Delis, Kramer, Kaplan, & Holdnack, 2004) was used in this study to measure EF and CP. Consistent with similar prior research (Franchow & Suchy, 2015, 2017; Williams, Suchy, & Kraybill, 2010), we used the scaled scores from the following tasks as measures of EF: Trail Making Test (Letter-Number Switching Condition completion time), Design Fluency (Filled Dots Condition total designs completed), Verbal Fluency (Letter Fluency Condition total words generated), and Color-Word Interference (Inhibition Condition completion time). We used the following tasks as measures of CP: Trail Making Test (Letter Sequencing Condition completion time) and Color-Word Interference (Color Naming and Word Reading Conditions completion time). A composite of scaled EF and CP scores was calculated for analyses. These measures were administered at baseline (Cronbach's α for EF = .57, CP = .61) and after the task (Cronbach's α for EF = .60, CP = .68). Cronbach's alpha for the total composite score calculated as the mean of EF and CP at baseline was .75 and after the task was .76.

Information, a subtest from the Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV; Wechsler, Coalson, & Raiford, 2008), was administered after Time 2 D-KEFS subtests as a gross measure of intelligence. Participant scores on this subtest were used as covariates in analyses predicting EF and CP to ensure any effects are not due to group differences in general crystallized intelligence.

Analysis

Correlations were run between demographic variables and EF and CP performance. No associations emerged so demographic covariates were not included in study analyses.

To test the hypothesis that participants in the anti-gay condition would show poorer subsequent performance on the EF measures than participants in the pro-gay condition (consistent with cognitive/executive depletion), a three-way 2 (score type: EF or CP) × 2 (time: baseline or after task) × 2 (condition: anti-gay or pro-gay) mixed Analysis of Variance (ANOVA) was conducted. The repeated-measures independent variables were time and score type, and the between-subjects independent variable was experimental condition. Information subtest from the WAIS-IV was included as a covariate.

Mediation analyses using bootstrapping procedures for estimating indirect effects were conducted to test the mediation hypotheses (that change in state anger, anxiety, and expressive suppression would mediate associations between study condition and EF). This approach was selected because it is considered the "method of choice" over the Baron and Kenny (1986) framework for mediation. This method is preferred due to bias in the estimates of standard errors and inflated Type I error rate in the Baron and Kenny approach (Hayes, 2009). It also allows for mediation to be detected in instances where one of the primary paths (i.e., from predictor to mediator, or from mediator to outcome) does not necessarily reach conventional levels of statistical significance, but the combined effect across both paths does (Hayes, 2009).

Results

Manipulation Check

Multiple items were included at the end of the lab session to confirm that experimental condition was manipulated appropriately. Participants were asked the following open-ended question: "What information about the other participant do you remember from the Q&A information form you were given before the task?" and recorded their responses on a form. Only 6% of the sample ($N = 8$) did not mention the manipulation information associated with their condition in response to this question.

Participants were asked how much they would like to be friends with the other participant, as well as how negative or hostile and positive or tolerant they perceived their attitudes to be toward people who identify as gay or lesbian. Response options ranged from 1 = *not at all* to 5 = *extremely*. These questions were asked at the very end to avoid raising suspicion about the true study aims before the experiment ended. Participants in the anti-gay ($M = 3.50$, $SD = 1.18$), relative to the pro-gay ($M = 1.26$, $SD = 0.70$), condition were significantly more likely to describe the other participant's attitudes as negative or hostile, $t(124) = 12.90$, $p < .001$. Participants in the anti-gay ($M = 1.98$, $SD = 1.02$), relative to the pro-gay ($M = 4.00$, $SD = 1.09$), condition were also significantly less likely to describe their attitudes as positive or tolerant, $t(124) = -10.76$, $p < .001$. Finally, participants in the anti-gay ($M = 1.86$, $SD = 0.92$), relative to the pro-gay ($M = 2.82$, $SD = 0.84$), condition were significantly less likely to report that they would want to be friends with the other participant, $t(124) = -6.12$, $p < .001$.

Table 2. Bivariate Correlations.

Variables	1	2	3	4	5	6	7	8	9	10
1. Condition										
2. State Anger Time 1	−.03									
3. State Anger Time 2	−.27**	.22*								
4. State Anxiety Time 1	−.001	.37***	.16							
5. State Anxiety Time 2	.10	.23*	.39***	.45***						
6. Emotion suppression	−.35***	.04	.30***	.04	.17*					
7. EF Time 1	−.13	.13	.14	−.04	−.01	.16				
8. EF Time 2	−.21*	.09	.18*	−.01	−.03	.15	.87***			
9. CP Time 1	−.08	−.02	.08	−.09	−.10	.10	.59***	.57***		
10. CP Time 2	−.26**	−.01	.20*	−.03	−.07	.09	.59***	.61***	.81***	
11. Information	−.09	.09	.07	−.08	−.06	.24**	.24**	.22*	.18*	.13

Note. Values displayed in this table are Pearson correlation coefficients for associations between continuous variables and point biserial correlation coefficients for associations between continuous and dichotomous variables. Condition was coded as 1 = anti-gay condition, 2 = pro-gay condition. EF = executive function; CP = component process.
*$p < .05$. **$p < .01$. ***$p < .001$ (two-tailed).

Participants were also asked to rate how stressful they found each of the interview questions. Participants in the anti-gay condition ($M = 3.25$, $SD = 1.14$) found the second question (i.e., ideal dating partner) to be significantly more stressful than participants in the pro-gay condition ($M = 2.60$, $SD = 1.20$), $t(119) = 2.86$, $p = .005$. No significant differences were found in stress ratings for the other three questions.

Bivariate Correlations (Main Study Variables)

Bivariate correlations among study variables are presented in Table 2. Participants in the anti-gay condition (relative to the pro-gay condition) reported a higher level of state anger, along with greater attempts to suppress negative emotions, during the task. There were no differences in state anxiety. Participants in the anti-gay condition actually performed *better* on cognitive testing after the stressor task on both the EF and CP composite measures relative to participants in the pro-gay condition.

Participants who reported higher state anger and anxiety after the task also reported greater expressive suppression. Participants who reported higher state anger (but not anxiety) demonstrated significantly better performance on both EF and CP subtests at Time 2. Expressive suppression during the stressor task was unrelated bivariately to cognitive testing. As expected, the cognition composite scores were strongly positively correlated, including both EF and CP at Times 1 and 2. Information from the WAIS-IV was significantly correlated with EF scores at Times 1 and 2, as well as CP scores at Time 1. Given these associations, participant scores on information were used as covariates in all analyses to ensure that effects were not due to differences in knowledge or intelligence.

EF

A three-way mixed ANOVA predicting cognitive scores revealed a significant main effect of time, $F(1, 124) = 20.13$, $p < .001$. Specifically, participant cognitive performance overall was significantly better at Time 2 ($M = 12.06$, standard error [SE] = 0.13) than Time 1 ($M = 11.02$, $SE = 0.13$). This finding suggests a practice effect. A significant interaction between time and condition was also present, $F(1, 124) = 14.88$, $p < .001$. This interaction is graphed in Figure 2. Analysis of simple effects revealed that cognitive scores increased from Time 1 to Time 2 in both the anti-gay condition, $F(1, 124) = 221.72$, $M_{diff} = 1.28$, $SE = 0.09$, $p < .001$, and the pro-gay condition, $F(1, 124) = 85.51$, $M_{diff} = 0.80$, $SE = 0.09$, $p < .001$. No difference by condition in cognitive score was observed at Time 1 testing, $F(1, 124) = 1.27$, $M_{diff} = 0.28$, $SE = 0.26$, $p = .26$. However, a significant difference was found at Time 2, $F(1, 124) = 8.01$, $M_{diff} = 0.76$, $SE = 0.27$, $p = .005$. Individuals in the anti-gay condition ($M = 12.44$, $SE = 0.19$) performed better cognitively after the stressor task than participants in the pro-gay condition ($M = 11.68$, $SE = 0.19$). The three-way interaction between time, condition, and score type was not significant. This finding suggests that EF and CP were affected in a similar manner by the experimental manipulation. Cognitive performance was better in the anti-gay condition (relative to the pro-gay condition) at Time 2 on both EF tests, $F(1, 124) = 4.62$, $M_{diff} = 0.68$, $SE = 0.32$, $p = .03$, and CP tests, $F(1, 124) = 8.61$, $M_{diff} = 0.84$, $SE = 0.29$, $p = .004$.

Mediators

Although the cognitive testing analyses were best interpreted using ANOVA models that could account for both between-subjects and repeated-measures variables, the following mediation analyses shifted to an ordinary least squares (OLS) regression framework to utilize standard bootstrapping techniques for estimation of indirect effects (Hayes, 2009). Change in EF composite scores from Time 1 to Time 2 was entered as the dependent variable. Information score and

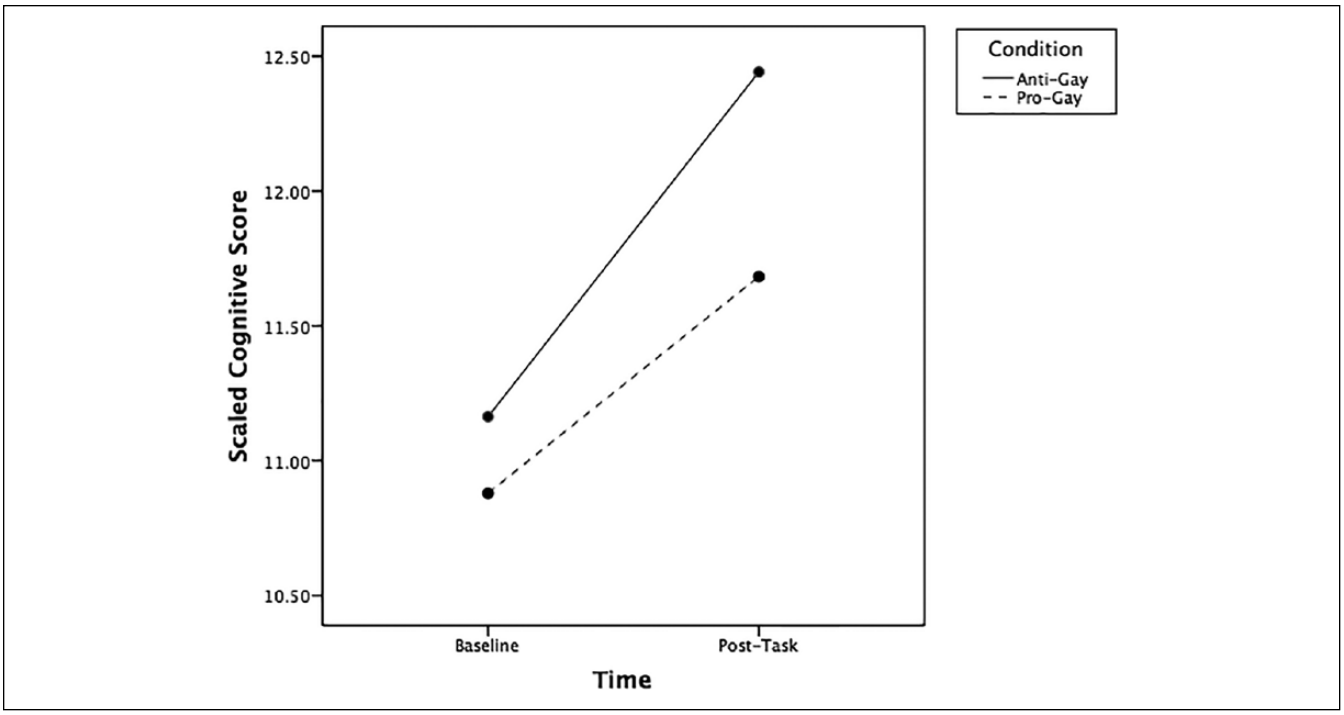

Figure 2. Graph of the interaction between time and condition predicting cognitive scores.

Table 3. Results of Mediation Models (Predicting Executive Function Change Score).

	Executive function change			95% CI (AB path)	
Potential mediators	A path	B path	AB path	Lower	Upper
Change in state anger	−.36* (.15)	.15 (.11)	−.06* (.04)	−.18	−.01
Change in state anxiety	.15 (.14)	−.13 (.12)	−.02 (.03)	−.11	.01
Expressive suppression	−.66* (.16)	−.05 (.10)	.03 (.07)	−.10	.18

Note. Bootstrapping techniques were used to conduct mediation analyses to determine whether each of the variables listed as "potential mediators" mediated the association between experimental condition and change in EF scaled composite from Time 1 to Time 2. Mediators were entered simultaneously. Covariates included change in CP scaled composite from Time 1 to Time 2, and Information subtest scaled. The "A Path" represents the association between experimental condition and each potential mediator. The "B Path" represents the association between each potential mediator and EF change score. The "AB Path" represents the indirect path from experimental condition to EF through potential mediators. The values in this table are displayed as path coefficient (standard error). CI = confidence interval; EF = Executive Function; CP = Component Process.
*$p < .05$.

change in CP composite scores from Time 1 to Time 2 were entered as statistical controls. Experimental condition was entered as the independent variable. All potential mediators (change in state anger, change in state anxiety, expressive suppression) were entered simultaneously.

Mediation results are presented in Table 3. The only variable that emerged as a significant mediator of the association between condition and change in EF was the change in state anger from baseline to after task. The "A" path revealed that experimental condition significantly predicted anger change score. Individuals in the anti-gay condition reported a greater increase in state anger from baseline to after the stressor task than individuals in the pro-gay condition. The "B" path revealed that the association between anger change score and EF change score did not reach statistical significance. The "AB" path revealed that the indirect effect of condition on EF score through change in state anger was significant. The association between experimental condition and EF performance was partially explained by change in state anger from baseline to after the stressor task. None of the other variables (change in state anxiety, expressive suppression) significantly mediated this association. However, the "A" path was significant for expressive suppression, such that individuals in the anti-gay condition reported greater use of emotion suppression as a strategy during the stressor task compared with participants in the pro-gay condition.

Discussion

This experimental study of gay and lesbian adults examined how a manipulation of exposure to anti-gay attitudes affected performance on executive and lower-order cognitive tasks, and explored negative emotions and expressive suppression as potential mechanisms. Unexpectedly, participants in the anti-gay condition actually performed better than participants in the pro-gay condition after the manipulation task on the cognitive measures, relative to their baseline performance. No differences were found by score type, such that this heightened performance in the anti-gay condition was true across both higher-order (i.e., EF) and lower-order (i.e., CP) processes. Interestingly, the difference by condition in EF performance (controlling CP) was partially mediated by change in state anger from baseline to after the stressor task.

The cognitive effects we observed were unexpected and contrary to our hypotheses. The neuropsychological literature offers competing theories about the effects of anger on EF. Some theoretical work has suggested that intense emotions (positive or negative) represent a form of "cognitive load" that may result in poor performance. Still other theoretical work focused on motivation has posited that negative mood states (including anger) have a beneficial impact on cognitive, especially executive, performance (Mitchell & Phillips, 2007). The rationale is that negative mood (especially anger) contributes to heightened threat perception and increased motivation for the task at hand. Studies increasingly suggest that the emotional experience of anger is associated with approach-oriented, as opposed to avoidance-oriented, motivational states (Carver & Harmon-Jones, 2009). Preliminary evidence has shown that negative mood can prevent use of "heuristics" (i.e., mental short cuts) and increase alertness or focused attention (Park & Banaji, 2000). Research on anger specifically has shown a "narrowing" effect on attentional processing (Fredrickson & Branigan, 2005). In presenting these competing theories, Mitchell and Phillips (2007) argued that the EF testing batteries most often used in short, lab-based studies demand the type of focused attention that is heightened during negative mood states, such as anger.

Theoretical and empirical work within the field of LGB health may also shed light on this unexpected finding. Evidence for the "best little boy in the world" hypothesis (Pachankis & Hatzenbuehler, 2013) demonstrates that sexual minority men compensate for domains in which they expect rejection and barriers to success (e.g., societal ideals regarding standards of masculinity/femininity, traditional relationships). They do so by excelling in areas over which they have more control (e.g., academics, competition, care around physical appearance). Thus, motivational factors complicate associations of minority stress and cognitive function in this particular population. If individuals in our anti-gay condition have grown accustomed to responding to minority stress with increased motivation for performance, it is possible that motivation to excel accounted for our findings on cognitive performance. This is particularly plausible if participants believed they were being evaluated.

Contrary to hypotheses, expressive suppression did not mediate the association between condition and cognitive performance. However, expressive suppression as a regulation strategy was endorsed to a greater extent in the anti-gay condition than the pro-gay condition during the stressor task. Even though expressive suppression was not related to EF in this study, it has been shown in the literature to have a range of negative outcomes. Research has documented an association between suppression and poor social functioning. Intentionally suppressing emotion can result in reduced interpersonal connections and even increased psychophysiological reactions in both the individual suppressing and interaction partners (Butler et al., 2003). Other research has documented negative effects of expressive suppression on symptoms of depression, anxiety, and posttraumatic stress (Moore, Zoellner, & Mollenholt, 2008). Our finding that individuals confronting anti-gay prejudice engaged in more expressive suppression could have implications for health and well-being of LGB individuals beyond the cognitive tasks assessed in this study.

Change in state anger from baseline to after task partially mediated the association between experimental condition and EF performance. This finding provides further evidence that participants in the anti-gay condition may have been motivated and able to focus attention to perform well on this task. They may have perceived the task as measuring intellectual ability or as part of the evaluative nature of the interpersonal task. Previous research has shown that standard self-regulatory depletion effects can be temporarily suppressed when participants are motivated for performance (Hagger, Wood, Stiff, & Chatzisarantis, 2010)—for example, when cash incentives are provided (Muraven & Slessareva, 2003). Although experimentally induced changes in state anger increased motivation and focused attention in the short term, the longer term consequences of this effort are unclear. In other words, participants in our study may have been able to override typical cognitive depletion on the task perceived as evaluative in this short lab study but may have shown a depletion effect in other areas in which this focused attention and motivation to excel was not present. Future research is needed to assess how minority stress is related to both EF performance over time and real-world self-regulation of health behaviors. An aim of future research should be to determine whether this study's findings generalize, as a form of resilient coping with minority stress, or whether longer term assessment reveals chronic depletion and health risks.

Multiple manipulation checks demonstrated that participants appropriately recalled and interpreted the attitude of the confederate as having anti-gay or pro-gay attitudes. However, only one of the interview questions (i.e., ideal dating partner) was interpreted as more stressful by participants in the anti-gay, compared with the pro-gay, condition. This question may have been most challenging in terms of prompting participants

to make a conscious decision about concealing or disclosing sexual orientation in their responses. We also note that the ratings in both conditions suggested that all questions were perceived as mildly to moderately stressful. It is possible the questions were perceived as relatively stressful across both conditions due to the evaluative nature of the task.

Limitations of this study should be acknowledged. First, this study utilized a community-based convenience sample of mostly "out" and mostly White gay and lesbian adults. Caution is advised in generalizing results to the full range of diverse individuals within the lesbian and gay community, to individuals who are less open about their sexual orientation, or to bisexual men and women. Second, this study manipulated exposure to anti-gay attitudes. This experience is a powerful aspect of minority stress but is not a comprehensive measure of the full construct. Minority stress includes both acute and chronic experiences, so additional research is needed to assess longer term effects. Third, a possible alternative explanation for results is that individuals in the anti-gay condition were angry and motivated and, therefore, performed the cognitive tasks more quickly than participants in the control condition but not necessarily more accurately. To investigate this possibility, errors on the cognitive tests were analyzed post hoc and results did not show support for this hypothesis (i.e., errors were not more common in either condition). Explicit measurement of motivation would have allowed us to better explore the unexpected results, and motivation should be assessed in future research on these phenomena. Finally, as with any study, imperfect measurement of our constructs may have impacted the results. The EF and CP composite scores had lower than expected reliabilities. These measures (composites of subtests from a well-validated testing battery) represent significant improvement over prior studies that have assessed cognitive depletion by using only one subtest or measures that have not been standardized or validated. However, the low reliabilities suggest that including a greater number of subtests to fully assess the EF construct would be beneficial.

Despite limitations, this study is the first to use an experimental paradigm to assess the effects of minority stress on EF among gay and lesbian adults, and to test potential mechanisms. The experimental method in this study allows for making stronger causal conclusions than have been made from the cross-sectional survey designs overwhelmingly employed in this research area. The results further our understanding of ways in which LGB individuals are affected by prevalent experiences of minority stress, including perceived discrimination, concealment of sexual orientation, expectations of rejection, and internalized homophobia. Attitudes toward sexual minorities and legal rights in the United States have undoubtedly improved in recent years. However, this increased visibility and attention to these issues (including constant media coverage of public votes, executive orders, and court decisions that directly impact the lives of LGB Americans) has likely resulted in more frequent interaction between LGB individuals and those who hold anti-gay attitudes. LGB individuals face decisions daily about how to cope with and express or suppress negative emotions that arise from these interactions and the changing cultural landscape. These results suggest complex associations and warrant additional study.

Future research should attempt to replicate the findings from this study and to expand on the findings with inclusion of additional conditions for comparison, such as a task that is not stressful and a group responding to a more neutral situation with respect to prejudice of the interaction partner. An important area of investigation will be to determine whether long-term effects of chronic minority stress are different than the effects that can be observed following an acute laboratory stressor. If executive and self-regulatory depletion is observed in response to chronic minority stress, it will be important to evaluate how this depletion impacts various health behaviors and ultimately outcomes and disparities. On the contrary, if the acute positive effects on cognition documented in the study are replicated more generally, this could represent a form of resilience or an adaptive way to respond to prejudice that actually benefits marginalized groups. In addition, future research should seek to understand whether other variables beyond those examined in this study moderate and/or mediate these findings. State anger emerged as a mechanism for the unexpected cognitive effects documented. However, the field could benefit from better understanding for whom and under what circumstances the findings hold true as well as the underlying mechanisms for these effects.

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Supplemental Material

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