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Contact and Role Modeling Predict Bias Against Lesbian and Gay Individuals Among Early-Career Physicians: A Longitudinal Study

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Introduction

Members of sexual minority groups, including lesbian and gay individuals, experience poorer health than their heterosexual counterparts (Bränström, Hatzenbuehler, & Pachankis, 2016; Jackson, Agénor, Johnson, Austin, & Kawachi, 2016). They have higher incidences of mental illness (Cochran, Sullivan, & Mays, 2003), as well as HIV, cardiovascular disorders, obesity, asthma, and certain cancers (Blosnich, Hanmer, Yu, Matthews, & Kavalieratos, 2016; Cochran, Björkenstam, & Mays, 2016). The stigma associated with being a member of a sexual minority group operates at multiple levels to contribute to these health disparities (Hatzenbuehler, 2014; Solazzo, Brown, & Gorman, 2018). Both anticipating and actually experiencing bias and discrimination on the basis of one's sexual orientation can produce stress that contributes to manifold health problems (Frost, Lehavot, & Meyer, 2015; Lick,

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Durso, & Johnson, 2013; Meyer, 2003). Physicians' and other clinicians' biases can also play a role, by weakening the quality of care they deliver to sexual minority patients and reducing the likelihood that these patients will continue to access care (Institute of Medicine, 2011). The present longitudinal study investigated interpersonal experiences during medical school that predict physicians' biases against lesbian and gay individuals two years later, during their second year of medical residency.

Physicians' professional training is extensive and intensive. In the United States, training consists of four years of medical school (involving two years of coursework and two years of clinical rotations) following undergraduate education plus three to seven years of residency, during which trainees work under the supervision of more experienced, state-licensed physicians. Although medical schools dedicate a portion of their formal curricula to cultural competence training, such training typically does not devote substantial attention to sexual minority issues, and this gap has gained increased attention in recent years (Obedin-Maliver et al., 2011). Medical students' interpersonal experiences within the context of their medical training – that is, their "informal curriculum" – may also play a critical role in shaping their subsequent attitudes toward and thus readiness to care for sexual minorities (Hafferty, 1998; Paul, Ewen, & Jones, 2014; van Ryn et al., 2015). Heterosexual, cisgender (i.e., non-transgender) medical students' interactions with sexual minority students, physicians, and patients, for example, along with their exposure to supervising physicians' comments about and behavior toward sexual minority patients, may influence their levels of bias not only during medical school but also during residency, when they provide more direct care to patients. These interpersonal experiences have the potential to attenuate or exacerbate biases. Thus, identifying elements of the informal curriculum that predict bias during residency can guide efforts to both decrease existing biases and prevent increases in bias over the course of medical school and residency.

As with bias against other stigmatized groups, explicit bias (i.e., consciously held and overtly expressed attitudes toward a group and its members) and implicit bias (i.e., automatically activated and often unconscious negative associations with a group and its members) against lesbian and gay individuals are only weakly to moderately correlated (Sabin, Riskind, & Nosek, 2015) and thus may independently predict behavior (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Kurdi et al., 2018). Greater explicit bias against gay men has been linked to provider decisions, such as less willingness to prescribe Pre-Exposure Prophylaxis (PrEP), which reduces HIV risk, to gay, as compared to heterosexual, men (Calabrese et al., 2018). Although, to our knowledge, the relationship between physicians' implicit bias against lesbian and gay individuals and their behavior toward lesbian and gay patients has yet to be explored, with respect to medical care of other minority group, greater physician implicit racial bias predicts behaviors that erode quality of care, such as less patient centeredness; FitzGerald & Hurst, 2017). Additionally, sexual minority patients' perceptions that their providers are biased can reduce their willingness to disclose their sexual orientation – and thus weaken the quality of care they receive (McNair, Hegarty, & Taft, 2015; St. Pierre, 2012). Understanding training experiences that shape physician bias against sexual minorities can therefore inform interventions that ultimately increase preparedness to serve this population.

Although both explicit and implicit bias are malleable (e.g., Devine, Forscher, Austin, & Cox, 2012), they are rooted in different cognitive processes and thus tend to shift in response to different experiences (Gawronski & Bodenhausen, 2014; McConnell & Rydell, 2014). Whereas exposure to or consideration of an idea (i.e., a proposition) may be sufficient to sustainably alter explicit bias, long-term changes in implicit bias may require more gradual replacement of previously learned associations with new ones (Gawronski & Bodenhausen, 2014). Thus, medical school experiences may affect one form of bias but not the other.

The present longitudinal study examined experiences during medical school that can attenuate or exacerbate bias. Specifically, it investigated the relationship between contact with sexual minorities (during which students may obtain new information about these groups and gradually develop new associations with them) and exposure to role modeling of anti-lesbian and gay bias and discrimination (during which students are exposed to negative propositions about sexual minorities) throughout medical school and both explicit and implicit bias against lesbian and gay individuals during second year of residency.

The robust literature on intergroup contact suggests that frequent and positive contact with lesbian and gay individuals during medical school would likely contribute to lower levels of subsequent bias against these groups (Allport, 1954; Dovidio, Love, Schellhaas, & Hewstone, 2017; Pettigrew & Tropp, 2006). Although the extant work on intergroup contact has largely focused on racial bias, it also extends to bias against sexual minorities, for which the contact-bias reduction relationship is particularly strong (Herek & Capitanio, 1996; Pettigrew & Tropp, 2006; Smith, Axelton, & Saucier, 2009). Indeed, testing participants in this sample, Phelan et al. (2017) found that when medical school contact with lesbian, gay, bisexual, and transgender (LGBT) individuals and bias were measured at the same time, contact was associated with lower levels of explicit and implicit bias.

Much of the research on intergroup contact has been cross-sectional, and thus the longitudinal nature of this study makes it particularly novel and informative. When predictors are assessed at the same time as outcomes, their associations can be inflated due to shared incidental features of the measurement context (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Cross-sectional studies are also unable to establish the temporal relationship between contact and bias. Their association may result from either “selection bias” – that is, the tendency for individuals with more positive attitudes toward an outgroup to seek more contact with members of that group (Paluck, Green, & Green, 2018) – or through the bias-attenuating effects of contact (Binder et al., 2009; Eller & Abrams, 2004). Thus, more longitudinal research is needed, both to clarify the temporal (and potentially causal) relationship between contact and bias, and to determine whether the effects of contact persist over time (Hewstone et al., 2014; Paluck et al., 2018). Based on the existing literature on intergroup contact, we predicted the following:

> Greater amount and favorability of contact with LGBT individuals during medical school will predict lower levels of explicit and implicit bias against lesbian and gay individuals among second-year residents (controlling for attitudes during the first semester of medical school).

In addition to intergroup contact, role modeling likely influences bias against lesbian and gay individuals. Role modeling consists of physicians' comments and behaviors in the presence of students and is a key component of the informal curriculum (Benbassat, 2014; Maudsley, 2001). Attitudes toward social groups, including sexual minorities (Goodman, Schell, Alexander, & Eidelman, 2008), are shaped by exposure to other people's comments (Blanchard, Crandall, Brigham, & Vaughn, 1994), particularly when those people are powerful or successful (Crandall, Miller, & White, 2018; Weiss, 1977). Thus, even if faculty members formally instruct students to treat sexual minority patients fairly and equitably, if they also exhibit behaviors indicative of anti-lesbian and gay bias, they may convey to students that this bias is acceptable and even normative.

Exposure to homophobic comments (Lee, Kelz, Dubé, & Morris, 2014) and discrimination against LGBT patients (Lambda Legal, 2010) may be particularly influential in shaping subsequent explicit, as compared to implicit, bias against lesbian and gay individuals because explicit attitudes may be readily altered by new information and events, even if such events occur infrequently (Gawronski & Bodenhausen, 2014). Additionally, negative role modeling signals a permissive social norm regarding bias expression, to which explicit attitudes may be especially responsive (Crandall & Stangor, 2005).

Given the established effects of negative role modeling on explicit bias (Blanchard et al., 1994; Goodman et al., 2008), we predicted the following:

> Exposure to negative role modeling (physicians' negative comments about and discriminatory behavior toward LGBT patients) during medical school will predict higher levels of explicit bias against lesbian and gay individuals among second-year residents (controlling for attitudes during the first semester of medical school).

Although our reasons for predicting a relationship between role modeling and bias were more specific to explicit than implicit bias, we tested the relationship between negative role modeling and implicit bias for exploratory purposes.

Method

The present study was part of the broader Medical Student Cognitive Habits and Growth Evaluation (CHANGE) Study, a longitudinal study of one cohort of medical students at 49 US medical schools. Data were collected during participants' first (fall 2010; Time 1) and final (spring 2014; Time 2) semesters of medical school and toward the end of their first (spring 2015), second (spring 2016; Time 3) and third (spring 2017) years of residency. Implicit bias against lesbian and gay individuals was measured during the two medical school time points and second year of residency. The current analyses focus on medical school factors, reported during the final semester of school (T2), as predictors of explicit and implicit bias during second year of residency (T3), adjusting for bias during the first semester of medical school (T1). We focus on lesbian and gay individuals because the Sexuality Implicit Association Test (IAT) only assessed bias against these two sexual minority groups.

Participants

We used multi-stage sampling to obtain our sample of first-year medical students. First, we categorized U.S. medical schools by geographic region (6 regions) and public/private status (2 statuses). Because the Northwest region did not include any private schools, we created 11 strata (Central South - Private, Public; Midwest - Private, Public; Northeast - Private, Public; Southeast - Private, Public; Southwest - Private, Public; and Northwest - Public). We aimed to include 50 schools in our final sample and selected schools within each stratum using a proportional to (first-year class) size sampling methodology (Särndal, Swensson, & Wretman, 1992), which ensures that larger schools are not overrepresented in the final sample. This resulted in inclusion of approximately 43% of schools from each stratum. One school was excluded because it was a military school, had a different schedule than the other schools, and if included, would have reduced the generalizability of our findings.

We then obtained contact information for as many first-year students at these 49 medical schools as possible using three methods: (a) Asking students who completed the American Association of Medical Colleges (AAMC) Matriculating Student Questionnaire in spring/summer of 2009 for their email addresses; (b) Purchasing a list of matriculating students from an American Medical Association-licensed vendor; (c) Asking students who completed the CHANGE Study survey in fall of 2010 to refer other first-year students. We sent electronic or postal mail to the 5823 first-year students (out of 8594, according to the AAMC'S statistics on matriculating students) whose contact information we could obtain (3310 through the AAMC questionnaire, 525 through the vendor list, 1988 through snowball sampling). During the fall of 2010, 81% of contacted students (N=4732) completed the baseline survey. In the springs of 2014 and 2016, we again contacted those students who had completed the baseline survey. After excluding participants who were not in their second year of residency in the spring of 2016, we were left with 3292 participants.

At baseline, participants also indicated whether their sexual orientation was "heterosexual," "bisexual," "homosexual," or "other." During the final semester of medical school and second year of residency, the options were "heterosexual or straight," "gay or lesbian," "bisexual," "something else," or "don't know." We excluded the 336 participants who at any data point they completed did not indicate that they were heterosexual.

At baseline and second year of residency, participants also indicated whether their gender was "male," "female," or "other." To ensure that only cisgender women and men were included in the sample, we excluded the nine participants who at any data point they completed did not indicate that they were male or female and then the seven participants whose reported gender changed between baseline and second year of residency, leaving a total sample of 2940.

Of the 2940 participants who completed the T1 survey, 2854 (97.07%) completed the T2 survey, 2601 (88.47%) completed the T3 survey, and 2526 (85.92%) completed all three timepoints.

At baseline and second year of residency, participants reported their race/ethnicity (see Burke et al., 2015 for details). Participants who did not report their race/ethnicity (n=24),

who reported that their race/ethnicity was unknown (n=15), or who did not fall into the categories of Black, East Asian, Hispanic/Latino, South Asian, or White (American Indian/Alaska Native: n=2; Native Hawaiian/Pacific Islander: n=6) were excluded from analyses that adjusted for race/ethnicity because we could not meaningfully account for the effects of membership in these racial/ethnic groups given their small sample sizes. (Inclusion of these participants and omission of the race/ethnicity covariate did not meaningfully change any results.)

At baseline, half of the participants were randomly assigned to complete the Sexuality IAT, which measures implicit bias against lesbian and gay individuals. (The other half were assigned to complete a Weight IAT.) These participants were again assigned to complete this IAT during their final semester of medical school and second year of residency. Of heterosexual male and female participants who were in their second year of residency at the third time point, 1155 completed the IAT at baseline and during second year of residency.

Participants received $50 at T1 and T2 and $100 at T3 for survey completion. The Mayo Clinic IRB approved this study. Participants were allowed to skip questions without penalty.

Procedure

Participants were recruited for a study examining “changes in medical students’ quality of life, social relationships, attitudes, and beliefs over the course of medical school.” Here, we focus on a subset of measures from the study that are directly related to our hypotheses.

Outcome variables.

Explicit bias against lesbian and gay individuals.: At T1 and T3, participants were asked to indicate their feelings toward several groups of people, including “lesbians” and “gay men,” by moving a slider along a 101-point scale ranging from “very cold or unfavorable” to “very warm or favorable.” In second year of residency, they were also asked to indicate their feelings toward “heterosexual women” and “heterosexual men;” these measures were used for comparative purposes. Feeling thermometers are a brief, reliable, and valid way to assess explicit attitudes towards various social groups (Alwin, 1997; Lolliot et al., 2015) and have previously been used to assess attitudes towards lesbian and gay individuals (e.g., Breen & Karpinski, 2013). Explicit attitudes toward lesbians and gay men were highly correlated, $r(2580)=.95$, $p<.001$, so we averaged these two items to form a single score. We also averaged attitudes toward heterosexual women and attitudes towards heterosexual men, $r(2584)=.95$, $p<.001$, to create a single score.

Implicit bias against lesbian and gay individuals.: At T1 and T3, 50% of participants were instructed to complete the Sexuality IAT (Nosek, Banaji, & Greenwald, 2006; Phelan et al. 2017), which measures implicit bias against lesbian and gay individuals. In one block, participants are instructed to categorize images and words either as “gay people” or “good” or as “straight people” or “bad”; in the other block, they are instructed to categorize images and words either as “gay people” or “bad” or as “straight people” or “good.” Relative preference for heterosexual women and men over lesbians and gay men (IAT d score) is calculated by subtracting the mean response latency for the latter trials from the mean

response latency for the former trials and dividing by the standard deviation for all trials. Scores can range from −2 (strong preference for lesbian and gay individuals) to +2 (strong preference for heterosexual women and men). We followed established criteria for excluding trials and participants with extremely long latencies or high error rates (Greenwald, Nosek, & Banaji, 2003).

Predictor variables.—At T2, all participants were instructed to report on three medical school experiences related to LGBT individuals, which serve as the predictor variables in the current analyses: amount of contact with LGBT individuals; favorability of contact with LGBT individuals; and exposure to bias against LGBT individuals. All predictor variables were measured using self-reports. Brief, highly face valid measures can capture quantity and quality of contact with outgroup members (e.g., Voci & Hewstone, 2003), as well as exposure to negative role modeling (Martinez et al., 2014), without overburdening participants, who in this case were completing a longer survey on medical school experiences and attitudes.

Amount of LGBT contact.: Participants indicated on 4-point scales how much interaction they had had during medical school with LGBT (a) medical students, (b) faculty, attendings (i.e., supervising physicians) or residents, and (c) patients (1=None, 2=Little, 3=Some, 4=Substantial). These items were developed for the present sample but are similar to items that have been used to assess amount of intergroup contact in other higher education settings (Schofield, Hausmann, Ye, & Woods, 2010). The three items were highly related (α=.81) and were averaged to create a composite score.

Favorability of LGBT contact.: Participants indicated on 4-point scales how favorable their interactions during medical school had been with LGBT (a) medical students, (b) faculty, attendings, or residents, and (c) patients (1=Very unfavorable, 2=Unfavorable, 3=Favorable, 4=Very favorable). These items were also developed for the present sample but mirror those that have been used to assess favorability of intergroup contact in other higher education settings (Schofield et al., 2010). The three items were highly correlated (α=.94) and were averaged to create a composite score.

Negative role modeling of LGBT bias.: Participants indicated how often they had heard professors or residents make negative comments, disparaging remarks, or jokes about lesbian, gay, or bisexual patients and how often they had witnessed discriminatory treatment of an LGBT patient. Participants responded to each item on a 5-point scale (1=*Never*, 2=*Rarely*, 3=*Sometimes*, 4=*Often*, 5= *Very often*), which were moderately correlated, $r(2822)=.52$, $p<.001$; because both tapped into key facets of negative role modeling, they were averaged to create a composite score.

To confirm that the items used to measure amount of contact, favorability of contact, and exposure to negative role modeling all loaded onto the anticipated constructs, we conducted a principal component analysis with varimax rotation. All items loaded as expected (see supplementary materials).

Results

Analyses were conducted using IBM SPSS Statistics 24. Participant demographic characteristics are reported in Table 1.

Levels of Contact and Negative Role Modeling during Medical School (T2)

On average, participants reported between "little" and "some" (M=2.65, SD=0.68, Mode=Some) and between "favorable" and "very favorable" (M =3.46, SD =0.53, Mode=Favorable) interactions with LGBT individuals during medical school. They also reported, on average, between "never" and "rarely" witnessing role modeling of bias against LGBT individuals (M =1.49, SD =0.63, Mode=Never). Descriptive statistics for the individual items included in these measures are reported in the supplementary materials.

Correlations among predictor variables were relatively low. The correlation between amount and favorability of contact was low to moderate, $r(2757)=.25$, $p<.001$. The correlations between amount of contact and negative role modeling, $r(2808)=.05$, $p=.016$, and favorability of contact and negative role modeling, $r(2752)=-.13$, $p<.001$, were low.

Levels of Bias against Lesbian and Gay Individuals during Residency (T3)

A repeated measures analysis of variance (ANOVA) indicated that second year residents held less favorable explicit attitudes toward lesbian and gay individuals (M=75.51, SD=22.69) than heterosexual women and men (M=83.22, SD=19.49), $F(1,2578)= 489.79$, $p<.001$,$\eta_p^2=0.160$. Resident physicians also demonstrated an implicit preference for heterosexual women and men over lesbian and gay individuals (M=0.34, SD=0.43), $t(1219)=27.35$, $p<.001$; this preference fell just below "moderate" according to standard IAT cutpoints.

Explicit and implicit bias against lesbian and gay individuals were only slightly correlated during residency, $r(1207)=.14$, $p<.001$, as well as at the other time points (see Table 2). Analogous bias scores assessed in the first year of medical school (T1), at the end of medical school (T2), and in the second year of residency (T3) were only moderately correlated, which is consistent with previous longitudinal studies of changes in implicit and explicit bias over time (Devine et al., 2012; Gawronski, Morrison, Phills, & Galdi, 2017). Also consistent with the previous longitudinal research, the correlations between time points were weaker for implicit bias, ranging from .26 to .32, than for explicit bias, ranging from .45 to .53.

Overall, explicit attitudes toward lesbian and gay individuals became slightly more negative between T1 (M=76.61, SD=23.26) and T3 (M=75.51, SD=22.69), $F(1,2534)=3.77$, $p=.052$, $\eta_p^2=0.001$, though this effect was only marginally significant. Nonetheless, implicit bias against lesbian and gay individuals significantly decreased between T1 (M=0.47, SD=0.45) and T3 (M=0.34, SD=0.43), $F(1,1154)=73.11$, $p<.001$, $\eta_p^2=0.060$.

Medical School Experiences as Predictors of Bias during Residency (T2 Predictors of T3 Bias)

Because there were meaningful differences between participants who did and do not complete the T1 measures of amount of contact with LGBT individuals, favorability of

contact with LGBT individuals, and exposure to negative role modeling and the T3 measure of explicit attitudes toward and implicit bias against lesbian and gay individuals, we conducted multiple imputation to estimate missing values for predictor and outcome variables (Lang & Little, 2018). (Details are provided in the supplementary materials.) As reported in the supplementary materials, we also ran all of the following analyses with missing data excluded, via listwise deletion, rather than imputed. For explicit bias, both strategies for handling missing data produced comparable results, suggesting that our multiple imputation assumptions were robust (Sidi & Harel, 2018). For implicit bias, two of the significant effects observed when missing data were imputed (detailed below) were no longer significant when missing data were excluded via listwise deletion, likely because excluding these missing values resulted in a reduction in statistical power.

Our primary analyses examined the relationship between medical training experiences (reported at T2) and explicit and implicit bias against lesbian and gay individuals during second year of residency (T3). We reverse-coded the thermometer ratings of gay and lesbian individuals by subtracting them from the midpoint (50) so that interpretation of the explicit bias results would match the implicit bias results. We then standardized all continuous variables by converting them to *z* scores. Beta weights indicate the amount of change in the outcome variable (in terms of standard deviations) that follows from a one standard deviation increase in the predictor variable, or a shift from one category to the other in the case of a binary indicator variable.

Bias.—To examine the relationship between medical school experiences and bias during second year of residency, we estimated a series of linear mixed-effects models. Each model included key predictor variables with fixed parameters. It also included as covariates variables that tend to be associated with both the predictor variables and the outcome variables: baseline bias, participant demographics (gender and race/ethnicity), and when possible, stratum. We included stratum as a covariate by including ten indicator variables for the eleven strata in our regression models, to account for overall differences between strata in degrees of bias. Each model also included a random intercept by school – that is, the intercept varied by school – so that overall mean differences between schools did not account for observed relationships between predictors and outcomes. Mixed effects models are appropriate when, as here, observations are grouped, or clustered, and the grouping (here, medical school) may have a shared influence on effects or outcomes. These models let us account for potential correlation of outcomes among students who attended the same schools; ignoring this correlation could lead to artificially narrow standard errors and potentially spurious findings, if schools differed substantially. Table 3 summarizes results from these models; we excluded the covariates from this table for ease of presentation, but the complete tables are included as supplementary materials.

Explicit bias.—For each key predictor, we estimated a linear mixed-effects model. These models included participant demographics, T1 explicit attitudes toward lesbian and gay individuals, T3 explicit attitudes toward heterosexual women and men, and stratum as covariates (we refer to these as the “individual predictor models”). We included T1 explicit attitudes toward lesbian and gay individuals as a covariate so that we could to determine the

relationship between each type of medical school experience and explicit bias during second year of residency after accounting for participants' attitudes toward lesbian and gay individuals at the beginning of medical school. We included explicit attitudes toward heterosexual women and men during residency as a covariate because individuals differ in their response tendencies on feeling thermometers (Wilcox, Sigelman, & Cook, 1989), and we wanted to ensure that we were specifically assessing the relationship between each type of medical school experience and explicit bias against lesbian and gay individuals, rather than a general response tendency.

With stratum included, several models predicting explicit bias failed to converge, so we eliminated stratum as a covariate. (Retaining stratum as a covariate but eliminating the random school intercept instead did not meaningfully change the results.) We then entered all three predictors, along with the aforementioned covariates, into a single model ("simultaneous predictors model"). This model allowed us to assess the strength of the association of each type of medical school experience with explicit bias, independent of the associations of the other types of medical school experiences with explicit bias.

In the individual predictor models, greater amount, $\beta=-0.09$, $SE=0.01$, $p<.001$, and favorability, $\beta=-0.07$, $SE=0.01$, $p<.001$, of contact during medical school (reported at T2) predicted lower levels of explicit bias against lesbian and gay individuals during residency (T3). In the simultaneous predictors model, greater amount, $\beta=-0.08$, $SE=0.02$, $p<.001$, and favorability, $\beta=-0.04$, $SE=0.02$, $p=.004$, of contact during medical school (reported at T2) again predicted lower levels of explicit bias against lesbian and gay individuals during residency (T3). In other words, a 0.68-point (one standard deviation) increase in amount of contact (on a 4-point scale) predicted a 1.82 to 2.04-point reduction in explicit bias (on a 101-point scale), and a 0.53- point (one standard deviation) increase in favorability of contact (on a 4-point scale) predicted a 0.91 to 1.59-point reduction in explicit bias (on a 101-point scale). Because on average explicit bias increased by 1.10 points between the first year of medical school and the second year of residency, our results suggest that participants with notably high levels of either amount or favorability of contact during medical school, on average, avoided this overall increase.

More negative role modeling during medical school (reported at T2) predicted higher levels of explicit bias against lesbian and gay individuals at T3 in both the individual predictor model, $\beta=0.03$, $SE=0.01$, $p=.018$, and the simultaneous predictors model, $\beta=0.03$, $SE=0.01$, $p=.015$. In other words, a 0.63-point (one standard deviation) increase in exposure to negative role modeling (on a 5-point scale) predicted a 0.68-point increase in explicit bias (on a 101-point scale). The relationship between one standard deviation in negative role modeling and explicit bias was comparable in magnitude to 62% of the expected increase in explicit bias from the beginning of medical school to the end of second year of residency.

To determine whether the different components of the composite predictor variables differentially predicted explicit bias, we estimated another series of linear mixed-effects models with each item (e.g., amount of contact with LGBT students, amount of contact with LGBT patients, etc.) entered individually. All individual items other than exposure to discrimination against an LGBT patient significantly predicted explicit bias (see

supplementary materials). However, because the majority of participants (75.37%) reported no exposure to discriminatory treatment of an LGBT patient, we dichotomized this variable (no exposure=0, any exposure=1). When dichotomized, exposure to discriminatory treatment also predicted explicit bias.

Implicit bias.—For each key predictor, we again estimated a linear mixed-effects model. These models ("individual predictor models") included stratum, participant demographics, and T1 implicit bias against lesbian and gay individuals as covariates. These models tested the relationship between each type of medical school experience (reported at T2) and implicit bias during second year of residency after accounting for implicit bias upon entry to medical school. We then entered all three predictors, along with the aforementioned covariates, into a single model ("simultaneous predictors model"), which allowed us to determine the strength of the association of each type of medical school experience with implicit bias, independent of the associations of the other types of medical school experiences with implicit bias. Because IAT scores are inherently comparative (representing relative preference for heterosexual women and men over lesbian and gay individuals), a separate estimate of attitudes toward heterosexual women and men was not included as a covariate.

Greater amount of contact with LGBT individuals during medical school (reported at T2) predicted lower levels of implicit bias against lesbian and gay individuals in second year of residency (T3) in the individual predictor model, $\beta=-0.06$, $SE=0.03$, $p=.049$. In other words, a 0.68-point (one standard deviation) increase in amount of contact (on a 4-point scale) predicted a .03-point reduction in implicit bias (on a 4-point scale). Because, on average, implicit bias decreased by 0.13 points between the first year of medical school and the second year of residency, this result suggests that the magnitude of the relationship between contact during medical school and implicit bias was comparable to 23% of the overall reduction in implicit bias from the beginning of medical school to the end of second year of residency. However, in the simultaneous predictors model, amount of contact with LGBT individuals was no longer a significant predictor of implicit bias, $\beta=-0.04$, $SE=0.03$, $p=.137$. As indicated in the supplementary materials, when missing data were excluded via listwise deletion, greater amount of contact with LGBT individuals no longer predicted lower levels of implicit bias ($p=.065$).

Neither favorability of contact with LGBT individuals (individual predictors model: $\beta=-0.05$, $SE=0.03$, $p=.093$; simultaneous predictors model: $\beta=-0.05$, $SE=0.03$, $p=.116$) nor exposure to negative role modeling (individual predictors model: $\beta=-0.05$, $SE=0.03$, $p=.103$; simultaneous predictors model: $\beta=-0.05$, $SE=0.03$, $p=.085$) predicted implicit bias against lesbian and gay individuals in second year of residency.

To determine whether the different components of the composite predictor variables differentially predicted implicit bias, we estimated another series of linear mixed-effects models with each item (e.g., amount of contact with LGBT students, amount of contact with LGBT patients, etc.) entered individually. Greater amount, $\beta=-0.07$, $SE=0.03$, $p=.018$, and favorability, $\beta=-0.02$, $SE=0.01$, $p=.043$, of contact with LGBT medical students predicted lower levels of implicit bias. When the other key predictors were included in the model, both

of these effect were marginally significant (amount: β=−0.06, *SE*=0.03, *p*=.053; favorability: β=−0.05, *SE*=0.03, *p*=.058). As indicated in the supplementary materials, when missing data were excluded via listwise deletion, greater favorability of contact with LGBT medical students no longer predicted lower levels of implicit bias (*p*=.066). No other items predicted implicit bias during second year of residency (T3).

Discussion

Physician bias against lesbian and gay individuals is one pathway by which sexual minority stigma translates into health disparities (Institute of Medicine, 2011). Although medical schools' formal curricula contribute to students' preparedness to provide care, their informal curricula can also play a critical role by shaping students' social attitudes and thus influencing their subsequent behavior toward patients with diverse identities (Hafferty, 1998; Paul et al., 2014). Identifying elements of the informal curriculum that mitigate or exacerbate physician bias against lesbian and gay individuals is therefore a critical step toward building inclusive medical institutions, improving the quality of care that physicians deliver to sexual minority patients, and reducing health disparities between heterosexual and lesbian and gay individuals.

The present study utilized a longitudinal design to establish temporal relationships between theoretically-informed predictors and subsequent levels of bias in an ecologically valid and socially important context. In line with our hypotheses, greater amount and favorability of contact with LGBT individuals during medical school predicted lower levels of explicit bias against lesbian and gay individuals two years later, during residency (see Table 3). Furthermore, as hypothesized, greater exposure to negative role modeling predicted higher levels of explicit bias (see Table 3). Thus, as hypothesized, interpersonal experiences during a key period of medical training predicted explicit bias against lesbian and gay individuals not only in the present (Phelan et al., 2017) but also two years later.

More frequent contact with LGBT individuals also predicted lower levels of implicit bias when tested individually but not when considered simultaneously with the other theorized predictors (see Table 3). Amount of contact with LBGT peers (but not faculty or patients), however, marginally predicted subsequent levels of implicit bias even when the other theorized predictors were included in the model. This finding is consistent with classic formulations of the contact hypothesis (Allport, 1954) and with empirical evidence concerning the role of equal status in intergroup interactions (Pettigrew & Tropp, 2006). These discrepant findings for contact with different LGBT groups should be interpreted cautiously, however, because the average amount of contact with LGBT medical students was greater than the average amount of contact with both LGBT faculty and LGBT patients (see supplementary materials). Thus, contact with LGBT peers might have been particularly effective at reducing implicit bias simply because it was more frequent than contact with LGBT faculty or patients.

In contrast to their effects for explicit bias, neither favorability of contact with LGBT individuals nor exposure to negative role modeling predicted implicit bias during residency (see Table 3). The weaker effects for implicit versus explicit bias are consistent with past

work suggesting that enduring reductions in implicit bias, though possible (Charlesworth & Banaji, 2019; Devine et al., 2012), are rare and more difficult to achieve (e.g., Gregg, Seibt, & Banaji, 2006) than are changes in explicit attitudes. Fluctuations in implicit association task scores may be more reflective of current environments and recent experiences than of enduring changes in attitudes (Dasgupta, 2013), which could help to explain why contact with LGBT individuals during medical school consistently predicted implicit bias against lesbian and gay individuals during medical school (Phelan et al., 2017) but not two years later, during residency.

However, a theoretical interpretation of the discrepant findings for explicit and implicit bias should be made cautiously because, by design, many fewer participants were tested for implicit bias than for explicit bias. To estimate the statistical power for our analyses, we first calculated the design effect (variance inflation factor) using the intra-school correlation, or *ICC*. The *ICC* was calculated directly from the models using $ICC = \sigma^2_{between} / (\sigma^2_{between} + \sigma^2_{within})$; the variance inflation factor was then calculated using $VIF = 1+(m-1)*ICC$, where m= the average number of students per school (Donner & Klar, 2000). We then divided the observed sample size by the *VIF* to get an effective sample size and used this effective sample size to estimate the detectable effects. Sensitivity power analyses (G*Power 3.1; Faul, Erdfelder, Lang, & Buchner, 2007) revealed that for explicit bias, we could detect effects of amount of contact, favorability of contact, and negative role modeling with a magnitude of β=0.05 or greater, whereas for implicit bias, we could only detect effects amount of contact, favorability of contact, and negative role modeling with a magnitude of β=0.08 or greater (with power=.80 and α =.05).

It is also noteworthy that the medical trainees in our sample reported relatively low levels of interaction with LGBT individuals during medical school (between “little” and “some”), which may have limited the ability of this intergroup contact to reduce implicit bias. Sexual minority identity is relatively concealable (Quinn & Earnshaw, 2011), and lesbian and gay individuals do not always disclose their sexual orientation to others, particularly when they fear discrimination or alienation (Mansh et al., 2015; Merchant, Jongco, & Woodward, 2005). Had heterosexual students had more interactions with openly LGBT individuals, stronger relationships between contact and implicit bias might have emerged.

Although in the present study, interpersonal experiences during medical school primarily predicted explicit – rather than implicit – bias, our findings still suggest that intervening upon these medical school experiences could be a fruitful avenue for shifting physicians’ behavior toward sexual minority patients. Explicit bias may influence medical decision-making (Calabrese et al., 2018) and verbal behavior (Dovidio, Kawakami, & Gaertner, 2002) toward lesbian and gay patients. Furthermore, amount of contact with LGBT peers emerged as a predictor of both explicit and implicit bias. Thus, building opportunities for heterosexual and sexual minority students to interact might be a particularly effective means of reducing future physicians’ biases.

To facilitate greater interpersonal interaction, medical schools could promote non-traditional pedagogical approaches such as “flipped” (or “inverted”) classrooms. This format, in which students are introduced to new material on their own, outside of class (often via online

videos) and then asked to engage in interactive learning experiences during class, can give students more opportunities to collaborate with peers with whom they might not otherwise interact (Ramnanan & Pound, 2017). Such cooperative activities – in which participants share a common goal and potentially a common, small group identity – may be particularly effective at reducing intergroup bias (Gartner & Dovidio, 2000).

At the institutional level, medical schools (and other organizations) can work to create and communicate more welcoming, inclusive climates. The more lesbian and gay students believe their school supports them and that they are not alone, the more open they will likely be about their sexual orientation (Griffith & Hebl, 2002; Lee et al., 2014; Przedworski et al., 2015; Ragins, Singh, & Cornwell, 2007). Thus, in addition to directly supporting sexual minority students, inclusivity initiatives can increase heterosexual students' contact with openly sexual minority peers.

Limitations

Limitations of the current research generally relate to the range of student experiences we were able to capture. Medical students in our sample reported primarily favorable contact with LGBT individuals. Thus, our findings concerning amount of contact may apply specifically to positive contact. Indeed, in other contexts, greater negative contact has exacerbated bias (Dovidio et al., 2017). Also, in examining exposure to role modeling, we looked solely at negative behaviors. Future research might consider the potential for positive role modeling to reduce bias against sexual minorities.

Furthermore, the current study was limited in its capacity to fully test the role of status in producing the observed relationships between both contact and bias and role modeling and bias. Research on intergroup contact emphasizes the role of equal status in facilitating bias reduction (Allport, 1954; Pettigrew & Tropp, 2006), whereas research on role modeling suggests that higher status models are particularly influential (Bandura, 1977; Crandall et al., 2018; Weiss, 1977). Although we measured contact with LGBT people of multiple statuses, because participants reported more frequent contact with LGBT peers than with LGBT faculty or patients, we are unable to determine whether peer contact was the sole predictor of subsequent implicit bias because the interaction partners were of equal status or because this contact was particularly frequent. Additionally, we measured exposure to negative role modeling primarily in terms of the behavior of people in positions of power. Thus, with the current data, we are unable to determine whether exposure to biased behaviors by people in equal or lower status positions would also predict increases in bias. Therefore, future research is needed to assess how the social status of interaction partners affects the relationships between medical school experiences and subsequent levels of bias.

The present study also focused on bias, rather than direct measures of behavior. Future research should explore the effects of training experiences on later patient-provider interactions. Furthermore, although previous research has documented the separate effects of physician explicit bias (Calabrese et al., 2018) and implicit bias (FitzGerald & Hurst, 2017) on medical decision making and care, future research might consider their joint effects on physician behavior. Although under some conditions having positive explicit attitudes can mitigate the negative impact of implicit biases on behavior toward sexual minorities

(Dasgupta & Rivera, 2006), in medical interactions, Black patients respond particularly unfavorably to physicians who hold combination of positive explicit and negative implicit attitudes (Penner et al., 2010), likely because such a combination undermines trust in the physician. Thus, future research is needed to determine how explicit and implicit bias against lesbian and gay individuals interact to predict physician behavior and patient satisfaction.

Finally, the unique historical background of this study should be considered. Data were collected between fall 2010 and spring 2016, a period during which a series of court cases legalized same-sex marriage in the U.S. Such rulings have been linked to reductions in bias against sexual minorities (Ofosu, Chambers, Chen, & Hehman, 2019), and it is possible that they also increased sexual minority students' disclosure of their sexual orientation and/or amplified the bias-attenuating effects of contact with LGBT individuals. Indeed, both explicit and implicit bias against lesbian and gay individuals decreased between 2010 and 2016 among the members of the general U.S. population who completed measures of anti-lesbian and gay bias on the public Project Implicit demonstration website, http://implicit.harvard.edu (Charlesworth & Banaji, 2019). However, even in this context of broader societal change, although average levels of implicit bias decreased over the course of the study, average levels of explicit bias marginally increased. In other words, even if changes in the legal status of same-sex marriage reduced explicit bias within the broader U.S. population, they did not reduce explicit bias within this sample of medical trainees. The slight increase in explicit bias against lesbian and gay men within this sample may be related to the more general decline in empathy – which involves taking the perspective of others – that medical trainees tend to experience during both medical school and residency (Neumann et al., 2011). Thus, understanding shifts in bias against sexual minorities requires consideration of organizational norms and interpersonal experiences alongside societal factors.

Conclusions

This study is the first, to our knowledge, to demonstrate that contact with LGBT individuals and exposure to negative role modeling during medical school predict bias against lesbian and gay individuals two years later, during residency. Physician bias represents one avenue by which sexual minority stigma contributes to negative health outcomes among lesbian and gay individuals (Elliott et al., 2015). Developing and implementing interventions that increase heterosexual students' ability to interact with sexual minority peers is therefore an important step toward reducing health disparities between heterosexual and sexual minority individuals. Improving medical school climates can improve medical students' attitudes toward sexual minority individuals years later and ultimately strengthen the quality of health care they deliver to lesbian and gay patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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- Medical schools' informal curricula can have enduring effects on anti-LG bias.
- More LGBT contact predicted less physician explicit anti-LG bias.
- More favorable LGBT contact predicted less physician explicit anti-LG bias.
- Greater exposure to anti-LGBT bias predicted more physician explicit anti-LG bias.
- More contact with LGBT peers predicted less physician implicit anti-LG bias.

Table 1

Demographic characteristics of heterosexual, female and male second year resident physicians.

	No. (%)
Gender	
Female	1469 (49.97%)
Male	1471 (50.03%)
Race / ethnicity	
American Indian/Alaska Native	2 (0.07%)
Black	136 (4.63%)
East Asian	393 (13.37%)
Hispanic or Latino/a	140 (4.76%)
Native Hawaiian/Pacific Islander:	6 (0.20%)
South Asian	298 (10.14%)
White	1926 (65.51%)
Other or Unknown	39 (1.33%)

Table 2

Correlations among baseline (T1) bias, end of medical school (T2) bias, & residency (T3) bias.

	1	2	3	4	5	6
1. T1 Explicit Bias	1					
2. T2 Explicit Bias	.50	1				
3. T3 Explicit Bias	.45	.53	1			
4. T1 Implicit Bias	.16	.14	.10	1		
5. T2 Implicit Bias	.17	.14	.11	.31	1	
6. T3 Implicit Bias	.14	.14	.14	.26	.32	1

Note. Each correlation is significant, $p<.001$.

Table 3

Amount of contact, favorability of contact, and negative role modeling in medical school as predictors of bias against lesbian and gay individuals in second year of residency.

	T3 Explicit Bias						T3 Implicit Bias					
	Individual predictor models			Simultaneous predictors model			Individual predictor models			Simultaneous predictors model		
Variable	***β***	***SE***	***p***	***β***	***SE***	***p***	***β***	***SE***	***p***	***β***	***SE***	***p***
Amount of contact	−0.09	0.01	< .001	−0.08	0.02	< .001	−0.06	0.03	.049	−0.04	0.03	.137
Favorability of contact	−0.07	0.01	< .001	−0.04	0.02	.004	−0.05	0.03	.093	−0.05	0.03	.116
Negative role modeling	0.03	0.01	.018	0.03	0.01	.015	−0.05	0.03	.103	−0.05	0.03	.085

Note. Each individual predictor model includes a single key predictor (amount of contact, favorability of contact, or negative role modeling), with gender, race/ethnicity, and childhood income entered as covariates. Simultaneous predictor models include the three key predictors (amount of contact, favorability of contact, and negative role modeling), with gender, race/ethnicity, and childhood income entered as covariates. Explicit bias models include T3 attitudes toward heterosexual women and men and T1 explicit attitudes toward lesbian and gay individuals as covariates. Implicit bias models include T1 implicit bias against lesbian and gay individuals and stratum as covariates. All models include a random intercept by school.