Same-sex marriage legalization associated with reduced implicit and explicit antigay bias

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Abstract

The current research tested whether the passing of government legislation, signaling the prevailing attitudes of the local majority, was associated with changes in citizens’ attitudes. Specifically, with ~1 million responses over a 11-year window, we test whether state-by-state same-sex marriage legislation was associated with decreases in anti-gay implicit and explicit bias. Results across five operationalizations consistently provide support for this possibility. Both implicit and explicit bias were decreasing prior to same-sex marriage legalization, but decreased at a sharper rate following legalization. Moderating this effect was whether states passed legislation locally. While states passing state-level legislation experienced a greater decrease in bias following legislation, states that never passed local legislation demonstrated increased anti-gay bias following federal legalization. Our work highlights how government legislation can inform individuals’ attitudes, even when these attitudes may be deeply entrenched, and socially and politically volatile.

Keywords: intergroup dynamics, prejudice, stereotypes
**Résumé**

La recherche présente a testé si l’adoption par le gouvernement de lois reflétant l’avis d’une majorité de citoyens, est associée avec des changements d’attitude de citoyen(ne)s. Grâce à 1 million d’observations sur plus de 11 ans, nous avons examiné si la légalisation du mariage gai pour chaque état américain a été associée avec la diminution des préjugés homophobes implicites et explicites. Cinq modèles statistiques appuient fortement notre hypothèse. Bien que les préjugés implicites et explicites étaient en diminution avant la légalisation du mariage homosexuel, les deux types de préjugés ont diminué plus rapidement après. Cet effet était modéré par le pallier de gouvernement ayant mis en œuvre la légalisation. Spécifiquement, les états ayant adopté la légalisation au niveau de l’état ont vu une diminution des deux types de préjugés après la légalisation, tandis que ceux n’ayant pas légalisé le mariage gai au niveau de l’état ont vu une augmentation des préjugés après la légalisation au niveau fédéral. Notre recherche souligne comment les lois gouvernementales peuvent influencer les attitudes individuelles, même quand ces attitudes sont fortement enracinées et sujettes aux débats sociaux.

*Mots Clés :* dynamiques intergroupes, préjugés, stéréotypes
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Authors Contributions

Eugene K. Ofosu conceived and designed the research along with Eric Hehman, Michelle Chambers, and Jacqueline Chen. Eugene K. Ofosu, along with Eric Hehman performed statistical analyses. The manuscript on which this thesis is based was heavily drafted Eugene Ofosu and Eric Hehman, along with feedback and modifications from Michelle Chambers and Jacqueline Chen.
Preface

Thesis Format

This Manuscript-based Master’s Thesis is composed of one research project submitted to and published in the journal of the *Proceedings of the National Academy of Sciences of the United States of America* (Ofosu, Chambers, Chen, & Hehman, 2019). It has therefore been slightly modified to adhere to APA formatting rules. Furthermore, a general introduction and modified general conclusion are included.

General Introduction

Social Identity Theory posits that individuals forgo their individualistic aspects and adopt a group social identity (J. C. Turner, Hogg, Oakes, Reicher, & Wetherell, 1991). The Theory expands that individuals think of themselves as templates of their group, leading to interpersonal relationships becoming intergroup relationships. Individuals adhere to established group norms and expectations when interacting with individuals from other groups and as such, an “us verse them” mentality emerges during interpersonal relationships. The theory furthers that the cognitive depersonalization of the self for a group identity bolsters self-esteem since a group’s social status becomes an individual social status. Furthermore, being part of a group encompasses believing in a particular set of beliefs of the group and acting according. Thus, uniformity of perceptions (Ethier, K.A, Deaux, 1994; Hogg & Abrams, n.d.; M. E. Turner et al., 1992), in-group bias (Sacchi, Paladino, Castano, & Yzerbyt, 2002), and stereotyping (Haslam, Oakes, Reynolds, & Turner, 1999), are sure to ensue, and eventually leading to prejudice.

Prejudice is defined as a negative valance response towards an individual belonging to a group or a group based on beliefs about such group (Greenwald & Banaji, 1995). Prejudice can
be further divided into implicit bias and explicit bias. Whereas implicit bias is thought of as either an automatic process, explicit bias is viewed as a deliberate effortful process. Although studies have found a low test-retest correlation for implicit bias (Gawronski, Peters, Brochu, & Strack, 2008), the constant presence of individual level prejudice significantly contributes to commonplace discriminatory acts such as negative social interactions (McConnell & Leibold, 2001), and has consequential ramifications such as constrained employment avenues (Bertrand & Mullainathan, 2004) and reduced chances of receiving life-saving emergency treatment (Green et al., 2007).

Regional level prejudice has also been observed to have equally far reaching effects. Whites’ explicit bias was found to be positively correlated with elevated black’s death rate due to circulatory diseases (Leitner, Hehman, Ayduk, & Mendoza-Denton, 2016a). Studies again found regional racial bias to be associated with in-group death rates such that counties where white’s exhibited higher anti-black explicit bias, recorded higher white dead rates, while counties where blacks harbored higher anti-white implicit bias, blacks died at a higher rate (Leitner, Hehman, Ayduk, & Mendoza-Denton, 2016b). Furthermore, county implicit and explicit bias have been associated with racial disparities in school based disciplinary actions (Riddle & Sinclair, 2019). Lastly, macro-psychological statistical models found only implicit racial prejudice and stereotypes of white residents were associated with disproportional police lethal force against blacks. In other words, the racial prejudice context in which police officers operated was significantly related to the disproportional use of lethal force (Hehman, Flake, & Calanchini, 2018).

Contact hypothesis suggests that contact with one’s outgroup member should reduce prejudice. And indeed a meta-analysis of 515 studies with approximately 250,000 subjects of
diverse identities from 34 countries reveal a negative relationship between contact and prejudice (Pettigrew & Tropp, 2006). Decrease of prejudice was not only confined to physical contact, imagined contact has been noted to also reduces prejudice (Miles & Crisp, 2014). Furthermore, studies revealed that not only did individuals having more interactions with gays and lesbian reported reduced prejudice, but also living in a region with more interaction between heterosexuals and gays was negatively associated with prejudice towards gays and lesbians. Thus, in addition to direct individual contact – physical or imagined – reducing prejudice, contextual contact has been observed to also decrease prejudice.
General Introduction Reference


Hehman, E., Flake, J. K., & Calanchini, J. (2018). Disproportionate use of lethal force in
policing is associated with regional racial biases of residents. *Social Psychological and Personality Science, 9*(4), 393–401.


Manuscript:

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Introduction

Social norms can exert a strong influence on attitudes and behaviors (Cialdini, Reno, & Kallgren, 1990; Deutsch & Gerard, 1955). People often modify their views and actions to align with the perceived norms in their environment (Tankard & Paluck, 2016). Norms are not necessarily explicit and often must be inferred (Cialdini & Goldstein, 2004). People tend to infer and reinforce social norms through social interaction (Kallgren, Reno, & Cialdini, 2012; Paluck, 2009). Given the implied nature of social norms, the attitudes and behaviors deemed acceptable are prone to change over time. Even when an individual personally disagrees with a normatively accepted behavior, they may uphold it through cognitive dissonance (Festinger, 1957). Specifically, to the extent that one consistently modifies their behavior to be congruent with perceived norms (Dickerson, Thibodeau, Aronson, & Miller, 1992; Stone, Aronson, Crain, Winslow, & Fried, 1994), personal attitudes, including prejudice toward social groups (Leippe & Eisenstadt, 1994), might change over time as well. The current research focuses on local government’s role in signaling such norms. Specifically, we examine whether the local changes to government policy supportive of a marginalized social group informed the biases of citizens toward that group.

There are multiple reasons why legislation passed by a democratic government might be perceived as a norm. The literal translation of democracy is the “rule of the people”, and theoretically is a system of government in which elected representatives create laws aligning with the interests of the majority of the population. Realistically, while the way in which legislation is formed is far more complex, people within a democratic system may generally
perceive laws to reflect the will of the people. Consequently, they may interpret enacted legislation as consistent with the values and beliefs of the majority. Consistent with this view, people do infer that policies enacted by a group reflect the group’s approval, even if the policy was not enacted by a majority opinion (Allison & Messick, 1988). Therefore, enacted legislation might be perceived as a strong signal of current local norms. Should any legislation impact the outcomes of specific social groups, this legislation might be perceived as reflecting prevailing societal attitudes toward those groups more broadly. Indeed, individuals update their perceptions of social norms over time based on environmental cues (Paluck & Shepherd, 2012). Similarly, from local legislation, individuals can learn to what extent they may be in the majority or minority, and therefore how acceptable it is to express any attitudes regarding those social groups.

The opportunities to examine the impact of government policy on attitudes toward marginalized social groups are very rare, yet there is some evidence that government policy can change attitudes. For instance, there was a 60% increase in support for interracial marriages following legalization in 1978 (Newport, 2013), a change various scholars have partially attributed to the Supreme Court’s verdict (Marshall, 1987; Schacter, 2009). In more recent history, following the 2016 United States presidential election of Donald Trump, participants reported an increase in the acceptability of prejudice towards stigmatized groups (Crandall, Miller, & White, 2018). Furthermore, experimental work is supportive of these conclusions, finding that consensus information causes changes in participants’ attitudes (Stangor, Sechrist, & Jost, 2001; Tankard & Paluck, 2017).

Same-sex marriage legalization is a unique phenomenon providing an opportunity to study the relationship between local legislation and citizens’ attitudes. This is because while the U.S.
Supreme Court adjudicated that the right to marry was fundamental and inalienable (“SUPREME COURT OF THE UNITED STATES,” 2015) on June 26th of 2015, 35 states and Washington D.C. had passed state-level same-sex marriage legalization in some form prior to this date at different times over the previous 11 years. This pattern of legalization over time provides a natural, quasi-experimental, multiple group, interrupted time-series, with staggered treatments across groups (states), a design that mitigates many of the threats to causal conclusions typically associated with observational data (Lesik, 2006; Moss & Yeaton, 2006; West et al., 2008).

The evidence regarding whether government legislation has an impact on citizens’ attitudes is mixed. Although institutions can successfully change personal attitudes surrounding political or social issues under given conditions (Beaman, Chattopadhyay, Duflo, Pande, & Topalova, 2009; Stangor et al., 2001), attitudes about contentious issues involving personal experiences, or strong religious and political views are less malleable (Hoekstra, 1995; Jost, Federico, & Napier, 2009). Therefore, attitudes regarding same-sex marriage legalization and sexuality issues in general may be less likely to change. There has only been limited previous research on the impact of same-sex marriage legalization on personal attitudes, with mixed conclusions. For instance, researchers found increased support for same-sex marriage legalization following legalization, but only among some demographic groups, and their data were from Iowa only (Kreitzer, Hamilton, & Tolbert, 2014). Others found warmer attitudes toward gay men and lesbians following legalization, though the panel data was limited to three states (Flores & Barclay, 2016). In contrast, researchers examining nationally representative two-wave panel data found that residents of states in which same-sex marriage legalization policies were introduced had the greatest reduction of explicit anti-gay biases, but these data were collected prior to state-level legalization for a majority of legalizing states and before national legalization (Flores &
Barclay, 2016). Recent research focusing on the one-year time period around federal legalization found no attitude change toward gay people following legalization, but they did find changes in the perceptions of social norms (Tankard & Paluck, 2017).

We extend from this work in several key ways. First, we analyze the attitudes of approximately 500,000-1 million people, depending on the analysis, whereas the largest samples collected previously were around 1,000 participants. Second, attitudes toward gay people were collected over a 12-year period, as compared to 1-2 year windows of prior research, providing a wider lens with which to capture continuity or change in social attitudes over time. Most importantly, the current work uniquely explores attitudes assessed with methods other than self-reports that are less susceptible to social desirability (Kim & Kim, 2016).

We focus on how state-level same-sex marriage legalization changed implicit and explicit anti-gay bias over time. Bias can be measured relatively directly (i.e., explicitly) or indirectly (i.e., implicitly). Biases measured explicitly are thought to reflect relatively deliberate and conscious mental processes, often predicting intentional judgments and behaviors, whereas implicit biases have traditionally been conceptualized as reflecting less intentional or controlled processes (Dovidio, Kawakami, & Gaertner, 2002; Gawronski, Peters, Brochu, & Strack, 2008) that can influence judgments and behaviors outside of conscious awareness. All previous research examining changes in attitudes toward gay people as a result of same-sex marriage legalization has measured attitudes via explicit responses (e.g., “How warmly or coldly do you feel toward gay men and lesbians?”). These previous results may have at least partially been due to respondents’ reluctance to report attitudes at odds with perceived norms. To conclude that changing governmental legislation can inform peoples’ actual attitudes, it is critical to examine those attitudes with measures that are less susceptible to social desirability than explicit self-
reported attitudes. The use of implicit measures to assess bias address this issue, because they measure bias indirectly from the speed or accuracy with which a response is made, rather than from the contents of the response itself (Gaertner & McLaughlin, 1983; Mierke & Klauer, 2003). The current research addresses this concern by examining both implicit and explicit anti-gay biases over time.

Method

Study Procedure

We did so by geolocating ~ 1 million respondents when they completed implicit and explicit measures of anti-gay bias at Project Implicit (Figure 1). Since 2002, Project Implicit has operated a website which people can visit and complete an implicit association test (IAT), one measure of implicit bias (Xu et al., 2013). The vast majority of prejudice research has focused on individuals, but by geolocating the millions of responses at Project Implicit, researchers have very recently begun examining associations between various outcomes and regional trends in prejudice (Hehman, Flake, & Calanchini, 2018; Leitner, Hehman, Ayduk, & Mendoza-Denton, 2016a, 2016b; Payne, Vuletich, & Lundberg, 2017; Rae, Newheiser, & Olson, 2015). Here, we examine changing regional implicit and explicit anti-gay biases over time, comparing these trends before and after local state-level legalization of gay-marriage in each state.
Figure 1. State-level anti-gay implicit and explicit bias, averaged across all responses between 2005 and 2016.

Consistent with the research finding that norms influence personal attitudes and vice versa (Cialdini et al., 1990; Paluck, 2009); (Festinger, 1957), evidence in support of our hypothesis would be obtained if implicit and explicit anti-gay bias diminished following state-level legalization. In other words, we hypothesized that government legislation would contribute to changes in the attitudes of those locally impacted by the policies. Our inferences were allowed by the manner in which state-level same-sex marriage legalization occurred in the U.S. Legalization occurred in a natural, quasi-experimental, multiple group, interrupted time-series with staggered treatments across groups (i.e., states). Because we have a large number of observations of bias pre- and post-legalization, and because the treatment (i.e., gay-marriage
legalization) happened over a 12-year period to a broad sample of different states in a staggered manner, it is unlikely an unmeasured variable is systematically explaining reductions in bias (Lesik, 2006; Moss & Yeaton, 2006; West et al., 2008). Given that the data is observational, this design is not definitive proof of causality. Nonetheless, it does allow for stronger conclusions regarding whether same-sex marriage legalization caused the decreases in anti-gay implicit and explicit bias.

We tested our hypotheses in a multilevel regression model, in which Project Implicit respondents (n = ~1 million) were clustered within states and Washington D.C. (k = 51). In separate models, implicit and explicit anti-gay bias were regressed on our primary variables of interest (i.e., Time and whether the date was pre vs. post gay-marriage legalization) and demographic covariates. At the respondent-level, all models controlled for gender, age, and racial majority-minority status. At the state-level, all models controlled for average employment rate, education, income, and population density. Conclusions are identical when examining zero-order correlations.

We believe our first model to be the strongest test of our hypothesis, restricting analyses to those who self-identified as heterosexual. Yet we performed a number of additional analyses on variants of this dataset to ensure our conclusions were not a result of subjective researcher decisions made throughout the analytic pipeline. Model 2 included participants of all sexualities, to confirm our initial results were not due to the sexuality of our sample. Using a self-identifying heterosexual sample, Model 3 addressed the generalizability of our conclusions by replicating results with a nationally representative American National Election Studies (ANES) dataset. Model 4 compared changes in bias following same-sex marriage legalization in states that passed laws locally to those for whom same-sex marriage was only legalized following federal
legalization. In sum, we adopted a “multiverse” approach (Steegen, Tuerlinckx, Gelman, & Vanpaemel, 2016), examining how robust our effects were to unavoidable subjective researcher decisions made in the course of analyses. We examine the influence of same-sex marriage legalization on both implicit and explicit bias in separate models throughout. Consistency across all analyses is stronger evidence in support of our conclusions.

Participants

Datasets. A number of different datasets with different exclusion criteria were created for different analyses. The anti-gay bias dataset had 949,664 respondents, completed between 2005 to 2016. Across all datasets, participants ($M_{age} = 24.72, SD = 10.8$; 60% female, 32% male, 8% undisclosed) were included only if: U.S.-based, had state-level geographic information included, and either implicit or explicit data, and gender, age, and racial majority/minority status reported. All reported effects are robust to inclusion of participant-level covariates, as models fully replicate when not included. In Dataset 1, analyses were restricted to participants who had self-identified as heterosexual, resulting in a sample of $n = 680,376$. In Dataset 2 we relaxed this assumption, including both gay respondents and those who had not answered this question, resulting in a sample of $n = 765,425$.

ANES data. Commencing in 1948, the ANES gathers information on public opinions and political participation. We limited our analyses to the time series cumulative dataset ($n = 10,870; M_{age} = 49.11, SD = 17.2$; 52.6% female, 47.1% male, .3% undisclosed) from 2008, 2012, and 2016, corresponding with the Project Implicit data. All ANES models were identical to Project Implicit models with the exception of racial majority or minority status. Models were weighted with the sample weight from online sampling only (“VCF0011y” in the ANES data), as it
uniquely included Alaska and Hawaii. See [electionstudies.org/] for more information on sampling methodology.

**Measures**

*Anti-Gay Bias.* Measures of implicit and explicit anti-gay prejudice were obtained from Project Implicit (Xu et al., 2013). Implicit bias was represented by the IAT $d$ score (Greenwald, Nosek, & Banaji, 2003), from an IAT task requiring participants to respond to social targets (e.g., Gay, Straight) and attributes (e.g. Good, Bad) simultaneously by timed keyboard input. Explicit bias was calculated from thermometer items. Participants had reported how warm they felt towards straight men, straight women, gay men, and lesbians on a 0 (*coldest feelings*) to 10 (*warmest feelings*) scale. Ratings of heterosexuals were averaged, and ratings of gay men and lesbians were averaged. Consistent with previous research (Hehman et al., 2018; Leitner et al., 2016a, 2016b), explicit bias was represented by the difference between rated warmth toward heterosexuals and gay people. Greater positive values for both implicit and explicit biases thus reflected more positive attitudes towards heterosexuals relative to the gay community.

*Legalization of Same-sex Marriage.* Same-sex marriage legalization date was defined as the date on which state-level institutions passed legalization locally. The earliest available data in the Project Implicit anti-gay dataset was 2005, after Vermont and Massachusetts had already passed forms of same-sex marriage legalization. All data from these states is coded as post-legalization. California initially enacted same-sex legislation in 2008, but it was subsequently blocked 5 months later. In 2010, legislation was again enacted legalizing same-sex marriage. Thus, implicit and explicit responses from California were coded as post-state legalization if they were performed on or after the 2010 date to be as conservative as possible. See SI Appendix for analyses examining changes in California specifically. In some states (e.g., Utah, Colorado,
Oklahoma), we defined same-sex marriage legalization as the date on which legislation defining marriage as “between woman and man” was ruled unconstitutional by state courts.

*Time-varying covariates.* A number of demographic variables were included as controls. These variables varied by year. Employment was represented by 5-year estimates of state-employment rates reported by the 2005-2016 American Community Survey (Bureau, 2012). Education was represented by the percentage of state residents with a BA or equivalent degree (Bureau, 2012). Population density was computed based on 2000 and 2010 census data (Bureau, 2012). Socioeconomic status was represented for by a 5-year estimates of mean household income (Bureau, 2012).

**Statistical Analyses**

Results were analyzed in a multilevel framework using lme4 (Bates, Mächler, Bolker, & Walker, 2015) in the R environment, with respondents nested within states and Washington D.C ($k = 51$). States were selected as the clustering unit since same-sex marriage legislation was passed at the state-level. State-level variables were grand-mean centered. Degrees of freedom, test-statistics, and $p$-values were derived from Satterthwaite approximations in the lmerTest R package (Kuznetsova, Brockhoff, & Christensen, 2017). Models included random intercepts and fixed slopes. Intraclass correlation coefficients across all three datasets consistently revealed approximately 3-4% of the variance was between states for implicit bias, and 1-5% of the variance was between states for explicit bias. The vast majority of variance was within-state. Model-explained variance was calculated using the formulas laid out by Rights & Sterba (Rights, Sterba, Rights, & Sterba, 2018).
Results

Model 1: Heterosexual Only

Our primary hypothesis was tested by examining whether the relationship between time and anti-gay bias varied depending on whether it was before or after state-level same-sex marriage legalization. In other words, did the within-state trend of anti-gay bias over time change following gay-marriage legalization? Model 1 was implemented on Dataset 1, restricted to self-reported heterosexuals. First examining implicit bias, consistent with our hypotheses a Year × Legalization interaction emerged ($B = -.0025, SE = .0003, p < .001$). Simple slopes revealed that while bias was decreasing over time prior to legalization ($B = -.0062, SE = .0003, p < .001$), this decrease doubled in magnitude following legalization ($B = -.0111, SE = .0006, p < .001$) (Figure 2). This data is available at [https://osf.io/prcd8/?view_only=bf50f34258c745408cce9a1481731df7]

An identical pattern was present with explicit bias. A Year × Legalization interaction ($B = -.0053, SE = .0016, p < .001$) indicated that while bias was decreasing over time prior to legalization ($B = -.0915, SE = .0016, p < .001$), this decrease was sharper following legalization ($B = -.1022, SE = .0029, p < .001$). See SI Appendix Tables 1A and 1B for full models.

Therefore, both implicit and explicit bias showed steeper declines over time following same-sex marriage legalization. The full model explained 4.29% of the total variance in implicit bias, and 3.27% of the within-state variance. Our effects of interest uniquely explained 1% of the within-state variance beyond demographic covariates. The full explicit model explained 8.79% of the total variance in explicit bias, and 6.46% of the within-state variance. Legalization uniquely explained 1.67% of the within-state variance beyond demographic covariates.

One concern threatening the validity of our conclusions is that Project Implicit respondents following legalization might be a different population than those visiting the site prior to
legalization. We examined this possibility with the demographic data available, comparing respondents pre- and post-legalization on age and gender-breakdown. Project Implicit respondents before ($M = 24.56$, $SD = 10.64$) vs. after legalization ($M = 25.06$, $SD = 11.13$) were on average 6 months older, $t(632,413) = 20.70$, $p < .001$. Further, 2% more of the respondents self-identified as female following legalization $t(38,810) = 13.12$, $p < .001$. These comparisons are significant due to our high statistical power, but small and not particularly meaningful (further, see Model 3). We interpret these differences as unlikely to be responsible for the observed changes in bias over time, and consider the populations pre- and post-legalization to be functionally the same age and gender percentage.

*Figure 2.* Contour plots of implicit bias over time before (left panel) and after (right panel) legalization of same-sex marriage, across all states, showing the decreasing trend in implicit bias over time post-legalization. Because there are several hundred thousand data points, contour
plots are used as data is too high-density to visualize with scatterplots. Higher density values (brighter colors) represent more observed data points in that region of the figure.

**Model 2: Unreported Sexuality**

Model 2 was identical to Model 1 but performed on Dataset 2 which relaxed the restriction that respondents self-identified as heterosexual, and therefore was 11% larger ($n = 765,425$). Repeating our primary analyses in this dataset provided identical conclusions. For implicit bias, a Year × Legalization interaction was present ($B = -.0046$, $SE = .0003$, $p < .001$). Again, bias decreased more sharply over time following legalization relative to prior. The pattern was identical when examining explicit bias. The effect size was slightly larger, with effects of interest explaining 1% and 2.2% of the within-state variance for implicit and explicit bias, respectively. See SI Appendix Table 2A and 2B for full models.

**Model 3: Replication with a Nationally Representative Dataset**

A major threat to the conclusions of the above analyses are that the subpopulation visiting Project Implicit is not representative of the U.S. population, and thus that any change in Project Implicit respondents’ biases do not generalize. To address this concern, we turned to a publically available, nationally representative survey sample, the American National Election Studies (ANES) dataset (“Time Series Cumulative Data File (1948-2016) - ANES | American National Election Studies,” n.d.). The ANES gathers information on public opinions and political participation during every presidential election cycle, and is representative of the both spatial and temporal demographics of the U.S. Ideal for our purposes, the surveys contained an explicit thermometer item similar to that of Project Implicit, regarding the extent to which participants felt warmth towards gay men and lesbians, with a score between 0 (cold) and 100 (warm). Critically, this data was collected across all 50 states and Washington D.C. before, during, and
after same-sex marriage legalization. Therefore, we could test a model identical to Models 1 and 2 reported above, examining whether anti-gay biases decreased at a greater rate following same-sex marriage legalization, but with a dataset weighted to be representative.

It is noteworthy that state-level anti-gay biases from the Project Implicit and ANES data were highly correlated \((r = .75, p < .001, 95\% \text{ CI } [.60, .85])\), indicating that despite sampling differences, the anti-gay bias captured by Project Implicit was highly correlated with a nationally representative estimate of explicit bias. Most importantly, we repeated Model 1 with the ANES data across the three most recent time points corresponding with the passing of same-sex marriage legislation: 2008, 2012, 2016. Identical to Models 1 and 2, a Year × Legalization interaction was present \((B = 1.1142, SE = .3943, p = .005)\). Unlike the Project Implicit data that indicated pre-legalization bias was declining slowly, simple slopes indicated that pre-legalization warmth toward gay men and lesbians was stable over time \((B = .1466, SE = 1.5062, p = .813)\). Yet, consistent with Project Implicit data and our hypotheses, warmth towards gay men and lesbians increased over time after legalization \((B = 2.3750, SE = .6107, p < .001)\). See SI Appendix Table 3 for full model. Because the ANES is a U.S. representative sample, these results provide evidence that our conclusions generalize beyond Project Implicit respondents.

**Model 4: State vs. Federal-level Legalization**

Although Models 1-3 revealed that anti-gay prejudice was, on average, decreasing at a sharper rate across all U.S. states following same-sex marriage legalization, it is possible this broad effect is concealing important moderators. For instance, we have hypothesized that local norms influence individuals’ attitudes. While 35 states and Washington D.C. passed same-sex marriage legalization prior to federal legalization, 15 states did not. Therefore, any norms signaled by federal legalization would not be local within-state, and may have different
implications for local anti-gay attitudes. To test this possibility, we coded states for whether legalization was first passed at the state or federal level, and included a Year × Legalization × State-Federal interaction testing whether the above Year × Legalization effects reported above varied by whether legislation was passed at state or federal level.

For implicit bias, this three-way interaction was significant ($B = .0088$, $SE = .0016$, $p < .001$), indicating that the pattern of change in bias over time depended on whether same-sex marriage legalization happened as a result of local (i.e., state) or federal law. Prior to legalization, anti-gay bias was decreasing both in states that ultimately passed same-sex marriage legislation ($B = -.0051$, $SE = .0004$, $p < .001$) and those that did not ($B = -.0077$, $SE = .0005$, $p < .001$). For the states passing same-sex marriage at the state-level, the demonstrated pattern was identical to that evident in Models 1-3 (Figure 3). Bias decreased at roughly double the rate over time following legalization ($B = -.0112$, $SE = .0006$, $p < .001$). In sharp contrast, for the 15 states that did not pass same-sex marriage legalization locally, anti-gay bias increased over time following legalization ($B = .0215$, $SE = .0065$, $p < .001$). An identical pattern was present with explicit bias. Effects of interest explained 1% and 4.4% of the within-state variance for implicit and explicit bias, respectively. See SI Appendix Tables 4A and 4B for full models†. These results, while exploratory, suggest that the locality of legislation may be an important moderator in influencing the biases of local residents. We return to this issue in greater detail in General Discussion.
Figure 3. The trends in implicit and explicit anti-gay bias over time, comparing the trend prior to and after same-sex marriage legalization in states that passed same-sex marriage legalization locally compared to states that did not pass same-sex marriage legalization locally. The dates of these trends vary across different states, so they have been plotted on the same panels for purposes of comparison.
Discussion

We find consistent evidence in support of the hypothesis that local government legislation informs changes in citizens’ attitudes. Consistent with previous research (Westgate, Riskind, & Nosek, 2015), we find that both implicit and explicit anti-gay bias was decreasing or stable over time prior to same-sex marriage legalization. Yet following the passing of legislation perceived as supportive of this marginalized population, on average anti-gay bias declined at a steeper rate. This conclusion converges with previous research finding that citizens of states passing state-level legislation had the greatest decrease in anti-gay attitudes (Flores & Barclay, 2016). Evidence is consistent across five different operationalizations and data from two distinct sources. The limited “multiverse” approach (Steegen et al., 2016) we pursued helps ensure these conclusions are robust to unavoidable subjective researcher decisions. The manner in which same-sex marriage legalization naturally unfolded across the U.S., a multiple groups time-staggered quasi-experimental design, mitigates many of the threats to causal conclusions typically associated with observational data (Lesik, 2006; Moss & Yeaton, 2006; West et al., 2008).

Results indicate that attitudes and legislation may be mutually reinforcing. More specifically, because results generally indicate that attitudes toward the gay community were improving in all states prior to legalization (though see Model 3), evolving attitudes toward same-sex marriage may have served as impetus and momentum for both state and federal legalization. These enacted legislations in turn strengthened and consolidated favourable attitudes towards lesbians and gay men.

Importantly, we find identical effects among both implicit and explicit measures of bias. The limited previous research on whether same-sex marriage legislation was associated with
changes in attitudes used self-reported measures that were susceptible to concerns regarding social desirability (Kim & Kim, 2016), especially so given the politically sensitive and controversial nature of the topic. That a similar pattern is evident among implicit measures, less susceptible to conscious control and social desirability, is important evidence supporting that government legislation is associated with true changes in the attitudes of its citizens.

Traditionally, implicit and explicit bias at the individual-level have been treated as weakly positively correlated but distinct phenomena (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005), yet throughout all analyses here results were identical across both, and the correlation between the two constructs was surprisingly high ($r = .88, p < .001$). Determining how regional biases may differ from individual-level biases is beyond the scope of the present research, but future work might examine this discrepancy to better understand regional biases.

Here, examining both implicit and explicit bias revealed identical conclusions.

A critical moderator of this effect appears to be whether same-sex marriage legalization was passed locally or at the federal level. In states that did not pass same-sex marriage legalization locally, we find a reactive or “backlash” effect (Flores & Barclay, 2016) such that federal legalization was associated with increased anti-gay bias over time, despite the decreasing trend in bias in these states prior to federal legalization. The specific factors driving this effect cannot be addressed by the present data. One possibility is that, even though attitudes were improving, a tipping point of local support had not yet been reached for the majority to accept the federal ruling. Research at the individual level suggests the attention given the federal decision may have sharpened some respondents’ sense of symbolic threat to their lifestyle and values (Riek, Mania, & Gaertner, 2006), and this sense of threat could have exacerbated anti-gay biases among those individuals. Most of 15 states that did not pass state legislation are those with
generally stronger and more traditional social norms (Cohen & Nisbett, 1994; Harrington & Gelfand, 2014; Vandello, Cohen, & Ransom, 2008).

These increasingly positive attitudes in some states and increasingly negative attitudes in others indicate that the federal legalization of same-sex marriage may have prompted national group polarization on attitudes towards gay people. We have proposed that legislation signals majority norms, and this polarized result highlights the potential importance of the perceived locality of that norm. Should legislation be perceived as imposed upon the local culture, a backlash effect might be expected. The analyses marshalled above provide tentative evidence that more localized policies may be more strongly associated with attitude change, perhaps because the norm is perceived as stronger and arising from a more local population.

One limitation of the present work concerns the representativeness of Project Implicit respondents. In general, these respondents are unlikely to be representative of the North American population, and indeed, our comparisons in the present research reveal they are younger and more likely to be female. And yet a growing body of literature using this sample finds it is predictive of meaningful population-level behaviors. Thus far, these include outcomes such as being killed by police (Hehman et al., 2018), mortality rates from cardio-vascular disease (Leitner et al., 2016a, 2016b), segregation (Rae et al., 2015), and Google searches for racial slurs (Rae et al., 2015). These results collectively indicate that Project Implicit is tapping meaningful variation in the population, but the generalizability of these results was a concern. Accordingly, a strength of the present research is finding an identical pattern of results in a representative sample, the ANES dataset. That we find that anti-gay bias declines at a sharper rate following same-sex marriage legalization in a representative sample strongly buttresses the conclusions of the present research.
Further, it should be noted the effects of same-sex marriage legalization reported here are modest in size, with models explaining between 1-5% of the within-state variance. In the field, smaller or similar effect sizes have been considered meaningful across diverse domains, including a baseball player’s batting skill on their likelihood of getting a hit ($R^2 = .0033$)(Abelson & Abelson, 2004) or the daily use of aspirin on heart attacks ($R^2 = .0011$)(Rosnow & Rosenthal, 2003). As others have pointed out, these seemingly small effect sizes may be societally meaningful when scaled across entire populations(Greenwald, Banaji, & Nosek, 2015). See page 11 of SI Appendix for more detailed contextualization of our effect sizes.

**Conclusion**

The broad conclusion of the present research, that representative governments can contribute to and/or intensify change in the attitudes of citizens by passing legislation, has important implications. For instance, research reviewing the effectiveness of bias interventions found limited effects, and no effect that persisted beyond several days (Lai et al., 2016). Yet the current results suggest that perceived norms may evoke more persistent change. Additionally, we examine attitudes toward a sexual minority, which previous research has found to be particularly entrenched (Hoekstra, 1995; Jost et al., 2009), and the current results therefore provide a strong test of our hypotheses. In this case, attitudes toward minority groups became more positive, though government signaling of norms might increase prejudice as well. For instance, recent research using a different theoretical lens has found increased xenophobic attitudes following Trump’s election(Crandall et al., 2018), which might be interpreted as signaling in support of such attitudes. Further, results might be extended toward other more malleable attitudes not involving social categories, such as toward littering or marijuana use. In addition, the amount of publicity any legislation receives may moderate these effects(Petty & Cacioppo, 1986). For
instance, should legislation pass with little media attention or fanfare, that this legislation represents the attitudes of the majority will be less salient to citizens. Subsequently, the norm-based model of legislation changing attitudes would predict little change in citizens’ attitudes. Finally, as government legislation may only be perceived as signaling “the will of the people” in representative governments, effects may be limited to such governing styles (i.e., not extending to citizens’ of autocratic governments). In summary, our results evince that state and federal legalization was associated with changes in anti-gay bias, providing important evidence supporting the idea that government legislation can cause changes in the attitudes of its citizens regarding minority groups.
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https://doi.org/10.1177/0022022107313862

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over lesbian women and gay men weakened from 2006 to 2013. Collabra, 1(1).


Supplemental Material

Same-sex Marriage Legalization Associated with Reduced Implicit and Explicit Anti-Gay Bias

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This document includes

1. R code for the Execution of Models
2. Result Tables
3. Supplementary Analyses in California
4. Contextualization of Effect Sizes
R code for the Execution of Models

**Model with Contrast Coded Pre_Post State Legalization**

```r
M1Im <- lmer(ImplicitBias ~ Year.Centered*Pre_Post.State.Legalization.Contrast
  + State.Education.Centered + State.Employment.Centered
  + (1 | State), data= Model1DatasetRevisedandResubmit)
summary(M1Im)
```

**Model with Dummy Coded Pre_Post State Legalization (simple slope for pre-legalization)**

```r
M1ImPre <- lmer(ImplicitBias~ Year.Centered*Pre_Post.State.Legalization
  + State.Education.Centered + State.Employment.Centered
  + (1 | State), data= Model1DatasetRevisedandResubmit)
summary(M1ImPre)
```

**Model with Dummy Coded Post_Pre State Legalization (simple slope for post-legalization)**

```r
M1ImPost <- lmer(ImplicitBias~ Year.Centered*Post_Pre.State.Legalization.Dummy
  + State.Education.Centered + State.Employment.Centered
  + (1 | State), data= Model1DatasetRevisedandResubmit)
summary(M1ImPost)
```
### Result Tables

#### Table 1.A Implicit Bias (Heterosexual Participants)

<table>
<thead>
<tr>
<th>Effect</th>
<th>B</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
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<td>.0059</td>
<td>72.42</td>
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<td>Year</td>
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<td>.0003</td>
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<td>&lt; .001</td>
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<tr>
<td>Pre_Post Legislation Contrast</td>
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<td>.0012</td>
<td>-5.26</td>
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<tr>
<td>Year and Pre_Post Legislation</td>
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<td>State Population Density</td>
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<td>State Employment</td>
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<td>.0002</td>
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</tr>
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<td>State Education</td>
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<td>.0001</td>
<td>-18.33</td>
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</tr>
<tr>
<td>State Socio Economic Status</td>
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<td>.0001</td>
<td>7.36</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Racial Majority</td>
<td>-.0395</td>
<td>.0007</td>
<td>-59.10</td>
<td>&lt; .001</td>
</tr>
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<td>Gender</td>
<td>-.0656</td>
<td>.0006</td>
<td>-107.88</td>
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</tr>
<tr>
<td>Age Centered</td>
<td>.0018</td>
<td>.0001</td>
<td>32.62</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Pre State Legislation

| Year                                        | -.0062| .0003| -19.99      | < .001 |

Post State Legislation

| Year                                        | -.0111| .0006| -19.57      | < .001 |

R² = 4.29%

#### Table 1.B Explicit Bias (Heterosexual Participants)

<table>
<thead>
<tr>
<th>Effect</th>
<th>B</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.3740</td>
<td>.0493</td>
<td>48.16</td>
<td>&lt; .001</td>
</tr>
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<td>Year</td>
<td>-.0968</td>
<td>.0017</td>
<td>-57.43</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Pre_Post Legislation Contrast</td>
<td>-.0198</td>
<td>.0061</td>
<td>-3.27</td>
<td>.001</td>
</tr>
<tr>
<td>Year and Pre_Post Legislation</td>
<td>-.0053</td>
<td>.0016</td>
<td>-3.40</td>
<td>&lt; .001</td>
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<td>State Population Density</td>
<td>.0000</td>
<td>.0001</td>
<td>-12.73</td>
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</tr>
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<td>State Employment</td>
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<td>-.0016</td>
<td>.0001</td>
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<td>&lt; .001</td>
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<tr>
<td>State Socio Economic Status</td>
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<td>.0001</td>
<td>16.49</td>
<td>&lt; .001</td>
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<td>Racial Majority</td>
<td>-.1535</td>
<td>.0034</td>
<td>-45.47</td>
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</tr>
<tr>
<td>Gender</td>
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<td>.0031</td>
<td>-164.27</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Age Centered</td>
<td>-.0112</td>
<td>.0003</td>
<td>-43.73</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Pre State Legislation

| Year                                        | -.0915| .0016| -58.76      | < .001 |

Post State Legislation

| Year                                        | -.1022| .0029| -35.69      | < .001 |

R² = 8.79%
Table 2 Demography of Sexualities

<table>
<thead>
<tr>
<th>Sexuality</th>
<th>Number of Participants</th>
<th>Percentage of Dataset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterosexuals</td>
<td>680,376</td>
<td>71.64</td>
</tr>
<tr>
<td>Bisexual</td>
<td>97,807</td>
<td>10.30</td>
</tr>
<tr>
<td>Gay or Lesbian</td>
<td>96,488</td>
<td>10.16</td>
</tr>
<tr>
<td>Asexual</td>
<td>9,002</td>
<td>0.95</td>
</tr>
<tr>
<td>Queer</td>
<td>2,215</td>
<td>0.23</td>
</tr>
<tr>
<td>Questioning</td>
<td>1,877</td>
<td>0.20</td>
</tr>
<tr>
<td>Other</td>
<td>1,666</td>
<td>0.18</td>
</tr>
<tr>
<td>NA</td>
<td>60,233</td>
<td>6.34</td>
</tr>
<tr>
<td>Total</td>
<td>949,664</td>
<td></td>
</tr>
</tbody>
</table>

We note the percentage of respondents identifying as LGBTQ is higher in this sample than that estimated in the North American population.
### Table 2.A Implicit Bias (All Sexualities)

<table>
<thead>
<tr>
<th>Effect</th>
<th>B</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>.3250</td>
<td>.0068</td>
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<td>&lt; .001</td>
</tr>
<tr>
<td>Year</td>
<td>-.0135</td>
<td>.0003</td>
<td>-43.28</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Pre_Post Legislation Contrast</td>
<td>-.0086</td>
<td>.0011</td>
<td>-7.88</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Year and Pre_Post Legislation</td>
<td>-.0046</td>
<td>.0003</td>
<td>-15.84</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Population Density</td>
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<td>.0001</td>
<td>-25.01</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Employment</td>
<td>-.0043</td>
<td>.0002</td>
<td>-22.23</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Education</td>
<td>-.0003</td>
<td>.0001</td>
<td>-22.19</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Socio Economic Status</td>
<td>.0001</td>
<td>.0001</td>
<td>17.61</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Racial Majority</td>
<td>-.0388</td>
<td>.0006</td>
<td>-61.16</td>
<td>&lt; .001</td>
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<tr>
<td>Gender</td>
<td>-.0458</td>
<td>.0006</td>
<td>-79.90</td>
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</tr>
<tr>
<td>Age Centered</td>
<td>.0010</td>
<td>.0001</td>
<td>20.00</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Pre State Legislation

| Year                                   | -.0089| .0003 | -30.09      | < .001 |

Post State Legislation

| Year                                   | -.0181| .0005 | -34.48      | < .001 |

R² = 3.54%

### Table 2.B Explicit Bias (All Sexualities)

<table>
<thead>
<tr>
<th>Effect</th>
<th>B</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.8270</td>
<td>.0482</td>
<td>37.81</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Year</td>
<td>-.1149</td>
<td>.0015</td>
<td>-75.14</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Pre_Post Legislation Contrast</td>
<td>-.0362</td>
<td>.0054</td>
<td>-6.75</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Year and Pre_Post Legislation</td>
<td>-.0211</td>
<td>.0014</td>
<td>-14.81</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Population Density</td>
<td>.0001</td>
<td>.0001</td>
<td>-22.08</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Employment</td>
<td>-.0205</td>
<td>.0009</td>
<td>-21.81</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Education</td>
<td>-.0016</td>
<td>.0001</td>
<td>-23.51</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>State Socio Economic Status</td>
<td>.0001</td>
<td>.0001</td>
<td>24.39</td>
<td>&lt; .001</td>
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<td>Racial Majority</td>
<td>-.1487</td>
<td>.0031</td>
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</tr>
<tr>
<td>Gender</td>
<td>-.4415</td>
<td>.0028</td>
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<td>.0003</td>
<td>-45.51</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Pre State Legislation

| Year                                   | -.0939| .0014 | -64.76      | < .001 |

Post State Legislation

| Year                                   | -.1360| .0026 | -52.83      | < .001 |

R² = 7.63%
Table 3 Explicit Bias (ANES)

<table>
<thead>
<tr>
<th>Effect</th>
<th>B</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
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<tr>
<td>Intercept</td>
<td>58.7734</td>
<td>1.5404</td>
<td>38.15</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Year</td>
<td>1.2608</td>
<td>.4722</td>
<td>2.67</td>
<td>.008</td>
</tr>
<tr>
<td>Pre_Post Legislation</td>
<td>-1.2984</td>
<td>.8611</td>
<td>-1.51</td>
<td>.132</td>
</tr>
<tr>
<td>Year x Pre_Post Legislation</td>
<td>1.1142</td>
<td>.3943</td>
<td>2.83</td>
<td>.005</td>
</tr>
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<td>State Population Density</td>
<td>-.0060</td>
<td>.0022</td>
<td>-2.73</td>
<td>.007</td>
</tr>
<tr>
<td>State Employment</td>
<td>-.2094</td>
<td>.6627</td>
<td>-.32</td>
<td>.752</td>
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<td>State Education</td>
<td>.1611</td>
<td>.0664</td>
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<td>.015</td>
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<tr>
<td>State Socioeconomic Status</td>
<td>.0002</td>
<td>.0003</td>
<td>.66</td>
<td>.512</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.8187</td>
<td>.3066</td>
<td>-12.46</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Age</td>
<td>-.2263</td>
<td>.0177</td>
<td>-12.76</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Pre State Legislation
Year                        | .1466  | 1.5062 | .24        | .813    |

Post State Legislation
Year                        | 2.3750 | .6107  | 3.89       | < .001  |

R² = 6.75%

Note. This analysis was weighted so variance explained was calculated by formulas in Raudenbush & Bryk (2002) rather than in Rights & Sterba (2018) as in all other models.
<table>
<thead>
<tr>
<th>Effect</th>
<th>B</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
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</thead>
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</tr>
<tr>
<td>State Employment</td>
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<td>.0001</td>
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</tr>
<tr>
<td>State Education</td>
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<td>.0001</td>
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</tr>
<tr>
<td>State Socio Economic Status</td>
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<td>.0007</td>
<td>-59.08</td>
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</tr>
<tr>
<td>Racial Majority</td>
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<td>.0006</td>
<td>-107.89</td>
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</tr>
<tr>
<td>Gender</td>
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<td>.0001</td>
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</tr>
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<td>Pre Legislation for states with State Legislation Year</td>
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<td>.0006</td>
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<td>Pre Legislation for states without State Legislation Year</td>
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</tr>
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<td>.0065</td>
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</table>

R² = 4.22%
Table 4.B Explicit Bias (3-Way Interaction)

<table>
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<th>Effect</th>
<th>B</th>
<th>SE</th>
<th>t-statistic</th>
<th>p-value</th>
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<tr>
<td>Intercept</td>
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<td>.0000</td>
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</tr>
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<td>State Socio Economic Status</td>
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</tr>
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<td>Racial Majority</td>
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<td>Gender</td>
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<td>&lt; .001</td>
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<td>Age Centered</td>
<td>-.0119</td>
<td>.0003</td>
<td>-43.69</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Pre Legislation for states with State Legislation
Year                                                 | -.0841| .0020| -41.81      | < .001  |

Pre Legislation for states without State Legislation
Year                                                 | -.1024| .0023| -43.99      | < .001  |

Post Legislation for states with State Legislation
Year                                                 | -.1017| .0029| -34.86      | < .001  |

Post Legislation for states without State Legislation
Year                                                 | .0702 | .0326| 2.15        | .031    |

R² = 8.60%

Model 4 could not be replicated with the ANES dataset as the measurement over time was lower resolution (i.e., data was collected only around the presidential election in 2008, 2012, and 2016), which did not capture differences between states passing legalization at the state vs. federal level.
Table 5 Comparison of Demographics

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Project Implicit Sample</th>
<th>National Sample (ANES Sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Median)</td>
<td>21 years</td>
<td>38.1 years</td>
</tr>
<tr>
<td>Female</td>
<td>60%</td>
<td>49.80%</td>
</tr>
</tbody>
</table>
Supplementary Analyses in California

California uniquely had four different phases of same-sex legalization status. There were periods of time 1) prior to any sort of legalization, 2) following the California Supreme Court decision functionally legalizing same-sex marriage, 3) following the passing of Proposition 8, again making same-sex marriage illegal, and 4) following federal legalization, again legalizing same-sex marriage in California.

In the present research, we’ve hypothesized that government legislation, being signaled as a norm, shapes the attitudes of the local populace. California provides a unique opportunity to test this possibility. It would be consistent with our hypotheses that, following the passing of Proposition 8, citizens should express more anti-gay implicit and explicit biases relative to after the California Supreme Court decision legalized same-sex marriage, and also relative to follow federal legalization.

In a linear regression model, we tested this possibility by comparing the slopes of anti-gay implicit and explicit bias over time to the next sequential time period at each of the four time periods described above using a series of contrast codes, and controlling for all individual-level covariates included in the primary analyses reported in the primary text. Project Implicit data had 101,313 observations within California across these four different time periods.

First examining implicit bias, the trend in bias over time was different before and after the California Supreme Court decision functionally legalized same-sex marriage ($B = -0.0001, SE = .0001, t = -9.82, p < .001$). Prior to legalization, anti-gay implicit bias was actually increasing, but anti-gay implicit bias decreased over time following legalization (Supplementary Figure 1; Panel A). Next, trends in bias over time were significantly different following this legalization relative to the passing of Proposition 8, functionally making same-sex marriage illegal again ($B =$
.0001, \( SE = .0001, t = 3.21, p = .001 \). The slope following the passing of Prop 8, while still negative overall, became less negative, indicating that anti-gay attitudes were no longer decreasing at the same rate as following initial same-sex marriage legalization (Supplementary Figure 1; Panel B). Finally, the trend in decreasing anti-gay implicit bias again became more sharp following federal legalization (\( B = -.0001, SE = .0001, t = -4.18, p < .001 \)) (Supplementary Figure 1; Panel C). All simple slopes were significantly different from zero. For purposes of better comparing the trends across different periods of time, we have visualized these trends in the same panels, but of course these trends occurred at different periods of time and for different lengths of time.

An identical pattern of effects was observed with explicit anti-gay bias. The trend in bias over time was different before and after initial same-sex marriage legalization (\( B = -.0004, SE = .0001, t = -7.24, p < .001 \)). Prior to legalization, anti-gay explicit bias was increasing, but anti-gay bias decreased over time following legalization (Supplementary Figure 2; Panel A). Next, trends in bias over time were also different after legalization relative to after the passing of
Proposition 8, though this effect was only marginal ($B = .0001$, $SE = .0001$, $t = 1.84$, $p = .066$). The slope following the passing of Prop 8, while still negative overall, became less negative, indicating that anti-gay attitudes were no longer decreasing at the same rate (Supplementary Figure 2; Panel B). Finally, the trend in decreasing anti-gay implicit bias again became more sharp following federal legalization, though this effect was also marginal ($B = -.0001$, $SE = .0001$, $t = -1.92$, $p = .054$) (Supplementary Figure 2; Panel C). All simple slopes were significantly different than zero.

In summary, the results of this smaller, targeted analysis supported that of our primary analysis reported in the text, as well as tentatively supporting our broader hypothesis. Just as government legislation signaling support for marginalized communities should decrease anti-group biases, government legislation signaling rejection of marginalized communities (e.g., the repeal of Proposition 8) should increase anti-group biases. However, because this was only a one specific case in a limited geographic area (i.e., California), we consider this a limited amount of evidence for this possibility. Future research might target this possibility more thoroughly.
**Contextualization of Effect Sizes**

The percentage of variance explained by the effects of interest in the primary manuscript are modest. Although explaining between 1-4.44% of variance in an outcome intuitively seems small, others have noted that variance explained as a metric of effect size is considered to be at odds with intuition. This was the main point of Abelson’s 1985 *Psychological Bulletin* paper, “A variance explanation paradox: When a little is a lot.” In this paper, Abelson finds that a baseball player’s batting skill explains one-third of 1% (or 0.33%) variance in whether they get a hit or not (page 131), an outcome that was at odds with intuition and estimates of the statisticians and baseball enthusiasts with whom he consults.

Further, our results must be situated among effects based on real-world interventions as opposed to being compared with effect sizes obtained in highly controlled laboratory studies. In general, variance explained in real-world settings tends to be smaller than that in highly controlled experimental work. Sue Dynarski, a leading educational economist, argues that in real-world settings, explaining 4% of the variance (what we observe for explicit bias in Model 4 of the present paper) is “a large effect” ([https://www.brookings.edu/research/for-better-learning-in-college-lectures-look-down-the-laptop-and-pick-up-a-pen](https://www.brookings.edu/research/for-better-learning-in-college-lectures-look-down-the-laptop-and-pick-up-a-pen)). Her observations are consistent with numerous examples of real-world effect sizes in the published literature.

For example, “A 61-million-person experiment in social influence and political mobilization” finds an effect size at fractions of a percent, as people receiving their manipulation were 0.39% more likely to vote than a control group (Bond et al., 2012, *Nature*). More similar to the present research, and in a similar domain, a meta-analysis
focusing on racism and health (Paradies et al., 2015, *Plos One*) of 293 studies found that racism explained 5.3% of the variance in negative mental health, 1.7% of positive mental health, 1.7% of general health, and 0.8% of physical health. Other areas of research that have received a huge amount of attention show similarly small effects. Intergroup contact explains between 1-2% of the variance in attitudes toward immigration policy (Pettigrew, 1997, *Personality and Social Psychology Bulletin*). Growth-mindset explains 1% of the variance in overall academic achievement (Sisk et al., 2018, *Psychological Science*).

Daily use of aspirin explains 0.011% of the variance in reduced heart attacks (Rosnow & Rosenthal, 2003), though overwhelmingly endorsed by physicians. These examples provide a context in which to situate the current findings, and they demonstrate that our effects are slightly larger than normal in the realm of explanation social attitudes and behavior.

These examples provide a context in which to situate the current findings, and they demonstrate that our effects are slightly larger than normal in the realm of explanation social attitudes and behavior. Given the combined importance of the conclusion that government legislation might impact citizens’ attitudes, the evidence of the effects of anti-gay bias on the health of the LGBTQ+ community, the effect sizes throughout the present work, and the extent of the evidence for causality, we believe this result important and meaningful.
Reference


2. Dynarski SM. For better learning in college lectures, lay down the laptop and pick up a pen [Internet]. 2017 [cited 2019 Jan 25]; Available from: https://www.brookings.edu/research/for-better-learning-in-college-lectures-lay-down-the-laptop-and-pick-up-a-pen/


**General Conclusion**

How does the legislation passed by governments influence citizens’ prejudice? We take advantage of the staggered manner in which same-sex marriage legalization occurred in the United States to examine this question with regard to antigay bias. By geolocating approximately 1 million respondents as they completed measures of bias over a 12-y window, we tested whether the local legalization of same-sex marriage was associated with changes in citizens’ implicit and explicit biases. While antigay bias had been decreasing over time, following local same-sex marriage legalization antigay bias decreased at roughly double the rate, indicating that government legislation can inform attitudes even on religiously and politically entrenched positions. These results have important implications for those interested in intergroup bias, norms, and how policy shapes attitudes.