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Changing Attitudes Toward Same-Sex Marriage: A Three-Wave Panel Study

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Abstract Opinions toward gay marriage, also known as same-sex marriage, have become dramatically more favorable in the last 20 years. Given the more accepting attitudes of younger Americans, generational replacement is one widely noted engine of change. However, the pace of shifts in public attitudes has been too rapid for this to be the sole explanation. Identifying other causes of increasing support has been difficult due to reliance on cross-sectional associations. Using nationally representative panel data from 2008 to 2016, we test three potential explanations for changes in public attitudes toward gay marriage. Our findings suggest that increased interpersonal contact with gays and lesbians, declining religiosity, and increasing levels of education in the U.S. all contributed to the rise in public support for same-sex marriage.

Keywords Same-sex marriage · Public opinion · Panel data

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Introduction

Public opinion toward same-sex marriage has changed dramatically over the last two decades. Although cross-sectional surveys are consistent on this point, they have shed relatively little light on precisely why these attitudes have changed so rapidly. In this study, we take advantage of a panel survey from 2008 to 2016 to test three proposed explanations for change in public attitudes toward same-sex marriage.

After a brief overview of how public opinion has changed, we describe three plausible theories about why these views have changed within this relatively short time period, beyond the widely acknowledged fact that younger generations are increasingly favorable toward gay rights. These explanations include (1) increased interpersonal contact between heterosexuals and people known to be gay or lesbian, (2) declines in the religiosity of the American public, and (3) rising levels of education. Panel data from a period of almost a decade allow us to provide one of the strongest possible causal tests using observational data.

Shifts in Opinions Toward Same-Sex Marriage

There is by now a strong consensus on the aggregate opinion trend toward increased support for same-sex marriage. Although the specific percentages vary a great deal by survey organization and question wording (see Flores 2015), the general storyline is clear: beginning around 2004–2005, support for the rights of gays to legally marry began to steadily increase (see Appendix A in Electronic Supplementary Material). To cite a few striking examples, the greatest shift over time was documented by the NBC News/Wall Street Journal poll, an increase of 29 percentage points in 11 years. The longest time series—14 years—comes from the Pew Research Center, which found a 19 percentage point increase from March 2001 to July 2015.[1]

While scholars know a great deal about correlates of support for same-sex marriage, there is little evidence about what has changed people's views. It is well known that Democrats are more favorable toward same-sex marriage than Republicans (Baunach 2012; Becker and Scheufele 2009), and that women, younger people, whites, the highly educated and those outside the South are also more favorable (Baunach 2012; Becker 2012; Grapes 2006; Lee and Hicks 2011). Further, liberal political ideology and low levels of religiosity are strong predictors of support for same-sex marriage (Gaines and Garand 2010; Schwartz 2010). However, even the best cross-sectional models make it difficult to argue that these relationships are causal.

Beyond cross-sectional associations, aggregated time-series have shed light on which demographic segments appear to have experienced the greatest increases in support for same-sex marriage. For example, although all generations have become

[1] Some polls suggested more subtle changes than others, but the pattern is highly consistent and not dependent on any particular wording or survey house.

more accepting of same-sex marriage, levels of support have risen particularly among the younger generations.[2] Although this provides convincing evidence that generational replacement is a boon to support for same-sex marriage, demographics tell us little about *why* people have changed their minds within single lifetimes. Without longitudinal data on the same individuals as they change their support for same-sex marriage over time, we do not know precisely what changed to bring about this remarkable shift in opinions.

Three Theories of Change

Effects of Intergroup Contact

Well-documented shifts in the American public suggest three possible causal influences. First, as more gays and lesbians have come out and publicly identified themselves, more people have become aware that they know someone who is gay. The percentage of Americans who personally know gays or lesbians increased from 61% in 1993 to 87% in 2013 (Pew Research Center 2013). As gays and lesbians have become more visible, they have made it more likely that heterosexuals personally know gay or lesbian individuals. In general, intergroup contact leads to more positive perceptions of outgroups such as those of a different race or ethnicity (Pettigrew 1998; Powers and Ellison 1995). Meta-analyses suggest that intergroup contact is particularly effective when individuals come to know one another *before* revealing their differing group identities (see Pettigrew and Tropp 2006), a process that occurs more frequently with gays and heterosexuals than among groups that differ by easily recognizable characteristics such as race.

Nonetheless, it remains an open question whether intergroup contact among heterosexuals and gay and lesbian people has positively influenced support for same-sex marriage. Some evidence to date is consistent with this theory. For example, individuals who have close personal interactions with gays and lesbians are more likely to express favorable attitudes toward them (Becker and Scheufele 2011; Herek and Capitanio 1996; Herek and Glunt 1993), and show greater support for laws that protect their rights (Barth et al. 2009). Further, close contact with gays and lesbians through family or friendship networks is a significant positive predictor of support for same-sex marriage even after controlling for demographics, religious preferences, and ideological predispositions (Becker 2012; Lewis and Gossett 2008). Nonetheless, cross-sectional evidence makes it difficult to establish that contact is a *causal influence*. These associations may occur for spurious reasons, particularly if the environments inhabited by liberals and conservatives influence their likelihood of contact. Further, gays and lesbians may selectively reveal their sexual orientation to those whom they believe to be more accepting, while not disclosing this information to less supportive acquaintances.

[2] For example, people who are 18–34 years old in the General Social Survey went from 47% supporting same-sex marriage in 2006 to 71% supporting it in 2014. However, half of this cohort was replaced in this amount of time, thus making it difficult to know if individuals' attitudes actually changed, or people were simply replaced by newer cohorts.

Effects of Declining Religiosity

In addition to rising levels of acknowledged interpersonal contact, Americans have become significantly less religious during this same period (see Hout and Smith 2015). Religious affiliation and religiosity are strong correlates of attitudes toward gay rights (Gaines and Garand 2010; Sherkat et al. 2011). More frequent churchgoers (Olson et al. 2006), supporters of biblical literalism (Gaines and Garand 2010) and self-identified evangelical Protestants (Becker 2012) are all likely to express more negative attitudes toward same-sex marriage.

Moreover, members of various religious traditions are likely to express opinions in agreement with their official denominational stances on homosexuality (Finlay and Walther 2003). Although religions vary in their levels of support for or opposition to gay marriage rights, white evangelical Protestant and black Protestant traditions tend to be the most conservative of Christians on this issue (Olson et al. 2006). American Baptists, Muslims, Mormons, and Roman Catholics also officially prohibit same-sex marriage. On the other hand, the Presbyterian Church formally amended its constitution to allow same-sex marriage ceremonies in 2015 (Pew Research Center 2015).

In recent decades, the American religious landscape has shifted toward burgeoning secularism (Hout and Smith 2015; Putnam and Campbell 2010). Increasingly, more Americans choose not to identify with any religious tradition, and religious non-affiliation has accelerated since 1990. For example, the percentage of the public preferring "no religion" was 8% in 1990, but increased to 14% in 2000, steadily rising to 18% in 2010, and to 21% in the 2014 General Social Survey (Hout and Smith 2015). Other indicators further confirm that the American public has become less religious. For example, the frequency of attendance at religious services has declined, along with the degree of conviction about the existence of God (Pew Forum 2012). Democrats have become particularly likely to identify as having no religion, and have become less actively religious over time (Hansen 2011; Putnam and Campbell 2010).

To the extent that views on same-sex marriage are rooted in religious beliefs, and the American public is growing less religious, this trend may have contributed to changes within individuals, resulting in the rise of support for same-sex marriage. Further, even if a person remains nominally religious, declining attendance at religious services could indicate weaker religious commitment, which could also lead to increasing support for same-sex marriage (Baunach 2012; Sherkat et al. 2011). One recent panel study including over-time measures of religiosity found no relationship between declining religious attendance and increasing support for same-sex marriage (Armenia and Troia 2017). However, this study was not able to assess changes in religion and religiosity in the same model. Using repeated measures over a full eight-year period, our study assesses effects of rising secularism as well as declining religious attendance.

Effects of Education on Tolerance

A third, less widely mentioned, possibility is that the long-term, ongoing increases in educational attainment have facilitated this trend. Levels of educational attainment in the United States have been steadily increasing over a long period of time, and education is a widely documented engine of increasing acceptance of non-mainstream groups. According to the Bureau of the Census, during the period we study, the percentage of Americans 25 years old or older with a four-year college degree or greater increased from 28.7% in 2008, to 32.0% in 2014. The proportion of Americans with a high school education or greater also rose from 86% in 2008 to 88% in 2014. Likewise, the proportion of Americans with Masters degrees also has increased.

On the one hand, these changes may appear relatively small; however, cross-sectional studies suggest that education is an exceptionally strong correlate of positive attitudes toward gay people (Becker 2012) as well as of tolerance more generally (Bobo and Licari 1989). Nonetheless, correlations are a premature basis on which to assume that education matters. Many outcomes that appear to be driven by education based on correlational evidence actually exist because education is an indicator of a citizen's location in the social hierarchy. For example, political participation is correlated with education, but increases in education do not result in increases in participation. This lack of influence despite persistent correlation occurs because even when the average level of education increases, people's *relative* educational attainment does not; their location in the social hierarchy stays the same (Nie et al. 1996).

When it comes to tolerance, on the other hand, the benefits of education are well-established and appear to be absolute rather than relative (Bobo and Licari 1989; Nie et al. 1996). Education increases people's cognitive proficiency and cultivates democratic values such as tolerance of difference (Ravitch and Viteritti 2001). This benefit does not depend on others' relative levels of education, and therefore, the benefits of increasing educational attainment for same-sex marriage support should be observable. Because this study covers eight years, some respondents' educational attainment will have increased, thus allowing us to examine whether changes in an individual's educational attainment predict changes in that same person's attitudes toward same-sex marriage.

Taken together, our three potential theories explaining increased support for same-sex marriage include: (1) increasing levels of interpersonal contact between heterosexuals and gay/lesbian people, (2) declining religiosity and/or declining identification with evangelical religious denominations, and (3) rising education levels that lead to greater support for same-sex marriage over time. While these three theories do not capture all possible explanations for changing opinions on same-sex marriage, using panel data that include repeated measures of both independent and dependent variables over time, we are able to test these three hypotheses outside of aggregate data or cross-sectional models.

Methods

Data come from a national online panel survey conducted by GfK, Ltd.. The panel is a large, nationally-representative probability sample of U.S. adults recruited for purposes of commercial and public policy surveys. After random selection and empanelment, participants were given free Internet access, if needed, and interviewed via personal computer or WebTV.[3] We utilized three waves of panel data, with identical questions about same-sex marriage asked in each wave.[4] Wave 1 took place in November 2008; wave 2 in October 2014; and wave 3 in February 2016 (see Appendix F in Electronic Supplementary Material for details on the representativeness of the sample). Thus, we have the same individual panelists' responses to identical questions over a span of eight years (n = 1378). By the last wave of this panel, same-sex marriage was legal in all 50 states.

Support for Same-Sex Marriage was measured on a three-point scale, with 1 = do not support any form of legal recognition of gay marriage, 2 = support civil unions or domestic partnerships, but not gay marriage, and 3 = support full marriage rights for gay and lesbian couples. Our representative national panel data document the same pattern of increasing support as in cross-sectional samples. As shown in Fig. 1, the percentage of people supporting same-sex marriage increased dramatically between 2008 and 2014, while the percentage in favor of neither same-sex marriage nor civil unions gradually declined from 2008 to 2016, with some moving instead to support civil unions, and others to advocating full gay marriage rights. Between each set of consecutive waves, between 16 and 29% of our sample changed views in one direction or another, but change was predominantly in the direction of greater support for same-sex marriage (see Table C.1 in Appendix C in Electronic Supplementary Material).

Our independent variables were likewise measured repeatedly over time in order to address each of the three explanations outlined above. To address the impact of changing levels of religiosity, we relied on identical items tapping *Frequency of Church Attendance*, running from never (1) to more than once a week (6). We also created measures of the type of religious affiliation that respondents claimed in each wave using four categories: *Religiously Unaffiliated,* that is, those who did not affiliate with any specific religion, *Evangelical Christians,* that is, those who identified with a Christian denomination (Baptist, Protestant, Catholic, etc.) and as "born again," *Mainline Christians*, those who were Christian but not born again, and *Other Religions*, including all of those claiming non-Christian religious affiliations.

Two questions were used to construct intergroup contact measures. First, we examined whether our panelists changed over time in the likelihood that they

[3] The first wave of the panel was interviewed after the 2008 presidential election cycle as part of the last wave of an election-related study, the 2008 National Annenberg Election Study (NAES). In 2014, a demographically stratified subsample of those panelists was re-contacted for interviews by the same survey organization as part of an election study sponsored by the Institute for the Study of Citizens and Politics (ISCAP) at the University of Pennsylvania. In 2016, the same panelists were re-contacted as part of another ISCAP study.

[4] Data and replication code are available at https://doi.org/10.7910/DVN/RYJK3W.

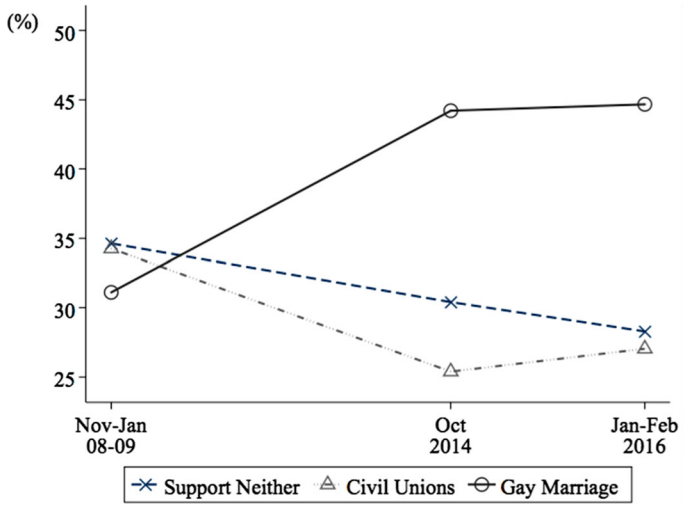

Fig. 1 Change in same-sex marriage attitudes over time among panelists. *Note*: Lines represent changes in the percentage of respondents who reported supporting same-sex marriage, supporting civil unions or domestic partnerships but not same-sex marriage, or supporting neither, from 2008 to 2016 (n = 1378)

personally identified as gay or lesbian. If more people are out and public about their sexuality, this obviously creates greater opportunities for recognizable intergroup contact between heterosexuals and gay people. Second, we asked respondents to report whether they had friends or relatives they knew to be gay, lesbian, or bisexual. This dichotomous measure of *Interpersonal Contact with Gays and Lesbians* allows us to evaluate whether increasing contact with gays over time influenced attitudes toward same-sex marriage.

Education was tapped using a four-level measure of whether the respondent had less than a high school education, a high school diploma only, some college, or a Bachelor's degree or higher at the time of each interview. Although education is understandably stable for many older adults, over the period of the study, some respondents (10%) gained high school diplomas, advanced their college educations, and/or acquired four-year or graduate degrees.

To provide the strongest causal tests possible with observational data, our analytic strategy utilized fixed effects regression, focusing exclusively on within-person change over time in support for same-sex marriage. A key advantage of fixed effects models is that it uses only within-person variation, thus controlling for both observed and unobserved time-invariant characteristics of individuals (Allison 2009; Halaby 2004). Other panel analysis approaches, including random effects models and lagged dependent variable approaches, do not. By controlling for all unobserved time-constant heterogeneity and individual differences, the potential for spurious associations is greatly reduced within the fixed effects framework.

Since the fixed effects approach discards individual differences from the model by treating each person as a fixed effect, individuals are compared to themselves at an earlier point in time, thus serving as their own controls (Morgan 2013). Fixed-

effects models also are less subject to model-specification error than lagged dependent variable or random effects models (Vaisey and Miles 2017). We also included a dummy variable for each survey wave in our models in order to account for all other possible changes affecting respondents from one wave to the next. In other words, the wave variable accounts for all other unmeasured independent variables that might have produced change over time in the population as a whole.

Given our ordinal dependent variable, we used an ordered logit fixed effects model. This approach adjusts standard errors for autocorrelation over time and allows us to examine whether *changes* in the independent variables produce *changes* in the dependent variable, without the need to fully specify a model including all possible influences. Fixed effects panel analysis, however, has three potential drawbacks. The first is that it produces more conservative estimates than other techniques, thus working against identifying significant effects (Allison 2009). In addition, fixed effects models have two assumptions that can potentially bias parameter estimates when violated: (a) the assumption that selection into "treatment" is based on unobserved time-constant factors rather than on previous values of the dependent variable, and (b) the equal trajectories assumption—the assumption that the "treated" and "untreated" have the same underlying time trends prior to treatment (Vaisey and Miles 2017). In the case of continuous independent variables, treatment means differences across various values of the independent variables. In Appendix D in Electronic Supplementary Material, we show that our data are largely inconsistent with endogenous selection as well as with different time trajectories for different levels of our independent variables/treatment groups. As a result, we expect the fixed effects model to yield unbiased estimates. Although a survey cannot provide the same level of confidence about causality as an experiment, the fixed effect approach provides one of the most rigorous tests of causality possible with observational data (Allison 2009).

Standard measures of both *Party Identification* and *Ideology* also were included in the statistical models as time-varying measures. Although these items were expected to remain relatively stable over time, they were asked on each survey wave. Including them allows to account for the possibility that individuals' general political orientation shifted over time for other reasons, and that these general changes drove shifting opinions on same-sex marriage.

Results

We first examined which segments of the population changed opinions the most. Testing for differential over-time change by respondents' wave 1 age, gender, race, income, college education, marital status, region, and sexual orientation demonstrated that increasing support was very much an across-the-demographic-board phenomenon.[5] Surprisingly, none of these characteristics predicted greater increases

[5] To test for differential change over time by subgroups in fixed effects models, we created interaction terms for each tested demographic variable by wave, and tested whether those in one or the other category (e.g., South vs. Non-South; less educated vs. more educated) changed more or less in support for same-sex marriage over time.

over time in support for same-sex marriage. This result echoes previous analyses suggesting that overall "culture" as a whole changed (Flores 2014). However, "culture" is not a very satisfying explanation for change because it does not exclude or include any specific facilitators of opinion change.

Although demographic categories did not identify those who changed any more or less, the rate of change over time differed significantly by partisanship and ideology. In particular, the slope in a more supportive direction was greater for Republicans than for Democrats ($p < .05$). Further, ideological moderates increased their support for same-sex marriage more than liberals ($p < .05$). While liberals and Democrats started out more supportive of same-sex marriage, their opinions did not change as much during this period of time.

To account for increases in support for same-sex marriage at the individual level, we turn next to our fixed effects model. In order for an independent variable to help account for increasing same-sex marriage support, there should be over-time change in the independent variable *in the particular direction* that would increase net support for same-sex marriage. In other words, religiosity would need to decline in our sample, intergroup contact between gays and heterosexuals would need to increase, and education would need to increase. For all three of our key explanatory variables, these assumptions were confirmed (see Table C.2 in Appendix C in Electronic Supplementary Material for the mean changes). Religiosity experienced a net decline during this period ($t = -3.69$, $p < .001$), with 28% becoming less frequent churchgoers. Interpersonal contact with gays demonstrated a net increase ($t = 4.12$, $p < .001$), with 17% gaining awareness of gay friends or relatives. Educational levels increased significantly as well ($t = 6.40$, $p < .001$), with roughly 10% of our sample becoming better educated during the course of the panel. These changes are not large, but they further confirm well-documented over-time trends that began well before our initial panel wave.

From 2008 to 2016, an increasing number of panel respondents also openly identified themselves as gay or lesbian. This provides clear evidence that more people came out during this period. The percentage of our sample reporting themselves to be gay or lesbian increased consistent with the national estimates reported by the General Social Survey from 2008 to 2014. Again, this change is important because if gays are more public about their sexual orientation, then heterosexuals have a greater baseline probability of knowing friends and acquaintances who are gay. Indeed, our dichotomous measure of interpersonal contact also showed a statistically significant increase from 64.0% of people who had gay relatives and friends in 2008, to 71.3% in 2016. All of these directions of change are consistent with our theoretical expectations.

In contrast, over-time changes in ideological and partisan preferences showed a pattern that would promote attitude change in the opposing direction. Ideology shifted in a slightly more conservative direction, and party identification also changed in the Republican direction during this period. So although the three key independent variables changed in their anticipated directions, these same panelists became increasingly conservative and pro-Republican, trends that would work against greater support for same-sex marriage.

Most importantly, to support these theories, over-time change in the independent variable must correspond to over-time change in the dependent variable at the individual level, as evaluated by a fixed effects model.[6] In Table 1, we present results from a single equation including the time-varying independent variables that are predicted to account for some of these changes over time. Each fixed effects coefficient represents the extent to which a unit of *change* in a given independent variable predicts *change* in the probability of a given response to the same-sex marriage question. As shown in Table 1, people's self-reported ideology and party identification changed along with their same-sex marriage attitudes over time as one would predict, and as also noted in the one previous panel study (Armenia and Troia 2017). Nonetheless, because ideology and party identification moved in a more conservative and Republican direction, these net effects cannot account for increasingly supportive same-sex marriage attitudes.

Interpersonal Contact

In the second panel in Table 1, change in the number of people who know gay friends or relatives is shown to significantly influence change in support for same-sex marriage over time ($p < .001$). Because ordered logit coefficients alone are difficult to interpret, in Fig. 2 we illustrate the impact of going from not having a gay friend or relative in one wave to having one in another wave, using the predicted probability of each of these three responses when holding all else constant. The size of these effects is substantial. The probability of supporting neither same-sex marriage nor civil unions decreased by 18 percentage points. At the same time, the probability of supporting full gay marriage rights increased with interpersonal contact with gays and lesbians by over 20 percentage points.

Religion and Religiosity

As shown in the third panel of Table 1, changes in religion and religiosity also had the predicted implications for levels of same-sex marriage support.[7] As people became *less* likely to call themselves born-again Christians, those same people voiced greater support for same-sex marriage over time ($p < .001$). Furthermore, as an individual's frequency of religious attendance declined, his or her support for same-sex marriage increased ($p < .001$). Interestingly, the significant increase in identifying with no religion whatsoever did not predict greater support for same-sex marriage. These findings suggest that increased same-sex marriage support came from those who were increasingly leaning away from religion, if not entirely, at least toward having it play less of a role in their daily lives.

[6] When attempting to explain change over time in panel data, the fixed effects approach is superior to both lagged dependent variable and random effects approaches because it is better at avoiding bias from omitted variables and evaluates strictly individual-level change (see Vaisey and Miles 2017).

[7] To consider the possibility that change in frequency of attendance at religious services has differential effects on change in same-sex marriage attitudes depending on denomination, we also tested the model using the interaction between religion and religiosity. We found no evidence of significant interactions.

Table 1 Predicting change in support for same-sex marriage, three-wave fixed effects panel analysis

		Coefficient (robust SE)	z value
I.	Change in political preferences		
	Ideology	– .439*** (.050)	– 5.32
	Party identification	– .114* (.033)	– 2.10
II.	Change in interpersonal contact		
	Having gay friends or relatives	.978*** (.109)	5.48
	Identifying as gay or lesbian	1.924** (.431)	2.72
III.	Change in Religion[a]/Religiosity		
	Evangelical Christian	– 1.074*** (.129)	– 5.07
	Non-Christian (other religions)	– .110 (.274)	– .25
	Religiously unaffiliated	.125 (.180)	.42
	Frequency of church attendance	– .324*** (.037)	– 5.32
IV.	Change in educational attainment		
	Education level	.382*** (.064)	3.65
Wave dummies (reference = wave 1, 2008)			
	Wave 2 (2014)	.405** (.082)	3.02
	Wave 3 (2016)	.483*** (.076)	3.87
Cutpoint 1		– 2.821 (.334)	
Cutpoint 2		– .987 (.315)	
Number of Individuals		1,361	

Note: Table reports the results of an ordered logit fixed effects regression. The coefficients can be interpreted as the estimated effect of a change in the independent variable on a change in same-sex marriage attitudes. Data are weighted to be representative of the American population. An analysis with the unweighted data can be found in Appendix G in Electronic Supplementary Material

[a]For religion, the baseline category is non-evangelical Mainline Christians

*$p < .05$, **$p < .01$, ***$p < .001$

As shown in Fig. 3, when a person previously identifying as a born-again Christian ceased to identify as born-again, this change more than doubled that respondent's probability of supporting same-sex marriage. Likewise, rejecting one's identification as an evangelical Christian lowered the probability that person would support neither civil unions nor same-sex marriage to less than half of its previous probability.

The size of effects from frequency of church attendance are illustrated in Fig. 4. The largest increase occured for supporting full gay marriage rights, which almost

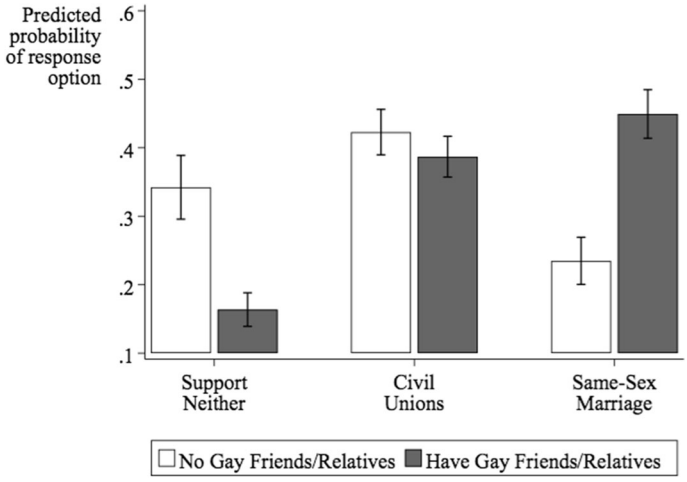

Fig. 2 Predicted probability of same-sex marriage attitudes by interpersonal contact. *Note*: Bars illustrate changes in the predicted probability of each of three ordinal responses as one changes from having no gay friend or relative in one wave to having one in another wave (with error bars representing 95% confidence intervals). All other independent variables are held constant at their means. Based on results in Table 1

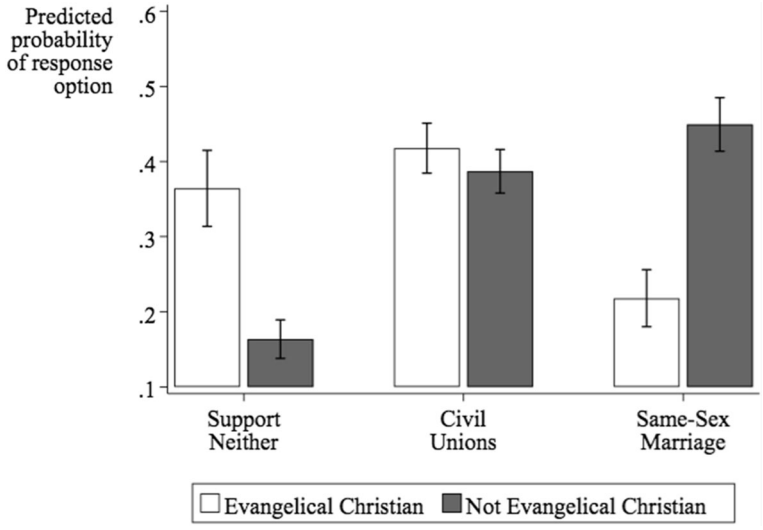

Fig. 3 Predicted probability of same-sex marriage attitudes by evangelical identification. *Note*: Bars illustrate changes in the predicted probability of each of three ordinal responses as one changes from identifying him/herself as a born-again Christian in one wave to not identifying as born-again in another wave (with error bars representing 95% confidence intervals). All other independent variables are held constant at their means. Based on results in Table 1

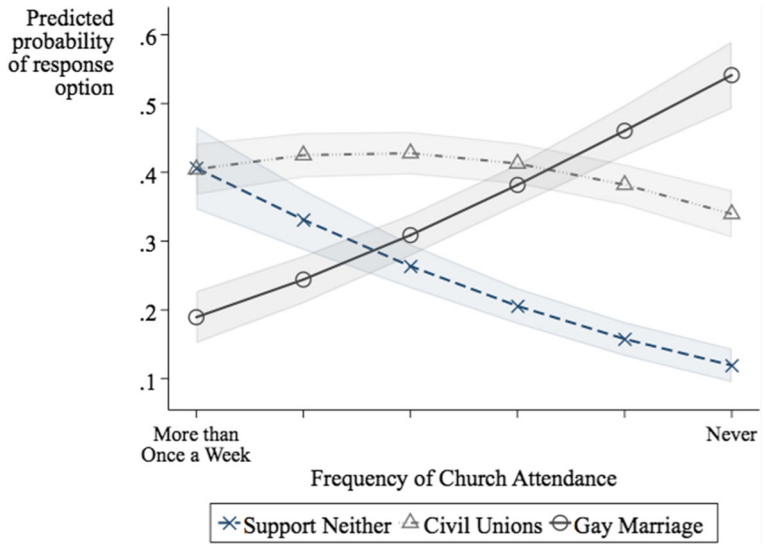

Fig. 4 Predicted probabilities of same-sex marriage attitudes by frequency of attendance at religious services. *Note*: Lines indicate changes in predicted probabilities of each response option as frequency of religious attendance changes over time (with 95% confidence intervals). All other independent variables are held constant at their means. Based on results in Table 1

tripled in probability when a person changed from attending more than once a week (18.9%) to not attending at all (53.3%). Along the same lines, the probability of supporting neither policy declined almost by 30 percentage points when changing from the highest (40.7%) to the lowest religious attendance (12.3%). Of course, most people did not change from one extreme to the other, thus moderating the overall real world impact of these changes.

Education

As noted earlier, during this eight-year period, a surprising number of the adults in the panel achieved new education milestones. As shown in the fourth panel of Table 1, these educational increases resulted in concomitant changes in those individuals' levels of support for same-sex marriage ($p < .001$). Just as suggested by theories predicting that education increases cognitive complexity and thus increases tolerance for groups different from one's own, when the same individual obtained more years of formal education, the person became increasingly supportive of same-sex marriage as well.

Figure 5 illustrates the size of education's impact by illustrating the predicted probability of each of three ordinal responses by changes in education. Although the extent of support for civil unions is largely unchanged by educational attainment, the predicted probability of supporting full gay marriage rights more than doubled when a person's education level changed from less than a high school education (21.8%) to a Bachelor's degree (46.3%), while the probability of supporting neither

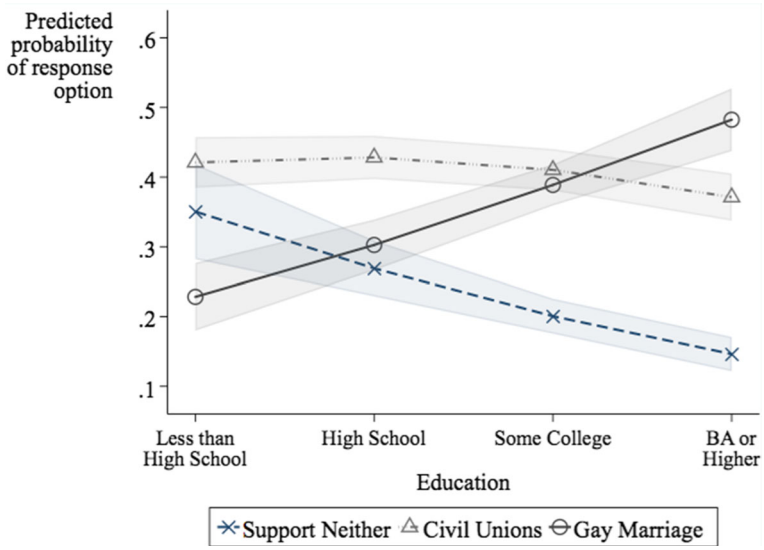

Fig. 5 Predicted Probability of same-sex marriage attitudes by education. *Note*: Lines indicate changes in predicted probabilities of each response option when education level changes (with 95% confidence intervals). All other independent variables are held constant at their means. Based on results in Table 1

policy decreased by 20 percentage points. Within the 8-year period of this panel, the average educational level increased by only a small amount because most respondents were past the age when they were likely to be acquiring new degrees. Nonetheless, levels of education for the sample as whole increased to a statistically significant, though modest extent.

Net Impact of Variables on Increased Same-Sex Marriage Support

Our results confirm that our three hypothesized sources of change—increases in intergroup contact, declining religiosity/identification as born again, and increases in educational attainment—all played roles in encouraging greater support for same-sex marriage. To understand the net impact of each of these factors, however, one must take into account not only the predictive power of changes in these independent variables on changes in attitudes toward same-sex marriage, but also the overall amount of change in each independent variable that occurred during this time period. In other words, the net effect size depends not only on the size of the probability coefficients in Table 1, but also on the average amount of change in that systematic direction in the independent variable.

Taking into account both the size of the fixed effect coefficients and the mean amount of change from the first to the last wave of the panel, we next summarized the net changes produced by each variable over this period using the highest possible level of support—full gay marriage rights (see Appendix E in Electronic Supplementary Material for calculations). Net effects only make sense for purposes

of obtaining a sense of which independent variables mattered most in explaining an over-time change. Toward this end, Fig. 6 should be interpreted as the net change in the probability of supporting full gay marriage rights for a person experiencing the average amount of change over time in that variable, while holding all other independent variables constant at their means.

Overall, the largest net effect occurred due to increased interpersonal contact with gays and lesbians. As more people reported knowing gay friends and relatives, support for same-sex marriage rose a great deal, specifically among those individuals. This unusually large increase is due to the combination of a large effect size along with a sizable average increase in interpersonal contact over time. Declining religiosity and increased education had smaller, and roughly equivalent, net effects. As people became progressively less active in their respective religions, they also became more supportive of same-sex marriage. Likewise, those individuals who increased their educational attainment during this eight-year period also disproportionately increased their support for same-sex marriage. For a person with the average amount of opinion change, the total increase in support for same-sex marriage from our four main variables represents roughly 30% of the total aggregate opinion change (4% of a total 13% change in support for full gay marriage rights).

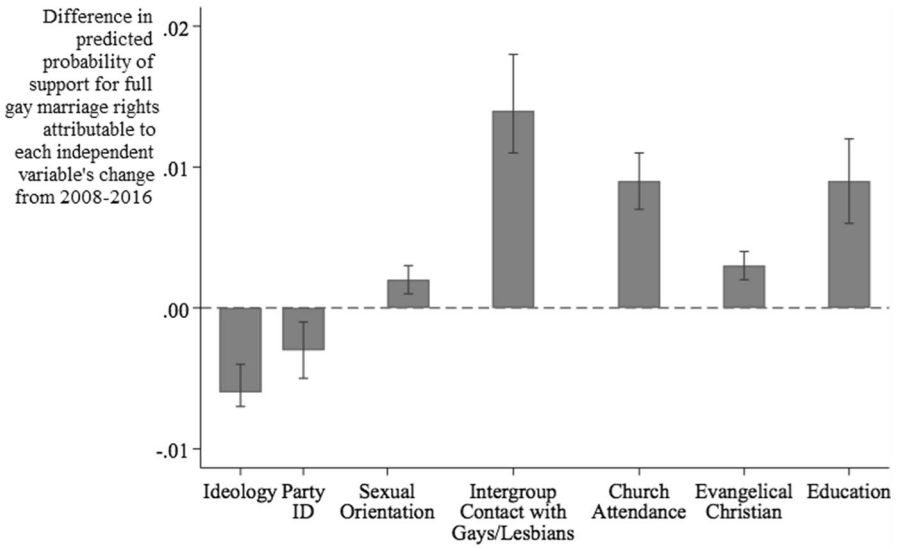

Fig. 6 Estimated net change in probability of supporting same-sex marriage. *Note*: Based on the estimates from Table 1 and average change in the predictors from 2008 to 2016. Error bars represent 95% confidence intervals. See Appendix E in Electronic Supplementary Material for details of calculations

Discussion

To our knowledge, this study provides one of the first nationally-representative panels offering evidence of who changed attitudes on same-sex marriage and why. The one previous panel study to date lacked measures of most independent variables over time, thus making it difficult to assess theories of individual level causal influence.[8] By incorporating repeated measures of independent variables that changed over a longer period of time, our research design allowed us to examine three explanations for intracohort change, that is, changing opinions within the same individuals over time.

Relative to cross-sectional studies demonstrating associations between interpersonal contact with gays and attitudes toward same-sex marriage, our findings are on much stronger causal footing for two reasons. First, we are able to demonstrate that over-time *changes* correspond to over-time *changes* in opinions within these same individuals, beyond what would be expected based on the overall trend in the population as a whole. Moreover, we are able to eliminate the potential for spurious associations that stem from stable characteristics of individuals. At the same time, this study improves on prior research by offering a more detailed account of why the American public changed on this issue, setting aside the changes from generation to generation. By incorporating more time-varying predictors over a longer period of time, our findings demonstrate some major sources of increased public support for same-sex marriage.

Although panel analyses provide the strongest observational tests of hypotheses about engines of change, our study has several limitations to consider. First, although panels are superior for purposes of establishing cause and effect, they are often subject to attrition problems as respondents drop out of the sample over time. Smaller sample sizes are not a problem per se, except for the inevitable decline in statistical power that works against statistically significant findings. But if attrition is systematic rather than random, then it is difficult to generalize the effect sizes.

To examine this issue, we first compared the demographic characteristics of our panel sample to the most recent Current Population Surveys, provided by the U.S. Census Bureau (see Appendix F in Electronic Supplementary Material). This allowed us to see what parts of the population were over- or under-estimated. Our unweighted sample systematically under-represents the least educated and over-represents those with a Bachelor's degree or higher. African-Americans are proportionally represented, but Hispanics are somewhat under-represented. However, given that population-based weights were available to compensate for non-response bias, we have used them in all of the analyses shown. Results with unweighted data do not differ in any substantive way from weighted results, although the standard errors are naturally larger with weights, thus making our estimates even more conservative (see Appendix G in Electronic Supplementary Material). Finally, because the panel sampled those 18 and over beginning in 2008,

[8] Armenia and Troia's (2017) model includes repeated measures of religious attendance, whether the respondent is married, has children, and their ideological self-placement. Only ideology varies over time with attitudes toward gay marriage, and this is in a direction that overall would predict less support for gay marriage.

there are naturally no respondents in the 18-24 years old group by the end of the panel, and those 25-34 are also somewhat under-represented, as should be expected.

In addition to attrition, panel conditioning effects are another potential source of concern. Fortunately, this is not likely to be problematic in this particular panel. First, because the time between asking respondents about same-sex marriage was unusually long—at times several years—it is unlikely that respondents remember having been asked these questions years before. Second, because panelists at GfK were asked about marketing as well as other public policy issues in the intervening surveys, they were not conditioned to focus on politics, and there was no attrition in the direction of the more politically interested and involved (see Dennis et al. 2011; Kruse et al. 2009). Notably, both aging panel members and conditioning would probably favor stability over time in same-sex marriage opinions, so we are, if anything, likely to have underestimated our effect sizes.

By design, fixed effects panel analyses are not susceptible to the most common model misspecification problems. This approach does an unparalleled job of ruling out potentially spurious relationships. All stable characteristics of individuals that might account for such relationships are automatically eliminated as threats to causal inference. Further, the inclusion of a wave variable in these models controls for the average extent of change in the dependent variable due to all other influences that went unmeasured in this study. Nonetheless, it remains possible that the effect of change in certain independent variables is significant among members of specific subgroups, or that change in one independent variable interacts with change in another. We examined interactions that might be theoretically expected, for example, Democrats or African-Americans changing to a greater extent due to Obama's opinion leadership on this issue, or Catholics changing more due to Pope Francis' more supportive views on same-sex marriage, or those in states recently legalizing same-sex marriage shifting toward the new legal norm. However, none of these hypotheses produced even marginal support. While other trends and events also may have led Americans toward greater support for same-sex marriage, we have not found empirical evidence consistent with these ideas.

In our study, fixed effects analysis eliminates many potential problems in establishing causation, but it cannot rule out reciprocal causation. For educational attainment, it is implausible that changes in attitudes toward same-sex marriage would cause changes in educational attainment over time rather than vice versa. To the extent that church-goers might curtail their religiosity or change their religious affiliation specifically due to discomfort with anti-gay church doctrine, then reverse causation is plausible. However, research on the causes of declining religiosity has emphasized other factors as likely causes, including rising divorce rates, the declining popularity of marriage, changing opportunity costs for religious participation, and increased emphasis on spirituality as an alternative to formal religious participation (Gruber and Hungerman 2008; Wald and Calhoun-Brown 2014).

With our strongest predictor of change, rising interpersonal contact, it is plausible that people changed their views on same-sex marriage for unrelated reasons, and this opinion change, in turn, increased their interpersonal contact with gays and lesbians. More gays and lesbians self-identified during this time period, thus creating opportunities for both directions of causation. Because of the centrality of

religion and interpersonal contact in our findings, we further addressed reverse causation by using fixed effects within a structural equation modeling framework (see Appendix H in Electronic Supplementary Material). This approach allowed us to estimate the effects of interpersonal contact, religion and religiosity on support for same-sex marriage while allowing for the possibility that changing opinions on same-sex marriage could affect these independent variables by means of reverse causation. Although the structural equation approach also has its limitations, by attempting to isolate the effect as it flows in one direction, we tried to obtain unbiased causal estimates. As shown in Appendix H in Electronic Supplementary Material, our findings are consistent with the analyses already shown in that changes in all three variables have an impact on changing opinions toward same-sex marriage.

Another potential limitation of this study is the measure of interpersonal contact. At each wave, respondents were simply asked to report whether or not they currently had gay friends or relatives. On one hand, a binary measure of interpersonal contact is less than ideal and more detailed information would have been preferable, particularly given that previous studies have suggested that some types of relationships are more influential than others (e.g., Herek and Capitanio 1996). Nonetheless, our measure has at least one key advantage. If respondents were instead asked to assess the closeness of the contact relationship, their responses might easily be endogenous. Respondents who disagree with others over same-sex marriage may, as a result, perceive their relationship as less close, and those with more supportive views may report feeling closer to their gay friends and relatives. In other words, measures that include characterization of the relationship as it is perceived by the respondent are at greater risk of endogeneity than a simple dichotomous contact measure. Given that we find strong effects consistent with contact theory even with a crude independent measure in a conservatively-estimated fixed effects model, the relationship is likely to be robust.

We further evaluated the plausibility of the interpersonal contact findings by examining whether the main social context in which increasing interpersonal contact occured was the same context in which contact was likely to occur by chance rather than through self-selection, that is, the same context in which more gays were publicly coming out. We should logically see effects of intergroup contact among heterosexuals who inhabit contexts where such contact could occur by chance. Foremost among such contexts are urban areas, where populations are more densely packed and where there are more openly gay individuals (Leonhardt and Miller 2015; Sigelman et al. 1996). Consistent with this prediction, fully 85% of those who acquired new gay contacts lived in metropolitan areas. Likewise, almost all of those respondents who came out during the panel period lived in metropolitan areas, thus lending further plausibility to this interpretation.

Conclusion

Public attitudes toward same-sex marriage changed for at least the three reasons offered here, though we have reason to believe that these are not the only causes. On the contrary, we have accounted for less than half of the within-person change over time. Nonetheless, as educational attainment continued its gradual rise, those who acquired more education increased their support for same-sex marriage as a result. Education provides the cognitive complexity necessary for acceptance of groups unlike one's own (see Nie et al. 1996), and discourages simplistic judgments of those who are different. In addition, the rising number of gays and lesbians who were public about their sexuality created an environment in which people were increasingly likely to have interpersonal contact with gay friends and relatives. Finally, the trend toward decreasing religiosity in America contributed to increasing support for same-sex marriage. The overall decrease in religiosity in particular contributed to this trend. Religious orthodoxies that oppose same-sex marriage declined in prevalence, and even mainline Christians became less religiously active. Substantial opinion change occurred within individuals during this relatively short period of time, and not simply as a matter of generational replacement.

The change in attitudes toward same-sex marriage has been unusually widespread. When analyzing patterns in cross-sectional data, one could easily be misled about where rising support for same-sex marriage has come from. Whereas cross-sectional studies cite liberals and Democrats as sources of support, they are not the prime sources of *increasingly supportive* views, at least not since 2008. Indeed, those groups were probably already supportive. Instead, the recent increases in support have come from Republicans and ideological moderates.

While not a focus of our study, the data hint at the possibility that opinion change may have been facilitated by the existence of a moderate policy option, that is, civil unions.[9] The combination of moving people away from a position that excludes gay couples from all forms of legal recognition, while simultaneously encouraging others to support same-sex marriage, means that this "compromise" option may have served an important purpose. Although few states ever recognized civil unions in actual practice, for members of the public whose religions prohibited recognition of same-sex marriage, civil unions might have served as a compromise, bridging the gap between denying gay couples all legal protections and supporting full gay marriage rights. To the extent that opinion change occurred by passing through this middle option, it suggests that change was incremental at the level of the individual. The analysis pertinent to this question reveals that for most respondents in our panel, the path to greater support for same-sex marriage indeed involved some

[9] Incremental policy shifts have been common with respect to gay rights. For example, in 1994, the issue of gays in the military was initially addressed by a partial measure known as "Don't Ask, Don't Tell," which prohibited military personnel from discriminating against or harassing closeted gays, while still barring openly gay persons from military service. In the same-sex marriage debate, civil unions and domestic partnerships have served as a middle option.

transition through this middle option, i.e., support for civil unions in advance of supporting full gay marriage rights.[10]

Overall, our results suggest that gays and lesbians themselves are responsible for most of the increasing support for same-sex marriage. By publicly acknowledging that they are gay or lesbian, they have facilitated influential positive intergroup contact. Because friends and relatives do not necessarily know a person's sexuality in advance of forming a relationship, intergroup contact theory predicts that contact will be especially effective under these circumstances.

For many social movements, the results of these analyses should be encouraging. Advocates of gay rights have long suspected that intergroup contact contributed to successfully increasing support for gay rights in the United States. But this was more an article of faith than an empirical finding. By encouraging gays and lesbians to come out to others, the hope was to destigmatize homosexuality and encourage equal treatment of gays and lesbians. Our results suggest that this strategy has been successful, if only slowly over time, perhaps due to the small percentage of the U.S. population that is openly gay, lesbian or bisexual. This is not to suggest that other factors are not also important. Still, our findings suggest that if a group self-identifies and resists segregation into like-minded communities, intergroup contact may have the potential to improve other intergroup attitudes as well.

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[10] We examined the patterns of change represented by individuals who became increasingly supportive of same-sex marriage over time. For this particular analysis, we included two additional panel waves, conducted in late-2007 and mid-2008, for which we had records of responses for these same respondents for the dependent variable only. These waves were not included in our main three-wave panel analysis because the key independent variables were not available for these additional waves. Over a span of nine years (2007–2016), the overwhelming majority of increasingly supportive respondents were incremental changers, taking one of three possible paths toward greater support: (1) moving from not supporting any form of legal recognition to supporting civil unions (9%), (2) moving from supporting civil unions to supporting full gay marriage rights (46%), and (3) moving from no support of any kind to supporting civil unions first, and then, shifting to full support for same-sex marriage (41%). In total, an impressive 96% of those who became more supportive did so by means of incremental shifts. Only 4% moved from no support of any kind directly to full same-sex marriage support, a pattern inconsistent with incrementalism.

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