

Transmission of Attitudes Toward Abortion and Gay Rights: Effects of Genes, Social Learning and Mate Selection

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Abstract The biological and social transmission of attitudes toward abortion and gay rights are analyzed in a large sample of adult twins, siblings, and their parents. We present a linear model for family resemblance allowing for both genetic and cultural transmission of attitudes from parents to offspring, as well as phenotypic assortative mating (the tendency to marry like) and other environmental sources of twin and sibling resemblance that do not depend on the attitudes of their parents. The model gives a close fit to the patterns of similarity between relatives for the two items. Results are consistent with a substantial role of genetic liability in the transmission of both attitudes. Contrary to the dominant paradigm of the social and political sciences, the kinship data are consistent with a relatively minor non-genetic impact of parental attitudes on the development of adult attitudes in their children. By contrast, the choice of mate is a social action that has a marked impact on the polarization of social attitudes and on the long-term influence that parents exert upon the next generation.

Keywords Abortion · Gay rights · Assortative mating · Political and social attitudes

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Introduction

Attitudes to abortion and sexual orientation are especially divisive, defying rational discussion and inflaming passions among the electorate in the United States (Abramowitz 1995). These issues involve questions of morality, religion, human life, and the rights of a woman to her own body. They have evoked bombings of abortion clinics, marches, assassinations, and even the torture and murder of homosexual citizens (Klein 1999). These highly polarized and deep-seated issues appear to be a specific focus of attempts to energize public opinion over and above any appeal to more general liberal or conservative positions. Political scientists have been studying attitudes toward abortion and gay rights in earnest since the 1970s, yet have provided little explanation of the roots of these deep-seated feelings. Opinions toward abortion and gay rights are highly salient and stable over time (Wilcox and Norrander 2002). In the 2000 National Election Studies fewer than 15% of respondents deemed abortion unimportant (Jelen and Wilcox 2003).

Regardless of the emergence of new issues dominating the US political climate in 2008, including the Iraq War, a slowing economy, immigration reform, the potential crash of the housing market, and terrorism, abortion and gay marriage remain among the most important issues to a substantial portion of the American electorate (see the 2008 Pew Forum on Religion and Public Life, US Religious Landscape Survey). The rise of Governor Mike Huckabee to challenge Senator John McCain for the Republican Presidential nomination in 2008 exemplifies the powerful role of these specific attitudes in political behavior. Governor Huckabee's support was largely drawn from evangelical and Christian conservatives who rallied behind his opposition to abortion and gay marriage (Meckler and Bauerlein 2007).

Parents and educators seek to influence the attitudes of their children and inculcate them through a variety of social mechanisms including religious education and by monitoring exposure to literature, media, the arts, schooling, and peers. Parents commonly assume that their investment is effective in the long term and traditional scholarly works largely support this view. Specifically, contemporary explanations of the transmission of attitudes to such issues as abortion and gay rights rely heavily on the traditional social science perspective that attributes familial correlation in attitudes largely to familial socialization (see Campbell et al. 1960; Carmines and Stimson 1980; Legge 1983; Page and Jones 1979).

However, several studies of families in psychology and the life sciences have documented the similarity in attitudes between nuclear family members finding a different source of familial transmission. Karl Pearson (1903) concluded an early study of teachers' ratings of "mental and moral characteristics" in siblings with the premature claim that such characteristics were inherited as much as physical characteristics similar to "the protopodite of the water-flea." Twin studies of broad attitude dimensions have implicated a possible underlying role for genetic as well as social factors in the etiology of individual differences in social and political attitudes (Bouchard et al. 1990; Eaves et al. 1989; Martin et al. 1986). Parallel studies in the social sciences have provided evidence that certain political issues are "hard" such as education reform, which requires evaluation, whereas other "easy" issues trigger a "gut" response eliciting instant and strong opinions (Carmines and Stimson 1980). Certainly, abortion and gay marriage are characterized as "easy" issues.

With one notable exception (see Alford et al. 2005), the political science literature implies that early socialization has inculcated a quick reaction to these symbolic issues. To a greater degree, little empirical explanation has been offered to test if this is the case or why these issues elicit instant responses or where these responses originate. In effect while socialization is significantly correlated for parent–child attitudes and is used to explain the similarity in attitudes, socialization does not answer where the source of deep seated political attitudes come from, or test alternative explanations for familial transmission.

Scholarly work outside of the political behavior literature offers a different perspective on these "easy" issues. Tesser (1993) provides evidence that attitudes with stronger genetic influences are manifested more quickly, are more stable, and are more likely to increase people's attraction to those who share similar attitudes. However, to our knowledge there has been no thorough attempt to address this finding or resolve the multiple biological and social mechanisms responsible for the transmission of individual differences in specific political attitudes such as

abortion and gay rights, or to provide a model to examine sources of political attitudes that include both parent and offspring measures. We present analyses of family resemblance for attitudes toward abortion and gay rights in a large sample of twins, non-twin siblings and parents (the nuclear family). The data yield significant insight about the social and biological influences that shape the development or adoption of specific attitudes from the smorgasbord of conflicting values apparent in a given culture.

Methods

Sample

The data are derived from a subset of relationships from the "Virginia 30,000" study of health and lifestyles in the kinships of twins. This constellation of relatives had been shown to be especially powerful and flexible for the resolution of multiple sources of biological and cultural inheritance (Heath et al. 1985). The 29,356 subjects were volunteer twins, or the spouses, parents, offspring and non-twin siblings of twins. Ascertainment and structure of the sample are described elsewhere (Maes et al. 1997). Subjects were adults aged 18–84 years.

Assessment

The items relating to abortion and gay rights were included in a 28-item attitude inventory gathered as part of a larger "Health and Life Styles" inventory conducted in 1986. Item format was that of the Wilson–Patterson Conservatism Scale (Wilson and Patterson 1968) that simplified the cognitive demands of attitude measurement by presenting each item in a one- or two-word format. Subjects responded "agree", "uncertain" or "disagree" to each item using the answer that came to mind first. Data were collected by mail, with mail follow-up of non-respondents and further telephone follow-up when needed. Approximately 2 years later, the attitude items were included in a follow-up questionnaire mailed to twins aged 50+ years, yielding measures of attitude stability for 1,019 men and 2,912 women.

Summary statistics

Response frequencies for the entire sample of men and women are shown in Table 1.

Table 2 gives the polychoric correlations between relatives (Pearson 1904) from nuclear families and twin pairs for the two items. The correlations are based on every possible pairing of each type. In many cases the same individual contributes to more than one correlation (e.g.

Table 1 Response frequencies in men and women

Item	Men (<i>N</i> = 11,851)				Women (<i>N</i> = 17,505)			
	Disagree	Undecided	Agree	Missing	Disagree	Undecided	Agree	Missing
Abortion	38.35	17.50	44.15	2.19	43.84	15.65	40.51	2.14
Gay rights	62.45	16.87	20.69	2.19	50.83	21.92	27.25	3.34

Note: Response frequencies expressed as a percentage of valid item responses. Missing values expressed as a percentage of total survey respondents

Table 2 Polychoric correlations for attitudes to abortion and gay rights

Relationship	Correlation		<i>N</i> (pairs)
	Abortion	Gay rights	
Husband–wife	0.632	0.581	5162
Mother–daughter	0.500	0.469	4802
Mother–son	0.373	0.391	3233
Father–daughter	0.428	0.365	3166
Father–son	0.398	0.389	2315
Male siblings	0.420	0.309	1564
Female siblings	0.463	0.453	3701
Unlike-sex siblings	0.405	0.346	4462
Male DZ twins	0.423	0.371	610
Female DZ twins	0.557	0.491	1273
Unlike-sex DZ twins	0.425	0.393	1397
Male MZ twins	0.553	0.574	814
Female MZ twins	0.676	0.599	1982
Retest male	0.801	0.774	1019
Retest female	0.864	0.806	2912

spouses and mother-offspring) and to multiple pairs within a correlation (e.g. more than one like-sex sib pair per family). Typically such estimates are not biased, but are less precise than estimates based on independent pairs (Rao et al. 1979).

The item responses are stable over the period between repeated measures. Note that all the correlations between relatives are large. Many are comparable with those reported for physical measures in the same sample. The correlation between spouses is remarkably high compared with physical measures and many other behavioral measures including personality (Eaves et al. 1999). There is some heterogeneity between correlations as a function of gender and the correlations for Monozygotic or identical (MZ) twins are somewhat larger than those for Dizygotic or fraternal (DZ) twins, implying a possible role for genetic factors. The correlations for DZ twins are, generally, quite similar to those for siblings suggesting that there is no marked tendency for twins to be more alike than non-twin siblings.

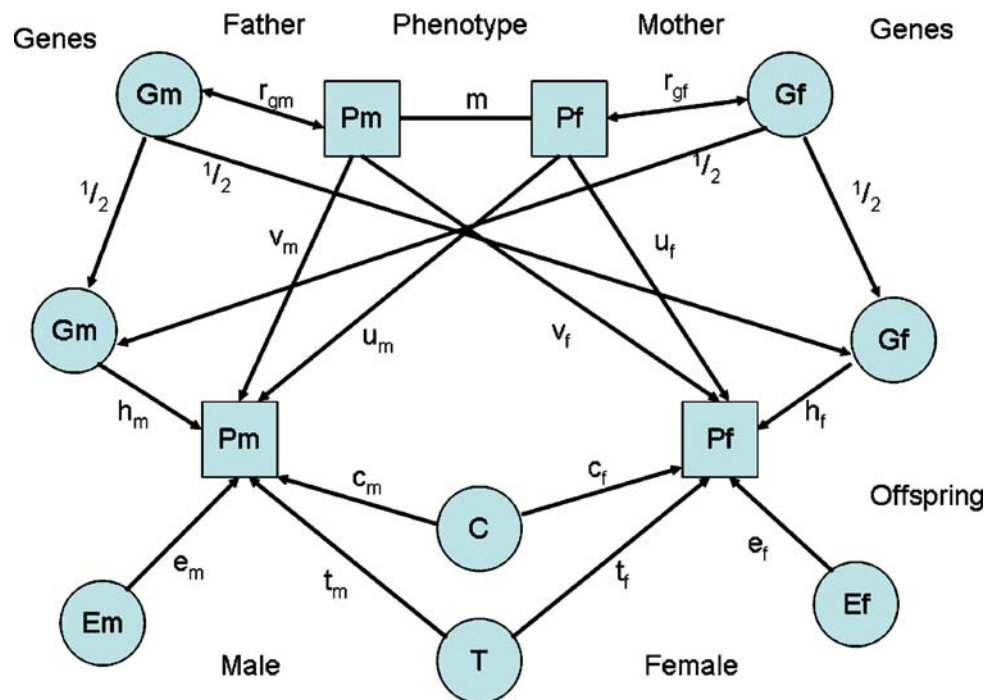
Model for family resemblance

Figure 1 presents a fairly general linear model for the influences of genes and environment on the reliable components of family resemblance for the social attitude items for families comprising unlike-sex DZ twins and their parents. Modifications of the figure for siblings, MZ twins and like-sex pairs, and the effects of measurement error, are derived by simple adjustments to the basic model. The model is simplified slightly from that developed by Truett et al. (1994) for the kinships of twins and is an extension of Cloninger et al.'s (1979) model for the simultaneous effects of biological and cultural inheritance.

The model presented in Fig. 1 allows for: (1) additive effects of genetic differences in males and females (h_m and h_f) on the manifest characteristics of opinions on abortion and gay rights (“phenotypes”, Johanssen 1911) of males and females; (2) the direct, non-genetic, social transmission (“vertical cultural inheritance”, Cavalli-Sforza and Feldman 1981) from mothers and fathers to their male and female offspring phenotypes (u_m , u_f , v_m , and v_f); (3) environmental effects not transmitted from parents but shared by male and female siblings and DZ twins, c_m and c_f ; (4) additional environmental similarity between twins (MZ and DZ) because twin environments correlate more highly than siblings, t_m and t_f ; (5) random environmental effects not shared by twins or siblings, e_m and e_f ; (6) phenotypic (attitude) correlation between mates (“assortative mating”), m .

In addition, the model contains two parameters corresponding to the correlations between genotypes and phenotypes of fathers and mothers (r_{gm} and r_{gf}). These can be expressed as functions of the other parameters of intergenerational transmission under the assumption that the model parameters are stable over generations. The paths from parental genetic effect to offspring genetic components are fixed at $\frac{1}{2}$ to reflect the assumption that genetic effects are additive (Jencks et al. 1972; Morton 1974). For simplicity, the figure assumes that the same genes affect males and females, although their relative contributions may differ across sexes. In practice, this assumption was relaxed in fitting the full model. The diagram for siblings is obtained by allowing the effects

Fig. 1 Path model for biological and cultural inheritance in kinships. *Note:* The effects of “ T ”, the “special twin environment” are specified in the figure in the form appropriate for twin pairs. In other, non-twin, relatives, T remains as an environmental influence that contributes to the total variance, but not to the correlations between non-twin relatives



contributing to T to be uncorrelated in siblings. The figure for MZ twins has the same genes contributing to both (like-sex) offspring.

The model makes several critical assumptions: the environmental correlations are the same for MZ and DZ twins for the traits under analysis. The empirical support for this assumption and its implications for estimates of genetic effects have been widely discussed (e.g. Kendler and Gardner 1998; Lykken et al. 1990). The principal assumption of the path model is that genetic effects are additive, that is, heterozygotes are intermediate between their corresponding homozygotes and different genes do not interact (epistasis). Non-additive genetic effects tend to inflate the sibling correlation relative to that between parents and offspring and to increase the difference between MZ and DZ twin correlations. The additive model also assumes no interaction between genes and environment or age. Interaction between genetic effects and age or secular changes will also tend to reduce parent-offspring similarity. Such effects will be confounded with other non-additive genetic effects in this analysis. The study was conducted in a sample of the US population in the climate that prevailed 20 years ago. Attitudes change with time and the sample examined here lacks the long-term follow-up data necessary to estimate the long-term consistency in the relative attitudes of subjects over time. However, Hewitt et al. (1977) showed that the basic factor structure of attitude differences was consistent over a 25-year period and repeated measures in this study show that the ranking of individuals' attitudes is relatively stable at least in the shorter term.

Finally, the model assumes primary phenotypic assortment for attitudes on abortion and gay rights. This is consistent with assumptions made in previous genetic analyses (Hewitt et al. 1977; Martin et al. 1986), and is supported by scholarship in the social sciences regarding spousal correlations (Stoker and Jennings 1995). The implications of this assumption are noted in the subsequent discussion of our findings.

Methods

The expected correlations between relatives were derived algebraically from the path model (see e.g. Cloninger et al. 1979; Duncan 1966; Wright 1921). Parameter estimates for the full model (including sex-specific genetic effects) were derived by non-linear, diagonal weighted least squares (DWLS) applied to the polychoric correlations, subject to the non-linear equilibrium constraints on r_{gm} and r_{gf} . While the application of full maximum likelihood (ML) to the raw observations takes into account the correlations between statistics derived from complex pedigrees we chose DWLS in our application because it extends very easily to the rapid simultaneous analysis of many variables and is more transparent in starting from observed correlations rather than unreduced data. In large samples such as used here, the results do not differ substantially from those using DWLS. Hatemi et al. (2007) found no significant differences using DWLS versus ML in a nuclear family model of political preferences (see also McGue et al. 1984). The observed sample sizes were used as weights. Optimization

was conducted in the *Mx* program employing a user-defined loss function for the weighted residual sum of squares (Neale et al. 2002). Two indices of goodness of fit were computed: the weighted residual sum of squares, S^2 , and the unweighted root mean square difference between observed and expected correlations, *rmse*. The latter is a guide to the typical discrepancy between the observed correlations and their values predicted from the weighted least-squares parameter estimates. In addition to the full model of Fig. 1, several reduced models were fitted in order to evaluate the implications of omitting principal sources of individual differences.

Results

Model comparison statistics are summarized in Table 3. By any criterion the full model (Model 1, in Table 3) gives an excellent fit to the data. The *rmse* is extremely small for both items and, if S^2 is distributed even approximately as $\chi^2_{(1)}$, there is little to suggest that the residuals are greater than might be expected by chance in these large samples. Deleting all sources of family resemblance (Model 0) yields, as is expected, an extremely poor fit with *rmse*s 40–100 times greater than the full model for both items. Of the remaining simplifications of the model, the omission of genetic effects (Model 3) and the assumption that genetic and environmental effects are the same in males and females (Model 8) do the greatest violence to the data judged by their impact on S^2 and the *rmse*. Removing each of the main sources of environmental similarity between

siblings has a smaller effect on the indices of goodness of fit. Deleting all non-genetic sources of family resemblance (Model 7) leads to greater discrepancies.

Estimates of the path coefficients under the full model are given in Table 4. Table 5 summarizes the contributions of the principal sources of genetic and environmental variation to individual differences in the *reliable* variation. In reporting estimates computed under the full model we are implicitly adopting the philosophy that estimation is to be preferred to hypothesis testing when exploring the properties of complex models for family resemblance. Whatever else may be said, this approach illustrates some of the heterogeneity of parameter estimates and minimizes the biases or spurious sense of precision that might accrue from setting parameters to zero in the course of a large number of post-hoc model comparisons. Contributions to the variation on any single occasion of measurement are obtained by the product of the tabulated proportions of variance and the corresponding reliability.

Cultural inheritance based on a phenotype or trait that is also partly genetic generates genotype environment covariance (rGE—Cloninger et al. 1979). Jencks et al. (1972) termed this the “double advantage” phenomenon, since individuals whose parents transmit advantageous genetic effects to their children may also provide the benefit of advantageous environments. The covariance will be positive if the non-genetic transmission is positive (i.e. parents reinforce genetic effects) and negative if social effects tend to oppose the effects of genetic transmission (Cattell 1965).

If the effects of short-term environmental effects are discounted, the results provide strong support for a substantial genetic component to long-term individual differences in these two prominent attitudes. The estimates of genetic and environmental contributions in this analysis include the effects of assortative mating reflected in the substantial correlations between mates for attitudes to abortion and gay rights. Genetic effects are estimated to account for 50–70% of the variance in liability to endorse an item, depending on gender and the specific item. Unique long-term environmental experiences of the individual that are not shared with siblings and cotwins account for 20–30% of these differences. The combined effects of social learning from parents (“vertical cultural inheritance”) and other sources of shared environment account for an estimated 10–20% of the total variance. Overall, social learning from the parental attitude phenotype accounts for less than 5% of the total variation in adult offspring. The relatively weak contribution of non-genetic parental effects produces very small estimates of the genotype–environment covariance. The fact that these estimates are negative implies, if anything, that there is a net effect for the environmental effects of parents on children to elicit *dissimilar* values from their children.

Table 3 Summary statistics for model comparison

Model	<i>k</i>	Abortion		Gay rights	
		<i>rmse</i>	S^2	<i>rmse</i>	S^2
0. No family resemblance	2	0.456	8371.03	0.412	7094.05
1. Full model	14	0.004	0.74	0.011	1.71
2. Random mating	13	0.164	2075.81	0.156	1767.64
3. No genetic effects	11	0.037	23.84	0.045	32.12
4. No vertical cultural inheritance	10	0.016	8.96	0.025	17.75
5. No shared sibling environment	12	0.025	18.04	0.019	11.03
6. No extra twin similarity	12	0.021	9.41	0.019	7.36
7. No non-genetic resemblance	6	0.037	72.40	0.036	31.20
8. No sex differences in parameters	7	0.030	28.19	0.033	32.95

Notes: *k* = number of model parameters; all models allow for sex differences in reliability of measurement; S^2 = sum of squared residuals weighted by number of pairs contributing to each correlation; *rmse* = square root of average unweighted squared residuals

Table 4 Estimates of path coefficients

Parameter	Abortion	Gay rights	Path
h_m	0.756	0.834	Additive genetic effects to male phenotype
h_f	0.716	0.710	Additive genetic effects to female phenotype
h_s	0	0	Sex-specific genetic effects
c_m	0.370	0.051	Non-transmitted shared environment to male siblings
c_f	0.255	0.341	Non-transmitted shared environment to female siblings
t_m	0.048	0.301	Additional twin shared environment (males)
t_f	0.355	0.203	Additional twin shared environment (females)
u_m	0.107	−0.040	Mother–son cultural inheritance
v_m	−0.140	−0.033	Father–son cultural inheritance
u_f	−0.100	−0.203	Mother–daughter cultural inheritance
v_f	0.184	0.261	Mother–son cultural inheritance
m	0.761	0.734	Phenotypic correlation between spouses
r_{gm}	0.895	0.881	Reliability (male)
r_{gf}	0.929	0.898	Reliability (female)

Note: “Reliabilities” are estimated as the path from “true” score to observed score. Test–retest correlations are the squares of the path coefficients

Table 5 Proportions of reliable variation explained by sources of variance (full model)

Component of variance	Proportion of reliable variance			
	Abortion		Gay rights	
	Males	Females	Males	Female
Additive genetic	0.572	0.513	0.696	0.505
Non-shared environment	0.316	0.213	0.288	0.253
Shared sibling environment	0.137	0.065	0.003	0.116
Extra-shared twin environment	0.002	0.112	0.091	0.041
Vertical cultural inheritance	0.008	0.016	0.005	0.031
Genotype–environment covariance	−0.035	0.080	−0.081	0.053
Total shared environment	0.147	0.193	0.099	0.188
Reliability (retest)	0.801	0.863	0.776	0.806

Note: The total contribution of the shared environment is the sum of the contributions due to vertical cultural inheritance from both parents, additional (non-parental) shared environmental effects in siblings/twins and any additional environmental resemblance of twins compared with siblings. Estimates are derived under the full model (see text)

Interaction of genetic effects with age and secular differences would also mimic these effects in kinship data.

Summary and discussion

The correlations between relatives for attitudes toward abortion and gay rights show considerable adult family resemblance for attitudes in which parents, preachers, and politicians are so deeply invested. Indeed the correlations for these two attitudes in nuclear families are not much lower than those for physical measures such as height and weight (Maes et al. 1997).

Nuclear family data by themselves cannot resolve the ambiguity with respect to the genetic and social effects of parents on their offspring (Galton 1883). Inclusion of data on MZ and DZ twins allows some resolution of the biological and social sources of family resemblance and offers a test of one of the main assumptions in the social science literature, that familial correlation is largely attributed to familial socialization. However, twin data alone tend to overestimate the effects of the shared environment (socialization) because they do not allow for the genetic effects of assortative mating (Eaves 1982). Combining twin and family data as done here allows many assumptions to be tested and admits a more detailed analysis of the effects of genes and shared environment.

The model we developed here makes the strong assumption that assortment is based on the (true) value of the manifest trait (i.e. phenotypic homogamy) rather than on aspects of the social background or more general latent constructs such as “conservatism”. Some models of social homogamy may yield larger estimates of the effects of socialization than those obtained under the assumption of phenotypic assortment. Further analysis of other relationships in the Virginia 30,000 study, such as the spouses of twins, siblings and in-laws, should elucidate the mechanism of mate selection. Although a thorough analysis of the mating system has still to be conducted, preliminary (unpublished) indications suggest that phenotypic homogamy is a significant component of resemblance between mates for social attitudes.

The current analysis does not take into account any main effects of age or their interaction with genetic and environmental influences. Typically, the main effects of age tend to be confounded with estimates non-genetic resemblance between relatives such as those of the shared sibling and twin environment. The effects of interaction between

age and, for example, genetic effects are more difficult to address, especially in the presence of assortative mating. Several models have been developed for the effects of $G \times$ age interaction on family resemblance in randomly mating populations but they remain beyond the analytical scope of the current study.

The data so far support the remarkable conclusion that social learning from parents plays a relatively minor long-term role in the development of attitudes toward abortion and gay rights among their adult offspring. By contrast, the apparent effects of genetic transmission of liability are substantial. The largest effects of the environment are those that contribute to long-term differences even within pairs of identical twins and the short-term fluctuations reflected in errors of measurement.

Overall, the principal *social* factor affecting parents' long-term influence on the attitudes of their offspring is the effort expended in mate selection and social structures that influence the process of mate selection. Although any model will be judged by the convergence of multiple lines of evidence, our analysis of these large samples of multiple kinship relations offers an empirically based alternative to widely accepted social learning theories of the origin and transmission of differences, particularly for the so-called "easy" issues. The model presented here does not discount the environment or human agency, far from it, but it suggests the conventional understanding of socially important differences is misleading if it ignores the fundamental contribution of genetic variation. If genetic differences affect the trait(s) on which assortment occurs (see e.g. Eaves 1979; Heath and Eaves 1985) then the choice of mate is a form of genotype–environment correlation in which genetic differences have an impact on the social behavior and preferences of their offspring. In a remarkable twist on traditional socio-psychological and behaviorist perspectives used to explain political attitudes, *social action* (i.e. choice of mate) increases the *genetic impact of parents on their children*. Thus, the consequences for children of the social psychological process of mate selection are mediated through the *genetic* influence of parents on children rather than through the direct social transmission of attitudes from parent to child. Other non-parental sources of shared environmental influence on adult attitudes such as shared educational and social background contribute relatively little to the long-term development of attitudes to abortion and gay rights in the US. Such evidence as is available suggests that the correlation between mates is due primarily to assortative mating and not to reciprocal spousal interaction or convergence.

The family data show small but statistically significant differences among the correlations between relatives as a function of gender. The raw correlations are only marginally higher for female pairs compared with male pairs and

the correlations for male like-sex pairs are of the same order as those for female like-sex pairs, implying that mothers and fathers contribute equally to the development of attitudes regardless of the sex of their offspring. Although the parent-offspring and sibling correlations are marked, they are rarely greater than 0.5. Attitudes are shaped as much, or even more, by factors over which parents exercise little or no control including the stochastic processes of Mendelian segregation and individual experience. Parents and other surrogates are only modestly successful in transmitting attitudes that persist into the adult life of the children in their care.

The data are gathered from adults and thus reflect the long-term consequences of parental influences. One study of changes in twin correlations for attitudes over age (Eaves et al. 1997) suggests that the correlations in attitudes are very similar for MZ and DZ twins during adolescence but diverge in young adulthood and persist throughout adult life. Thus, the investment of parents and educators in shaping attitudes has a substantial effect in adolescence but is largely discarded when children leave home. The precise mechanism by which cultural effects in adolescence interact with latent genetic differences in the development of subsequent adult attitudes remains to be elucidated.

Our data are consistent with the traditional social science findings confirming large familial correlations for attitudes toward abortion and gay rights, but the analyses suggest strongly that the correlation is more genetic than social. This claim seems contrary to, and has still to be reconciled with, the predominant theoretical framework of the social and political sciences. The fact that attitude differences appear to be influenced more by genetic rather than social differences may be an ontogenetic vestige of genetic variation in phylogenetically more primitive behavioral adaptation predating the rapid evolution of language and other higher cognitive functions necessary for social learning.

Whether transmission be genetic or social, assortative mating has two important social and epidemiological implications. Firstly, assortative mating increases diversity (polarization) in the population. If assortment is introduced into a hitherto randomly mating population, the phenotypic variance increases over successive generations (e.g. Fisher 1918). *Ceteris paribus*, under purely phenotypic assortment, and direct transmission from parental phenotype to offspring phenotype, after relatively few generations of assortment the variance will approach an equilibrium value that depends on the degree of assortment, μ and the intensity of parent-offspring transmission, b . For example, if $\mu = 0.4$ and $b = 0.3$ the total variance is expected to be more than 30% larger than the value under random mating leading to a marked increase in the frequency of

individuals of more extreme phenotype. That is, assortment increases polarization of individual differences. Secondly, assortative mating leads to an increase in the resemblance between parents and children. That is, assortment increases the influence parents' exercise over the development of their offsprings' behavior. For example, if a randomly mating population $b = 0.3$ begins to mate assortatively with $\mu = 0.4$, in a relatively small number of generations the parent–offspring correlation will increase from 0.3 to 0.42. That is, simply by taking care about their choice of mate, potential mothers and fathers can increase their impact on the long-term development of their children. The implications of these calculations for the transmission of social behavior have still to be integrated within the framework of the social and political sciences.

Although the model is comprehensive, conclusions depend on the assumption that the environments of MZ twins are no more correlated than those of DZ twins and siblings for their attitudes to abortion and gay rights. The empirical support for this assumption has been explored for a wide number of social and clinical traits (e.g. Kendler and Gardner 1998; Lykken et al. 1990) but will continue to be questioned. The model also assumes that assortment is based primarily on the stable component of the individual attitude and not on other unmeasured aspects of population stratification that influence the genetic and/or social resemblance of spouses (Heath and Eaves 1985). Data from kinships of adoptees would add further power to the resolution of biological and cultural inheritance but such data are difficult to obtain in large samples.

It is essential to be clear what it means to claim there is a genetic component to the transmission of one or more attitudes. It certainly does not mean there is “a” gene “for” an attitude. Following Ronald Fisher's classical (1918) treatment, it is assumed that variation in complex outcomes depends on genetic variation at a large number of genes. The pathway from DNA to phenotype is very long and convoluted so that the effects of individual genes may be too small to stand out against the background of all other genes and environmental factors combined. Genetic liability may be expressed even through the complex developmental interplay between the person and the environment (“genotype–environment correlation”, see e.g. Eaves et al. 2003; Scarr and McCartney 1983; Silberg and Rutter 2001). The model for transmission between generations suggests that transmission is based on latent influences on liability, rather than a direct impact of individual parental values on those of their children, and this liability is mainly a function of genetic differences. Neither does the model discount environmental factors. The parameter estimates imply that as much as 50% of the variation in liability is due to the non-genetic unique environmental effects of individual personal experience,

not correlated in families. However, these attitudes do not follow the pattern of inheritance directly associated with social learning based on the values modeled by parents. Rather, the principal environmental differences are those that have shaped the attitudes of individual children, independent of their siblings or parents. Moreover, the findings are consistent with the political psychology literature (Zaller 1992) emphasizing the importance of the current environment on political behaviors. However, our data demonstrate that, for social attitudes at least, stable individual differences such as the genetic influence of parents play an even greater role. Subsequent analysis of longitudinal twin data on social attitudes will address the sources of long-term stability and change in social attitudes (in preparation).

This is not to say that culture, or social environments do not matter; quite the opposite. Rather, genetic and unique environmental variance can only be assessed in a given cultural context that ascribes salience to the trait. The roles of genes and environment influencing opinions on abortion and gay rights cannot be elucidated without the cultural context where abortion or gay rights are sources of contention. Genetic influences on complex contemporary social issues may be sensitive to cultural context, in our case that of a modern industrialized society. On the other hand, the salience of attitudes to some issues, such as those involving reproduction, may be a current manifestation of long-term differences in adaptive behavior that transcend any local cultural milieu. Our data do not allow us to resolve this major theoretical issue.

Parents may think they are accomplishing more than they do by their actions after childbirth, and scholars, while giving parents due credit for the source of their children's social attitudes, may have been giving them credit for the wrong reasons. In spite of any apparent social influence of parents while children are at home, their adult children are likely to assume attitudes compatible with their own individual experiences and biological propensities. The claim that there is so little apparent long-term social effect of parents on the attitude differences among their adult children to such specific topics as abortion and gay rights is counter-intuitive but receives strong support from the data. The extent to which evolutionary and neurobiological theories can both broaden the theoretical and anthropological significance of these findings remains to be seen. However, the findings here support a different theoretical perspective from those implied in social–psychological or rational choice theories used to explain political behaviors and offer the elements of a different theory of familial transmission and source for political preferences and attitudes.

While the traditional social science theories rely on one's personal experiences and social background for

sources of preferences, or take them as “given”, we contend that one of the most significant social sources of familial transmission is not just the social environment of the individual child but the individual parent’s choice of mate. Assortative mating for political or social preferences is widely documented in the literature of both the social (Buss and Barnes 1986; Kalmijn 1994; Kalmijn and Flap 2001; Mare 1991; Merikangas 1984) and life sciences (Bouchard et al. 1990; Eaves and Eysenck 1974; Heath et al. 1987; Martin et al. 1986; Vandenberg 1972), yet the implications of mate selection for the transmission of political and social attitudes is seldom addressed.

Thus, the familial correlation in social attitudes is antecedent to childhood and adolescent experience but arises because of genetic differences between pairs of parents transmitted according to Mendelian principles, generalized to reflect the effects of multiple genes and non-random mate selection (Fisher 1918). Variation within families of genetically related offspring (more than half the total variation) is due to the random effects of individual life experience and the segregation of genetic differences within the family. Rational choice and socio-psychological theories are thus simplifications or possibly subsets of a more general theory of family resemblance that address both social and genetic transmission. Speculation about the philosophical implications of the findings lay beyond their purely scientific motivation.

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