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ORIGINAL PAPER

Familiality of Gender Nonconformity Among Homosexual Men

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Abstract

We examined whether recalled childhood gender nonconformity and self-reported adult gender nonconformity is familial, using data from 1154 families selected for having at least two homosexual brothers. Specifically, we examined the extent to which homosexual men's variation in gender nonconformity runs in families by examining pairs of genetic brothers who were both homosexual (N = 672–697 full sibling concordant pairs). We also examined similarity between homosexual and heterosexual brothers (N = 79–82 full sibling discordant pairs). Consistent with past studies, concordant pairs yielded modest positive correlations consistent with moderate genetic and/or familial environmental effects on gender nonconformity. Unlike results of smaller past studies, discordant pairs also yielded modest positive, though nonsignificant, correlations. Our results support the feasibility of supplementing genetic studies of male sexual orientation with analyses of gender nonconformity variation.

Keywords Sexual orientation · Homosexuality · Gender nonconformity · Familiality · Genetics

Introduction

Gender nonconformity is a strong correlate of homosexuality across cultures, especially among males (Bailey et al., 2016). Robust sexual orientation differences in childhood gender nonconformity have been established in both prospective and retrospective studies (Bailey & Zucker, 1995). These differences can occur in early childhood and often persist into adulthood (Bailey et al., 2016; Li, Kung, & Hines, 2017; Lippa, 2005; Rieger, Linsenmeier, Gygax, & Bailey, 2008; Rieger, Linsenmeier, Gygax, Garcia, & Bailey, 2010). Effect sizes for recalled childhood gender nonconformity tend to be large (with a meta-analysis finding an average d = 1.3, Bailey & Zucker, 1995), and those for adult gender nonconformity tend to be moderate to large depending on the measure (e.g., Rieger et al., 2010). The fact that homosexual persons are more gender nonconforming than heterosexual persons has influenced causal hypotheses of sexual orientation. For example, one especially influential theory has been that prenatal hormonal influences organize the brains of homosexual individuals in a partly sex-atypical manner (Bailey et al., 2016).

Although considerable attention has focused on between-orientations differences in gender nonconformity (e.g., Bailey & Zucker, 1995; Bailey et al., 2016), much less attention has been given to gender nonconformity variation within orientations. This variation is both substantial and informative in its own right. For example, if homosexual men tend to be more feminine than heterosexual men because their brains have been prenatally feminized, what are we to make of a homosexual man who is unremarkably masculine? Does homosexuality associated with femininity have different causes than homosexuality associated with masculinity? Perhaps the homosexuality of more feminine men is especially likely to be attributable to the fraternal birth order effect. There is some empirical support for this possibility (Blanchard, 2018, but see Bogaert, 2003). The

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present study aims to illuminate within-orientation variation in gender nonconformity among homosexual and heterosexual men, using data collected for a family-genetic study. As such, we focus henceforth on male gender nonconformity variation.

Although homosexual men tend to be more gender nonconforming than heterosexual men, there is also considerable variation within both groups, with substantial overlap. Furthermore, the variance among homosexual men's retrospectively reported childhood gender nonconformity greatly exceeds that of heterosexual men's (Bailey & Zucker, 1995). There are reasonable concerns about the validity of retrospective measures—perhaps within-orientation variation in recalled gender nonconformity reflects memory error. However, the validity of variation among homosexual men's recollections of gender nonconformity was supported in a study of homosexual men and their mothers, who both provided their memories of the men's boyhood behavior (Bailey, Nothnagel, & Wolfe, 1995). There was a high degree of concordance regarding the general level of sons' gender nonconformity, $r = .69$. That is, mothers and sons agreed well regarding which sons were relatively masculine and which relatively feminine. In a study of twins, male twins from the same pair agreed substantially, $r = -.56$, regarding which twin was more gender nonconforming during childhood (Bailey, Dunne, & Martin, 2000).

Further validation for within-orientation variation in gender nonconformity comes from studies of homosexual and heterosexual adults (targets), who were videotaped during brief behavioral displays (Rieger et al., 2008, 2010). Raters blind to targets' sexual orientations were moderately accurate at guessing targets' sexual orientations from watching the videos. Furthermore, others' ratings tended to agree with targets' self-report. However, there was considerable variation in ratings within orientation, and such variation was larger in homosexual than heterosexual men. That is, raters tended to agree that some homosexual men were much more masculine than others, whereas others were very feminine.

What might cause variation in gender nonconformity among homosexual, or among heterosexual, men? Furthermore, how might this be studied? One possible approach is via analysis of family-genetic data, including data from twins and other kinds of siblings. This approach uses patterns of familial resemblance to infer the magnitude of different influences, including heredity. With the right kind of data, for example, one could examine whether homosexual and heterosexual men vary in their degree of gender nonconformity due to genetic or environmental reasons. With more limited data, one can examine the degree to which gender nonconformity tends to run in families.

Three studies have explored variation in self-reported childhood gender nonconformity among homosexual men using a family-genetic approach (Table 1). Although these studies were small, two generalizations are apparent. First, genetically related brothers concordant for homosexuality were somewhat similar in their degree of recalled childhood gender nonconformity. For these concordant pairs, correlations were higher for MZ twins than for dizygotic (DZ) twins or for non-twin genetic brothers, but they were also appreciable for the latter two kinds of relatives. Second, brothers discordant for homosexuality showed no appreciable correlation in their degree of childhood gender nonconformity, even if they were MZ twins. These findings support—but do not prove—two hypotheses. First, the substantial familiality of childhood gender nonconformity is consistent with the possibility that genetic factors may differentiate homosexual men with higher and lower degrees of gender nonconformity. That is, different genetic variants might contribute to masculine versus feminine homosexuality, leading homosexual brothers from the same families (who will tend to share the same genetic variants) to be relatively similar to each other in degree of gender nonconformity. Second, the evidence that familial resemblance for childhood gender nonconformity appears higher among genetic brothers who are concordant for homosexuality than among those who are discordant—although limited due to small

Table 1 Childhood gender nonconformity correlations for pairs of brothers either concordant or discordant for homosexuality from three previous studies

Study	Correlations (*N* pairs)							
	Concordant pairs				Discordant pairs			
	MZ twins	DZ twins	Non-twin genetic brothers	Adoptive brothers	MZ twins	DZ twins	Non-twin genetic brothers	Adoptive brothers
Bailey and Pillard (1991)	.76 (25)	.43 (11)		−.26 (6)	.10 (25)	−.02 (32)		−.06 (25)
Watts, Holmes, Raines, Orbell, and Rieger (2018)	.59 (19)				−.18 (24)			
Dawood, Pillard, Horvath, Revelle, and Bailey (2000)			.54 (29)					

samples—suggests that gender nonconformity variation may be differently explained in homosexual and heterosexual men.

Although the results of studies in Table 1 are intriguing, the studies are all small, and the estimates they provide are subject to substantial sampling error. Across the three studies, the total number of concordant homosexual genetic brother pairs is 84, and the total number of discordant genetic brother pairs is 81. The current study investigated familial resemblance in gender nonconformity using a much larger sample of genetic brother pairs, including more than 700 pairs concordant for homosexuality. Our primary aim was to examine the degree to which homosexual brothers were similar to each other, and to their heterosexual brothers, with respect to gender nonconformity. The specific analyses involved simple correlations among both concordant and discordant pairs. We expected that concordant pairs would be positively correlated for gender nonconformity. However, based on the limited available results from small prior studies, we were less certain that discordant pairs would show a positive correlation of similar magnitude. Note that our study is primarily about familiality—and not heritability—of gender nonconformity among homosexual men. Although the sample includes several twins, there are an insufficient number of them to allow an examination of genetic influences.

Method

Participants

Homosexual men with homosexual brothers were recruited from 2004 through 2008, for a molecular genetics study of male sexual orientation. Probands were recruited opportunistically, mostly during Gay Pride festivals, supplemented by online and homophile media, advertisements, and organizational announcements. Almost all probands were from the U.S. (98%). Individuals of European ancestry comprised approximately 98% of the final sample (Sanders et al., 2015). Although homosexual men comprised the target population, other family members (brothers and parents) were encouraged to enroll. Full siblings were targeted, but smaller subsamples of half-siblings and of MZ twins also participated, and we report their results herein. We included all participants returning a questionnaire, which were more than those whose DNA we were able to obtain and study for linkage (Sanders et al., 2015). We obtained institutional review board approval from NorthShore University HealthSystem, and all participants provided informed consent.

Measures

Sexual Orientation

We distinguished sexual orientations by participants' sexual identities: heterosexual or homosexual. (We excluded participants who identified as bisexual.) We checked that these identities were consistent with their self-reported sexual feelings, assessed by 7-point Kinsey ratings (from 0 = sexual attraction only to women to 6 = sexual attraction only to men; Kinsey, Pomeroy, & Martin, 1948) and by two 5-point items in which participants rated their separate feelings about having sex with men or with women (1 = disgusting to 5 = very sexually exciting). Heterosexual men's Kinsey ratings were required to be 0 or 1, and homosexual men's Kinsey ratings were required to be 5 or 6. Eight men's sexual identities (all heterosexual) were inconsistent with their reported sexual feelings (based on any of the three aforementioned scales) and were excluded from the present study.

Childhood Gender Nonconformity

This measure used the 23 items from the Recalled Childhood Gender Identity/Gender Role Questionnaire (Zucker et al., 2006). Example items include "As a child, my favorite playmates were," with answers ranging from "Always boys" to "Always girls" and "As a child, I had the reputation of a sissy" with answers ranging from "All of the time" to "Never." Each item response was associated with a number, depending on the degree of childhood gender nonconformity it represented. Numeric item responses were standardized (for the sake of computational simplicity) and then averaged. Higher scores represented greater degrees of childhood gender nonconformity. Reliability (coefficient alpha) was .91.

Adulthood Gender Nonconformity

This measure, previously called the Adulthood Continuous Gender Identity Scale (Rieger et al., 2008) included eight items regarding the degree to which the respondent reported feeling more feminine and less masculine. Each item used a 7-point rating scale, and higher scores represented increased femininity. Example items include "I feel like part of me is male and part of me is female" and "In many ways I feel more similar to women than to men." Prior studies have shown moderate correlations between this scale and observer ratings of gender nonconformity (e.g., Rieger et al., 2010). Coefficient alpha for the scale was .76 for this sample.

Demographic Information

We examined year of birth as one potential correlate of childhood gender nonconformity. This variable is obviously highly correlated with age at which data were provided, but in a multi-year study such as this one, these variables are not perfectly correlated. Year of birth allowed us to examine whether there were age or cohort effects in the expression (or reporting) of gender nonconformity. (Cross-sectional data do not allow the separation of age and cohort effects; Schaie, 1965.) Because brothers tend to be highly correlated for age in samples that draw from a wide age range, it is important to control for the effects of age in examining familial factors via correlations between brothers.

We assessed educational level with values ranging from 1 (no high school) to 7 (graduate degree). There is some evidence that persistence of gender nonconformity between childhood and adulthood is greater for men of lower social class (Harry, 1985). The earlier research used information from father's occupation to assess social class. Respondent's educational level is the most pertinent variable available in the current study.

Results

The sample included 1959 homosexual men and 100 heterosexual men from 1154 distinct families. On average, the heterosexual participants reported Kinsey ratings of sexual feelings during the past year of 0.1 (SD = 0.36) and homosexual participants 5.86 (SD = 0.38). The average birth year of participants was 1962.8, SD = 11.0, range 1930–1989). Heterosexual participants were born significantly later than homosexual participants, with respective years of birth of 1962.5 (SD = 11.1) and 1957 (11.0), $t(1998) = 3.30$, $p = .001$. This may have reflected younger homosexual participants being more willing than older homosexual participants to involve their heterosexual brothers, due to the increase in positive attitudes toward homosexuality during the past few decades (e.g., Loftus, 2001). On average, participants had educational attainment of 5.3 (SD = 1.4), or somewhat more than a college degree; heterosexual and homosexual participants did not differ significantly.

Gender Nonconformity Differences Between Heterosexual and Homosexual Men

Adult and childhood gender nonconformity were significantly correlated with each other, for both heterosexual and homosexual men, $r(94) = .54$, $p < .0001$ and $r(1898) = .60$, $p < .0001$. (Six heterosexual men and 61 homosexual men were missing data for at least one measure.)

Table 2 shows the means and SDs for measures of gender nonconformity during childhood and adulthood, separately for heterosexual and homosexual men. In order to examine differences in their gender nonconformity between homosexual and heterosexual men, we treated family as a random effect (thus accounting for dependencies in the data due to similarity of brothers). Homosexual participants were more gender nonconforming than heterosexual participants, both for childhood $t(1466) = 15.66$, $p < .0001$, $d = 1.99$, and adulthood, $t(1706) = 7.51$, $p < .0001$, $d = 0.85$.

Figure 1 presents the distributions of heterosexual and homosexual men for both variables. The distribution of childhood

Table 2 Group Ns, means, and SDs for childhood and adult gender nonconformity

	Childhood gender nonconformity			Adult gender nonconformity		
Group	*N*	Mean	SD	*N*	Mean	SD
Heterosexual	94	−0.90	0.30	99	1.68	0.78
Homosexual	1910	0.04	0.60	1943	2.48	1.08

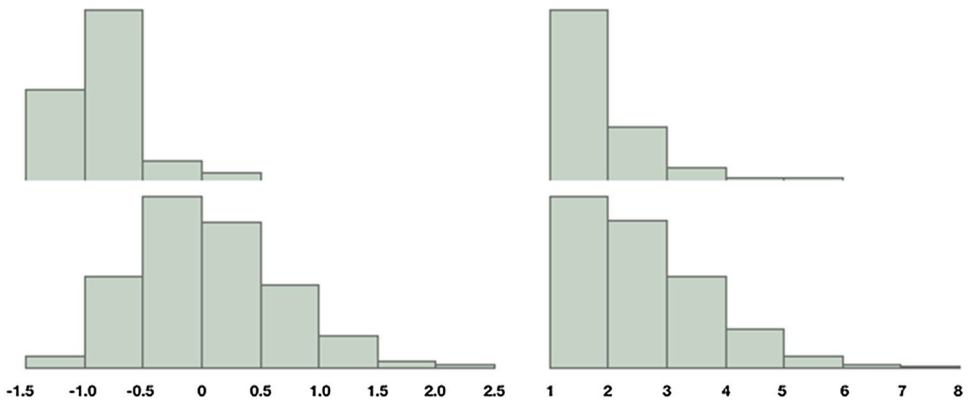

Fig. 1 Self-reported childhood gender nonconformity (left) and adult gender nonconformity (right) distributions for heterosexual (top) and homosexual (bottom) participants. Higher scores (i.e., to the right) indicate increased gender nonconformity

gender nonconformity was typical of this literature, with heterosexual men's scores tending toward the low end (suggesting a floor effect) and with homosexual men's scores more evenly distributed with higher variance (see, e.g., Figure 2 of Bailey & Zucker, 1995). For gender nonconformity during adulthood, the two orientations were less separated, and both tended to congregate in the low regions of the scale.

Familial Resemblance in Gender Nonconformity

We examined similarity between brothers' gender nonconformity separately for those concordant and discordant for homosexuality. Analyses for concordant pairs used data from families which contributed at least two brothers to the study. Only data from the first two homosexual brothers in a family were used in analyses of similarity among brothers concordant for homosexuality. (That is, for a few families, more than two homosexual brothers provided data. In order to simplify data analysis, only two were included from each family.) The first brother's childhood and adult gender nonconformity were predicted from his brothers' respective scores, controlling for both the first brother's birth year and his educational level. Results for these analyses are shown in the left-hand columns of Table 3, separately for MZ twins, full siblings (who comprised the bulk of concordant brother pairs), and half-siblings. Among the full siblings (the only group with adequate statistical power), both childhood and adult gender nonconformity were significantly related among concordant pairs. Furthermore, full siblings' birth year was a robust predictor of brothers' gender nonconformity. That is, younger men (i.e., those with higher birth years) tended to report more gender nonconformity.

Although there were only 8 pairs of MZ twins, their correlation for childhood gender nonconformity was statistically significant. The 34 pairs of half-brothers were significantly correlated for adult gender nonconformity. In principle, the three kinds of brothers on the left-hand side of Table 3 could be used to estimate heritability of childhood and adult gender nonconformity. However, the sample sizes of the MZ twins and half-brothers were too small to provide useful estimation.

To analyze data for brothers discordant for homosexuality, we began by identifying families who contributed both at least one heterosexual brother and at least one homosexual brother. (Two pairs who were genetic half-siblings were eliminated. All the rest were full siblings.) We then conducted multiple regressions predicting the heterosexual men's childhood and adult gender nonconformity scores from their homosexual brothers' gender nonconformity scores, controlling for heterosexual brothers' birth year and educational level. Results for these analyses are shown in the right-hand side of Table 3. The correspondences between discordant brothers' gender nonconformity (both from childhood and adulthood) were not significant. However, Table 3 also shows that regression coefficients for homosexual brothers' gender nonconformity were only slightly smaller than respective coefficients in the analyses for concordant pairs of full siblings. Furthermore, the respective confidence intervals overlapped.

Discussion

Our results were generally consistent with those of past studies in showing substantial family resemblance for homosexual brothers in their degree of gender nonconformity (Table 1). Our sample was much larger than the aggregate of previous samples. Estimates of familiality were accordingly more precise, and they excluded zero by a very large margin. For our largest sample, the full siblings, the partial regression coefficients between brothers concordant for homosexuality were .26 for childhood gender nonconformity and .17 for adult gender nonconformity. Although these estimates were small in magnitude, the effects that they imply are larger for two reasons. First, in order to estimate the proportion of variance attributable to familial factors, one does not square the coefficients; the coefficients estimate this proportion directly (Bouchard, Lykken, McGue, Segal, & Tellegen, 1990). Second, to the extent that the factors responsible for familial resemblance are genetic rather than environmental, the magnitude of their effect will be even larger than the coefficients. At the extreme, if resemblance was due entirely to genes, then one would double the regression coefficients to estimate the effect of heritable variation. (Siblings who are not MZ twins share only half of their genetic variation, and thus, their resemblance reflects only half the effect of heredity.) A greater role of heredity than for shared environment is likely, based on findings for most behavioral traits (Turkheimer, 2000).

In total, our results are consistent with the likelihood of considerable genetic variation in the expression of male gender nonconformity, and possibly even in its causes. Further support for this hypothesis comes from Table 1, in which the average correlation for concordant MZ twins, .68, was larger than that for concordant DZ twins and non-twin brothers, .49; our correlation for concordant non-twin brothers, .26, was even smaller. It is likely that genetic factors play a role in gender nonconformity variation among homosexual men, but clearly demonstrating this will require more research. Examining genetic variants related to gender nonconformity is one obvious path, for example, by following up genetic linkage or genome-wide association studies of sexual orientation with analyses of gender nonconformity. Homosexual men appear to be especially variable in their gender nonconformity, relative to heterosexual men (Table 2 and Fig. 1), and may therefore be an especially useful population in which to study contributory genetic variants.

Our sample of brothers discordant for homosexuality was much smaller than our sample of concordant brothers, but it was slightly larger than the aggregate of previous samples (Table 1; note that prior studies of genetic brothers discordant

Table 3 Standardized partial regression coefficients for predicting brothers' gender nonconformity

Type of brother		Concordant pairs[a]				Discordant pairs[b]			
		Predictor				Predictor			
		N (pairs)	Brother's gender nonconformity	Birth year	Education	*N* (pairs)	Brother's gender nonconformity	Birth year	Education
Full sibling	Childhood Gender Nonconformity	672	0.263** 0.188–0.337	0.151** 0.075–0.226	−0.037 −0.112–0.037	79	0.220 −0.011–0.451	0.170 −0.051–0.392	0.183 −0.039–0.405
	Adult Gender Nonconformity	697	0.168** 0.094–0.241	0.153** 0.079–0.228	−0.031 −0.105–0.043	82	0.079 −0.138–0.296	0.259* 0.046–0.471	0.085 −0.119–0.289
MZ twin	Childhood Gender Nonconformity	8	0.541* 0.123–0.958	0.277 −0.464–1.019	0.418 −0.353–1.189				
	Adult Gender Nonconformity	8	0.342 −0.991–1.674	1.481* 0.112–2.849	1.449* 0.160–2.739				
Half-sibling	Childhood Gender Nonconformity	31	0.160 −0.245–0.410	0.210 −0.316–0.540	0.193 −0.189–0.603				
	Adult Gender Nonconformity	34	0.329* 0.036–0.622	0.171 −0.157–0.542	−0.053 −0.384–0.278				

Coefficients for concordant pairs are from the multiple regression predicting the first homosexual brother's childhood and adult gender nonconformity scores from the second brother's respective scores, controlling for the first brother's birth year and educational level. Coefficients for discordant pairs are from the multiple regression predicting heterosexual brothers' childhood and adult gender nonconformity scores from homosexual brother's respective scores, controlling for heterosexual brothers' birth year and educational level. Cells for predictors include the standardized estimate in the first row and their 95% CI in the second row

*$p < .05$; **$p < .0001$

for sexual orientation all focused on twins). Unlike in previous studies (e.g., Bailey & Pillard, 1991), gender nonconformity correlations were not much lower among discordant brothers compared with brothers concordant for homosexuality. Furthermore, confidence intervals overlapped (Table 3). Thus, our results do not support the hypothesis we raised in Introduction that causes of gender nonconformity may differ among homosexual and heterosexual men.

The two covariates we included, birth year and educational attainment, yielded consistent findings for the brothers concordant for homosexuality. Specifically, birth year was positively correlated with both childhood and adult gender nonconformity, meaning that more recently born homosexual men reported more gender nonconformity. These effects were not large (Table 3). For example, for full siblings, a one SD increase in birth year (approximately 10 years) was associated with a 0.15 SD increase in childhood gender nonconformity; the effect for adult gender nonconformity was even smaller. One possible explanation for this finding is an age effect, in which younger men recall or report gender nonconformity more readily than older men. This explanation would be supported if, in longitudinal samples, the same gay men recalled less childhood gender nonconformity as they age. Alternatively, a cohort effect would mean that more recently born men recall or report more gender nonconformity compared with men born earlier. This interpretation of the finding would be supported if cohort reports were stable over time.

Educational attainment was unrelated to childhood and adult gender nonconformity among homosexual men. This contrasts with findings of Harry (1985), who reported that feminine men from lower social classes were more likely to stay feminine from childhood through adulthood. Thus, we expected to observe a correlation between educational attainment (an important component of social class) and adult gender nonconformity. However, we did not.

We have noted that our study did not have the intention or ability to disentangle the effects of genes and environment on either sexual orientation or gender nonconformity. But family studies like ours—studies that examine the degree to which traits run in families and attempt to identify moderating factors—have long been common in genetic epidemiology. Such questions suggest that studying within-orientations variation in gender nonconformity could be scientifically useful. Analogous questions have often been asked in the context of psychiatric epidemiology, such as familiality of schizophrenia subtypes (Kendler, McGuire, Gruenberg, & Walsh, 1994) and age of schizophrenia onset (Kendler, Tsuang, & Hays, 1987). A second kind of question has addressed the extent to which familiality or heritability of a disorder is related to a phenotypic trait, such as age of onset in depression (Weissman et al., 1984). We hasten to add that we are not suggesting here that any sexual orientation is disordered. Rather, our point is that our general topic has ample precedent in the vibrant field of psychiatric epidemiology. We hope our study's results will be useful alongside other studies examining familial correlations for gender nonconformity and sexual orientation.

Limitations

Like most studies of sexual orientation, ours used non-representative sampling techniques subject to various volunteer biases. This can cause distortions in certain kinds of findings, such as twin concordances for sexual orientation, because twin pairs concordant for homosexuality may be more likely to volunteer for family-genetic studies compared with twin pairs discordant for homosexuality (Bailey et al., 2016). An analogous volunteer bias could extend to gender nonconformity. Such bias would mean that the likelihood of volunteering for our study (concerning molecular genetics of male sexual orientation) would be higher for homosexual brothers correlated in gender nonconformity than in brothers unrelated in their gender nonconformity. We cannot exclude the possibility that such bias occurred; however, recruitment materials for the study did not emphasize gender nonconformity.

Self-report bias is also a concern. To be valid, retrospective childhood gender nonconformity measures such as ours require both accurate memories and honesty; similarly, contemporaneous adult gender nonconformity measures require accurate self-assessment and honesty. Although we acknowledge the potential limitations of self-report, it is unclear that these facts would result in spuriously high findings of familial gender nonconformity. Furthermore, other studies have supported the validity of measures of childhood gender nonconformity (Bailey, Miller, & Willerman, 1993, Bailey et al., 2000; Rieger et al., 2008).

One final limitation concerns the measurement sensitivity of our scales at different regions of measurement. The general issue is this: Do our scales measure gender nonconformity variation equally well at high, moderate, and low values of the trait? If they do not—for example, if the measures are more sensitive at high than at low levels of gender nonconformity—this would diminish the magnitude of standardized associations within the less sensitive regions. This would be especially misleading in correlations involving heterosexual men, who have relatively low levels of gender nonconformity. Although we cannot evaluate this issue herein, we did not find statistically significant differences between correlations between concordant pairs versus those between discordant pairs.

Both childhood and adult gender nonconformity are markedly variable among homosexual men. We have shown that both run in families to an appreciable degree. We hope that our results will encourage research to elucidate their precise nature.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical approval of NorthShore University HealthSystem IRB.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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