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ORIGINAL PAPER

Fertility in the Mothers of Firstborn Homosexual and Heterosexual Men

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Abstract This study tested the balancing selection hypothesis, that is, genes predisposing men to homosexuality escape elimination from the population because the decreased fertility of men with the heritable form of homosexuality is offset by an increased fertility among biological relatives who carry the same genetic variants. The index subjects (probands) were 40,197 firstborn heterosexual men and 4,784 firstborn homosexual men retrieved from six archival data sets, all of which had previously been used in published research. The measure of familial (specifically, parental) fertility was the proband's number of younger siblings. The results directly contradicted the prediction of the balancing selection hypothesis. In four of the six samples, the homosexual probands had significantly fewer younger siblings; in the other two samples, the means were not significantly different. It is possible that mothers who produce a homosexual son at their first delivery include a biologically distinct subpopulation of mothers of homosexual sons.

Keywords Adaptive fitness · Balancing selection · Behavior genetics · Birth order · Evolutionary psychology · Fertility · Homosexuality · Sexual orientation

Introduction

Research on sexual orientation in men has repeatedly shown that homosexuality tends to run in families—that is, homosexual research volunteers report more homosexual brothers than do heterosexual research volunteers—and that male identical twins more often share the same sexual orientation than do male fraternal twins. This research, which has now been reviewed several times (e.g., LeVay, 2011), suggests the conclusion that inherited genes increase the probability of homosexuality in men.

This conclusion leads immediately to a conundrum: How can genetic variants that predispose to homosexuality remain at a (seemingly) constant rate in the population, when the men who carry them are so much less likely to produce offspring? One theoretical solution to this conundrum has gained increasing acceptance over the past two decades: The decreased fertility of men with the heritable form of homosexuality is offset by an increased fertility of biological relatives who carry the same genetic variants (e.g., Hamer & Copeland, 1994). This hypothesis has been denoted with the pre-existing term *balancing selection* by authors such as Schwartz, Kim, Kolundzija, Rieger, and Sanders (2010). There are at least two versions of this hypothesis, the *overdominance* and *sexual antagonism* models (Camperio Ciani, Cermelli, & Zanzotto, 2008; Gavrilets & Rice, 2006); however, the distinction between them will not be important for this article. The hypothesis of balancing selection has received some empirical support from the small number of studies that have compared the relative fertility of their homosexual and heterosexual research subjects' (hereafter, *probands*') relatives and found greater fertility among their homosexual probands' aunts, uncles, grandparents, and so on (e.g., Iemmola & Camperio Ciani, 2009; King et al., 2005; Rahman et al., 2008; Schwartz et al., 2010; VanderLaan & Vasey, 2011).

It might seem that a convenient and efficient way to study the basic notion of balancing selection is simply to compare homosexual and heterosexual probands with regard to their average numbers of siblings. The parents of homosexual probands should produce more offspring, whichever version of the balancing selection hypothesis is correct, so homosexual probands should have more siblings than heterosexual probands. Furthermore, there exist many archival data sets with information on heterosexual and homosexual probands' numbers of brother and

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sisters, in contrast to the lesser number of data sets that include information on second- and third-degree relatives.

In fact, the simple research design sketched above is somewhat problematic because of a well-established phenomenon that would tend to inflate the mean size of a homosexual group's sibships. Numerous studies have found that older brothers increase the odds of homosexuality in later-born human males. This phenomenon has been called the *fraternal birth order* (FBO) *effect*. The FBO effect has been reviewed several times (e.g., Blanchard, 2004, 2008; Bogaert & Skorska, 2011). Additional studies not included in the most recent reviews include one from the UK (Rahman, Clarke, & Morera, 2009), Spain (Gómez-Gil et al., 2011), and the Netherlands (Schagen, Delemarre-van de Waal, Blanchard, & Cohen-Kettenis, 2011) (see also de Rooij, Painter, Swaab, & Roseboom, 2009). Because biological brothers increase the odds of homosexuality in later-born males, even if they were reared in different households, whereas stepbrothers or adoptive brothers have no effect on sexual orientation (Bogaert, 2006), the most likely explanation of the FBO effect is the progressive immunization of certain mothers to male-specific antigens by succeeding male fetuses, and the increasing effects of anti-male antibodies on sexual differentiation of the brain in succeeding male fetuses.

Because randomly selected homosexual groups will tend to have more older brothers than well-matched heterosexual comparison groups, they will tend to have larger sibships (Zietsch et al., 2008). Schwartz et al. (2010) used statistical procedures to demonstrate that the larger sibships of their homosexual group were partly a result of greater parental fertility and not simply an artefact of the fraternal birth order effect. An alternative, elegant, and simpler procedure was introduced by Camperio-Ciani, Corna, and Capiluppi (2004). Camperio-Ciani et al. compared firstborn homosexual men and firstborn heterosexual men with regard to their mean numbers of younger siblings. Since the effect of birth order (fraternal or otherwise) is eliminated by this selection procedure, any differences in sibship size (barring religious, socioeconomic, ethnic, or other demographic confounds) can reasonably be attributed to differences in parental fertility. Camperio-Ciani et al. did find a difference in the predicted direction (more younger siblings for the firstborn homosexuals), but the difference was not statistically significant. In a replication study with a somewhat larger sample, however, the predicted difference was statistically significant (Iemmola & Camperio Ciani, 2009).

In the present study, the analysis devised by Camperio-Ciani et al. (2004) was carried out on six archival data sets, all of which were large enough to yield substantial groups of firstborn homosexual and heterosexual men, and all of which had previously been used in published research. It was hoped that this project would establish the reliability of the finding of increased fertility in the parents of firstborn homosexual men and thus address the likelihood of the balancing selection hypothesis.

Method

The strategies for recruiting subjects, the incentives offered for their participation, the information used for determining their sexual orientation, and so on, may be found in the original six studies. This section of this article presents some more specific information about the subjects from which the firstborn subgroups were drawn.

Blanchard and Bogaert (1996a)

These authors investigated birth order in a subsample age 18 and older to minimize any possible distorting effects of incomplete sibships (Blanchard & Bogaert, 1996a, p. 560). The mean number of siblings (older brothers + older sisters + younger brothers + younger sisters) was virtually identical for the two groups; the data are reproduced in Table 1.

Blanchard and Bogaert (1996b)

The present study used the full heterosexual group (Blanchard & Bogaert, 1996b, p. 28) rather than the subgroup individually matched to the homosexual group.

Blanchard and Lippa (2007)

In the present study, as in many of the analyses in the original study, bisexual males were combined with homosexual males to form a dichotomous sexual orientation variable (Blanchard & Lippa, 2007, p. 168). The original study kept the bisexual and homosexual males separate in its comparison of mean family sizes (p. 166); thus, the means for the dichotomous groups were analyzed for this study to make them comparable with the other means presented in Table 1. The family demographic items in the data set could be used to calculate participants' total numbers of younger siblings, but it was not possible to calculate numbers of younger brothers and younger sisters separately (p. 165).

Blanchard and Zucker (1994)

The original comparison of family size was carried out on the 850 men who were not missing the necessary data (Blanchard & Zucker, 1994, p. 1376). In the original report, the group means included the probands; these have been recalculated without the probands in Table 1.

Blanchard, Cantor, Bogaert, Breedlove, and Ellis (2006)

The original study was carried out on a composite of five different samples. Data on younger siblings were not collected in

Table 1 Total number of siblings for all probands

Original study	Heterosexual group			Homosexual group			Comparison		
	n	*M*	*SD*	*n*	*M*	*SD*	*t*	*df*	*p*[a]
Blanchard and Bogaert (1996a)	3,807	2.28	2.02	799	2.27	2.11	0.13	4,604	ns
Blanchard and Bogaert (1996b)	434	2.25	1.74	302	2.43	1.95	−1.33	734	ns
Blanchard and Lippa (2007)	79,519	1.80	1.38	8,279	1.85	1.43	−3.10	87,796	.002
Blanchard and Zucker (1994)	281	1.88	1.74	569	1.94	1.73	−0.48	848	ns
Blanchard et al. (2006)	1,957	2.33	2.08	807	2.25	2.15	1.01	2,762	ns
Blanchard et al. (1998)	225	1.59	1.40	385	1.89	1.64	−2.33	608	.02

[a] Two-tailed

one of the original samples (see Blanchard et al., 2006, p. 407). Therefore, the analyses presented in Table 1 were conducted on 2,764 probands, not the 3,146 in the original study.

Blanchard, Zucker, Siegelman, Dickey, and Klassen (1998)

The original study did not compare the total numbers of siblings for the homosexual and heterosexual male probands. These data were analyzed for this study and presented in Table 1.

Results

The six archival data sets yielded 40,197 firstborn heterosexual probands and 4,784 firstborn homosexual probands. The mean ages of the two groups from each study are shown in Table 2. Because the mean ages differed significantly in four of the studies, age was covaried in all comparisons concerning younger siblings.

Table 3 indicates that the fertility of the homosexual probands' mothers was less—not greater—than the fertility of the heterosexual probands' mothers. In all four of the statistically significant comparisons, the homosexual group had fewer younger siblings than the heterosexual group. It is noteworthy that the mothers of all groups represented in Table 3 reproduced at or above the population replacement rate, which is generally accepted as roughly 2.1 births per woman for industrialized countries. The least fertile mothers were the mothers of the heterosexual group from Blanchard et al. (1998), who had an average of 2.04 children (proband plus siblings).

It does not appear that between-groups differences in younger siblings for the firstborn probands (Table 3) were merely reflections of between-groups differences in total siblings for the full samples of probands (Table 1). In the full samples for Blanchard and Bogaert (1996b) and Blanchard and Lippa (2007), the homosexual groups had larger numbers of total siblings; in the firstborn subsamples from these same studies, the homosexual groups had smaller numbers of younger siblings. In the full sample for Blanchard and Bogaert (1996a), the homosexual and heterosexual groups had virtually identical numbers of total siblings; in the firstborn subsample from this study, the homosexual group had a smaller number of younger siblings than the heterosexual group.

The numbers of younger brothers and younger sisters were compared separately in additional analyses (Tables 4, 5). There was no clear-cut evidence that the smaller sibships of the homosexual probands related primarily to fewer younger brothers or younger sisters.

Discussion

The results did not support the prediction of the balancing selection hypothesis. On the contrary, the results suggest that

Table 2 Group sizes and mean ages of firstborn probands

Original study	Heterosexual group			Homosexual group			Comparison		
	n	*M*	*SD*	*n*	*M*	*SD*	*t*	*df*	*p*[a]
Blanchard and Bogaert (1996a)	1,789	28.21	10.76	354	30.31	9.75	−3.41	2,141	.001
Blanchard and Bogaert (1996b)	209	40.41	12.57	118	38.88	10.35	1.12	325	ns
Blanchard and Lippa (2007)	37,071	32.36	11.48	3,475	31.84	11.01	2.57	40,544	.01
Blanchard and Zucker (1994)	157	35.96	12.16	288	36.65	12.05	−0.58	443	ns
Blanchard et al. (2006)	844	27.68	11.26	358	37.26	11.61	−13.37	1,200	<.0001
Blanchard et al. (1998)	127	29.28	11.53	191	36.05	11.36	−5.17	316	<.0001

[a] Two-tailed

Table 3 Younger siblings of firstborn probands, comparisons controlling for proband's age

Original study	Heterosexual group		Homosexual group		ANCOVA		
	M	*SD*	*M*	*SD*	*F*	*df2*[a]	*p*[b]
Blanchard and Bogaert (1996a)	1.35	1.40	1.12	1.24	13.58	2,140	.0002
Blanchard and Bogaert (1996b)	1.71	1.34	1.39	1.14	4.63	324	.03
Blanchard and Lippa (2007)	1.33	1.15	1.22	1.08	22.04	40,543	<.0001
Blanchard and Zucker (1994)	1.13	1.33	1.24	1.54	0.72	442	ns
Blanchard et al. (2006)	1.39	1.34	1.18	1.48	15.64	1,199	.0001
Blanchard et al. (1998)	1.04	0.96	1.15	1.29	0.61	315	ns

[a] Denominator degrees of freedom. Numerator degrees of freedom for all *F* tests = 1

[b] Two-tailed

Table 4 Younger brothers of firstborn probands, comparisons controlling for proband's age

Original study	Heterosexual group		Homosexual group		ANCOVA		
	M	*SD*	*M*	*SD*	*F*	*df2*[a]	*p*[b]
Blanchard and Bogaert (1996a)	0.68	0.93	0.57	0.90	6.62	2,140	.01
Blanchard and Bogaert (1996b)	0.90	0.97	0.68	0.93	3.82	324	.05
Blanchard and Zucker (1994)	0.53	0.81	0.63	0.95	1.41	442	ns
Blanchard et al. (2006)	0.71	0.94	0.60	0.95	8.50	1,199	.004
Blanchard et al. (1998)	0.50	0.79	0.59	0.85	1.81	315	ns

[a] Denominator degrees of freedom. Numerator degrees of freedom for all *F* tests = 1

[b] Two-tailed

Table 5 Younger sisters of firstborn probands, comparisons controlling for proband's age

Original study	Heterosexual group		Homosexual group		ANCOVA		
	M	*SD*	*M*	*SD*	*F*	*df2*[a]	*p*[b]
Blanchard and Bogaert (1996a)	0.67	0.87	0.55	0.80	9.58	2,140	.002
Blanchard and Bogaert (1996b)	0.81	0.83	0.71	0.78	1.12	324	ns
Blanchard and Zucker (1994)	0.60	0.87	0.61	1.02	0.03	442	ns
Blanchard et al. (2006)	0.68	0.86	0.58	0.89	9.63	1,199	.002
Blanchard et al. (1998)	0.54	0.66	0.56	0.85	0.06	315	ns

[a] Denominator degrees of freedom. Numerator degrees of freedom for all *F* tests = 1

[b] Two-tailed

the mothers of firstborn homosexual sons produce fewer subsequent offspring than do the mothers of firstborn heterosexual sons. The results were the direct opposite of the two previous studies that used the identical experimental design (Camperio-Ciani et al., 2004; Iemmola & Camperio Ciani, 2009). It should be noted that the fertility of the primiparous mothers in these studies was strikingly lower than the fertility of the primiparous mothers in the present study. In the study by Camperio-Ciani et al. (2004, Table 2), the firstborn homosexual probands had a mean of 0.94 younger siblings and the firstborn heterosexual probands had a mean of 0.77 younger siblings. In the study by Iemmola and Camperio Ciani (2009, Table 2), the corresponding means were 0.78 and 0.54. These means were lower than all 12 of the means found in the present study (Table 3). It is unclear whether that particular difference has any theoretical significance, however, because the present findings were also in general contradiction to the several studies, mentioned in the Introduction, that investigated the collective fertility of homosexual and heterosexual probands' extended families.

What can explain the discrepancy? One possibility is that some sort of sampling bias operated to obscure the greater fertility of homosexuals' mothers in the six data sets examined here. This is certainly possible and it is difficult to refute; on the other hand, it requires the auxiliary notion that the same sampling bias operated across studies conducted in very different circumstances (e.g., face-to-face interviews, self-administered paper questionnaires handed to volunteers, an anonymous Internet survey) or else the notion that different sampling biases operated in different studies, but these biases all happened to have the same effect.

Another possibility is that the phenomenon of balancing selection is both real and reliable, but comparing mothers of firstborn homosexual and heterosexual sons is not a good way to demonstrate it. That would be the case if mothers who produce a homosexual son at their first delivery are, or include, a biologically distinct subpopulation of mothers of homosexual sons. Suppose, for example, that there exist women who repeatedly produce placentas that are unusually inefficient barriers between the maternal and fetal compartments. The relatively early and relatively strong immunization of such mothers by fetal products might increase both their probability of producing a homosexual male in their first pregnancy and their probability of miscarrying on subsequent pregnancies. Arguing against such a scenario are data indicating that the birth weights of firstborn homosexual and heterosexual men are similar (Blanchard & Ellis, 2001; see also Blanchard et al., 2002), a result which suggests nothing unusual about the gestation of firstborn homosexual men. These studies did not have especially large sample sizes, however, and they did not consider the probands' birth weights in relation to their numbers of younger siblings.

It is obvious that the apparent heritability of homosexuality, considered together with the low fertility of homosexual men, begs some kind of explanation, and the balancing selection hypothesis seems like a good one. The present study, however, shows that additional empirical demonstrations of heightened fertility in the relatives of homosexual men should be provided before the hypothesis of balancing selection is accepted as the definitive answer to the conundrum.

The finding of the present study, considered as a novel phenomenon of potential interest in its own right, should also be replicated by independent investigators before being accepted as reliable. This should not be difficult, because other researchers have analyzed family demographics in large samples of homosexual and heterosexual men, and their original data are probably available in archived computer files. Of special interest are those studies that collected data on the probands' extended families. Researchers who possess such data could compare mean numbers of younger siblings for firstborn homosexual and heterosexual probands, while covarying global measures of family fertility derived from the probands' second- and third-degree relatives on their father's side, their mother's side, or both. This could help to establish whether there is something atypical about the subsequent fertility of mothers who produce a homosexual son on their first pregnancy.

Previous research has estimated the proportion of homosexual men who owe their sexual orientation to the fraternal birth order effect at 15% in one study (Cantor, Blanchard, Paterson, & Bogaert, 2002) and 29% in another (Blanchard & Bogaert, 2004). If the "gay primogeniture effect" suggested by the present study is genuine and is also immunologic in nature, then fetal–maternal immune interactions might cumulatively account for a substantial proportion of gay men whose sexual orientations are not simply genetic in origin.

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