Birth Order and Sibling Sex Ratio in Homosexual Versus Heterosexual Males and Females

RAY BLANCHARD

During the past decade, scientists have revisited several old questions about homosexuality, for example, whether it is related to brain anatomy, and whether it is shaped by genetic or other prenatal influences (e.g., Allen & Gorski, 1992; Bailey & Pillard, 1991; Diamond & Sigmundson, 1997; Hamer, Hu, Magnuson, Hu, & Pattatucci, 1993; LeVay, 1991; Whitam, Diamond, & Martin, 1993; Zucker et al., 1996). The interpretations of the new research—in some cases, the findings themselves—remain to be verified, but the general thrust of this work is a greater emphasis on biological factors in sexual orientation. Another old question that has been reconsidered is the relation between homosexuality in adulthood and cross-gender behavior in childhood. This particular issue has now been settled, thanks to a comprehensive meta-analysis of all relevant studies in the English-language literature (Bailey & Zucker, 1995). The positive correlation between childhood cross-gender behavior and adult homosexuality is not perfect, but it is one of the strongest developmental continuities to have emerged from prospective and retrospective study in the past 40 years in any area of human behavior research (Zucker, 1987). A final question to be reopened is whether homosexuality correlates with specific aspects of family demographics, namely, birth order and sibling sex ratio. In what follows, I review the evidence that the mean birth orders or sibling sex ratios of homosexual men and women differ from those of comparable heterosexuals, touch upon some of the methodological problems and solutions in this type of research, and discuss the various theories that have been, or could be, advanced to account for the cumulative findings.

Review of the Data

Birth Order

Researchers began asking at least 60 years ago whether the mean birth order of homosexual persons is unusually early or late (e.g.,

Terman & Miles, 1936). The answer has been a long time in coming, partly because of methodological problems in the early research, and partly because this line of inquiry was pursued sporadically at best. There are now, however, sufficient data to permit some basic conclusions.

Males

Older data. In most of the earlier studies on birth order and sexual orientation, the probands' birth orders were divided into categories such as *firstborn, middle-born,* and *last-born*. The data from all such studies—with the exception of Bieber et al. (1962), which was reanalyzed from the raw data and is presented later—are summarized in Table 1.

Inspection of Table 1 shows that much of this research might be described as casual; some studies lacked control groups, others omitted statistical tests. Those studies that include control groups and statistical testing still suffer from methodological flaws: Firstly, the procedure of dividing birth orders into categories results in a significant loss of information. For example, the second of three children is placed in the same category (i.e., middle-born) as the fifth of six children. Thus, the information that one proband had three more older siblings than the other is wasted. Secondly, the statistical test usually used to analyze the data (the Pearson chi-square test) did not take into account the natural ordering of the categories *firstborn*, *middle-born*, and *last-born*, and thus had unnecessarily low statistical power. In spite of the foregoing problems, a possible trend may be discerned in Table 1. In about half of these studies a late birth order for homosexual men is suggested, whereas in none is an early birth order clearly suggested.

Slater (1958, 1962) devised a method for quantifying birth order that is much simpler, more elegant, and more efficient than that of dividing birth orders into discrete categories. His method is not the only reasonable approach to quantifying birth order, but it is still one of the more useful ones. In Slater's method, a proband's birth order is represented by a numeric value rather than a discrete category. This is computed according to the following formula:

$$\textit{Slater's Index} = \frac{\textit{older siblings}}{\textit{older siblings} + \textit{younger siblings}} .$$

Slater's Index equals the number of siblings older than the proband divided by the proband's total number of siblings. This index cannot be calculated for only children; for all other individuals, regardless of

Table 1
Studies Comparing Homosexual and Heterosexual Males on Categorical Measures of Birth Order

Authors	Description of the sample	Birth order categories	Result/conclusion
Bene (1965)	Homosexual men from "clubs" and homophile organization; heterosexual men were married hospital staff, graduate students, businessmen. Homosexuals = 83, heterosexuals = 84.	Only child, oldest child, middle child, youngest child.	No difference. Chi-square test.
Braaten & Darling (1965)	College students attending a university mental health center. Homosexuals = 76, heterosexuals = 50.	Only child, oldest child, middle child, youngest child.	Nonsignificant trend for homosexuals to be later born. Chi-square test.
Evans (1969)	Homosexual volunteers recruited through homophile organization; heterosexual volunteers for cardiac study. Homosexuals = 43, heterosexuals = 142.	Only child, oldest child, middle child, youngest child.	No difference. Statistical analyses not reported.
Jonas (1944)	Homosexual (psychiatric?) patients; heterosexual controls were convalescent surgical patients. Homosexuals = 60, heterosexuals = 60.	Only child plus youngest child, other (?)	Proportion of only-children plus youngest higher for homosexual patients. Statistical analyses not reported.
Liddicoat (1961)	Homosexual volunteers; heterosexual controls individually matched on age and education. Homosexuals = 50, heterosexuals = 50.	Only child, older or oldest child, middle child, younger or youngest.	No difference. Chi-square test.
Manosevitz (1970)	Homosexual volunteers recruited through homophile organization; heterosexual volunteers from various sources. Homosexuals = 28, heterosexuals = 22.	Not reported.	No difference. Statistical analyses not reported.

(continued on next page)

Table 1 (cont.)

Authors	Description of the sample	Birth order categories	Result/conclusion
Martensen-Larsen (1957)	Volunteers from social "clubs" for homosexuals. Homosexuals = 63, heterosexuals = 0.	Upper third of sibship, middle third of sibship, lower third of sibship.	Homosexual men tend to be born late in their sibships. No statistical tests performed.
Raboch & Raboch (1986)	"Homosexual delinquents" (intercourse with a male under age 18 or homosexual prostitution); sexually dysfunctional patients. Homosexuals = 57, heterosexuals = 600.	Only child, oldest child of two or more, middle child plus second of two children, youngest of three or more children.	Homosexuals more frequently the youngest of three or more children. Chi-square test.
Schofield (1965, p. 131)	Men who never received psychiatric treatment. Homosexuals = 50, heterosexuals = 50.	Only child; only son and youngest child; only son, not youngest child; youngest child, not only son; other.	Nonsignificant trend for homosexuals to be youngest son or only son. Statistical test not reported.
Schubert et al. (1976)	Counseling/psychotherapy patients plus 278 college freshman. Homosexuals = 86, heterosexuals = 1,063.	Only child, oldest child, middle child, youngest child.	Inconsistent results: Homosexuals most likely youngest in sibships of three, most likely oldest in sibships of four or more. Statistical test not reported.

(continued on next page)

Table 1 (cont.)

Authors	Description of the sample	Birth order categories	Result/conclusion
Stephan (1973)	Members of a homophile organization; heterosexual males in undergraduate psychology classes. Homosexuals = 88, heterosexuals = 105.	Only child plus oldest child, youngest child, all others (?)	No difference. Statistical analyses not reported.
Terman & Miles (1936, p. 246)	"Passive" homosexuals, recruited from prisoners and their contacts. Homosexuals = 70, heterosexuals = 0.	Only child, oldest child.	No difference from expected order. Authors' impression; no statistical tests performed.
Westwood (1960, p. 12)	Volunteers recruited from various sources. Homosexuals = 127, heterosexuals = 0.	Only child; only son and youngest child; only son, not youngest child; youngest child, not only son; youngest son, not only son or youngest child; other.	Only children, youngest children, and youngest sons more likely to be homosexual. No statistical analyses performed.
Whitener & Nikelly (1964)	College students presenting at a university health service, 3/4 of whom were homosexual. Homosexuals plus miscellaneous paraphilics = 39, heterosexuals = 0.	Only child, oldest child, middle child, youngest child.	Most homosexuals + paraphilics were youngest children. No statistical analyses.

sibship size, it expresses birth order as a quantity between 0 and 1, where 0 corresponds to firstborn and 1 corresponds to last-born. In a hypothetical stable population, the expected value of Slater's Index for samples drawn at random would be .50, and one could determine whether a given group's birth order is significantly early or late by comparing its mean on Slater's Index with this theoretical value.

Slater (1962) found a mean birth order index of .58 in a consecutive series of 337 homosexual male patients at London's Maudsley Hospital. This was significantly greater than the expected value of .50, indicating a birth order later than that of the general population. Slater's study was replicated by Hare and Moran (1979) in a second series of patients from the same hospital. The mean birth order of their 565 homosexual males was .55, which was again significantly later than the expected value.

Unfortunately, these large and seemingly convincing studies proved to have a methodological problem of their own. Several theorists and researchers have shown that the probabilities of ascertaining early-born, middle-born, and late-born probands are altered in complex ways when total population size or average family size or both are changing during the years in which a sample of probands is being born (Berglin, 1982; Birtchnell, 1971; Cobb, 1914; Hare & Price, 1969, 1974; Jagers, 1982; Price & Hare, 1969). For this reason, the expected value of Slater's Index may depart from .50, so that one-sample tests comparing observed data with this theoretical mean are not conclusive. Thus, the Maudsley studies, despite their superior approach to quantifying birth order, did not resolve the question of whether homosexual men tend to be born late in their sibships. It should be understood that the problem was not with Slater's measure per se, but rather with his notion that the use of this measure could allow one to dispense with empirical control groups.

For the sake of completeness, two additional studies from this generation should be mentioned. Tsoi, Kok, and Long (1977) reported a mean Slater's Index of .58 (i.e., late births) for a sample of 43 homosexual male-to-female transsexuals. These are the only published data on birth order and sexual orientation for a non-White—in this case, Asian—sample. Discrepant results were reported by Saghir and Robins (1973), who found a mean score of .49 in a sample of 62 homosexual community volunteers. This mean was not, of course, significantly different from .50. Although Saghir and Robins did have a control group of heterosexual men, they did not report Slater's Index for that group, and they do not appear to have compared the two groups with each other.

Recent data. In 1989, my colleagues and I at Toronto's Clarke Institute of Psychiatry began to re-examine the question of birth order and homosexuality in a series of studies that used heterosexual control groups as well as more powerful statistical procedures. We have now completed 10 studies on this topic, including a total of 13 male samples. For purposes of this review, two of the smaller samples, both from the same study (Blanchard, Zucker, Cohen-Kettenis, Gooren, & Bailey, 1996), have been collapsed into one. The 12 resultant samples are described in Table 2.

In order to provide an overview of this research, I have converted the birth order data for all of the samples into a common metric, namely, Slater's Index. The results are shown in Figure 1. In this figure, taller bars denote later birth orders. The results from these 12 samples show that, in every instance, the homosexual probands had a later mean birth order than the heterosexual probands.

The more than 7,000 probands in these samples were examined in four countries, over a period spanning 7 decades, with years of birth ranging from 1861 to 1989. The consistency of these findings, and the diversity of the groups in which they have been obtained, strongly reinforce the suggestive findings of the earlier research. Birth order is one of the most reliable epidemiological variables ever identified in the study of sexual orientation.

The between-groups differences depicted in Figure 1 are, in most cases, rather small in absolute magnitude. The interpretation of the actual size of the differences is unclear. It is virtually certain that it is not birth order per se that influences sexual orientation, but rather some unknown variable for which birth order is merely an observable proxy. It is possible, for example, that the variable of real importance is not maternal *parity* (the number of live-born children delivered by the proband's mother, prior to the proband), but rather maternal *gravidity* (the number of times the proband's mother was pregnant, before she became pregnant with the proband). Because we do not know how well birth order correlates with the underlying variable of interest, we cannot know whether the sizes of between-groups differences in birth order accurately reflect the sizes of between-groups differences in the underlying variable. I will return to the topic of birth order effect size later in this paper, in the context of a specific theory of the birth order phenomenon.

The data in Figure 1 underscore the warning of demographers that a theoretical mean of .50 cannot be assumed for Slater's Index. The mean score for 11 of the 12 heterosexual control groups was less than .50; in most cases, it was substantially less. This shows that a

Table 2

Studies on Birth Order and Sexual Orientation in Males, from the Clarke Research Program on Biodemographic Correlates of Sexual Orientation

Sample	Authors	Description of the sample	Number homosexual[a]	Number heterosexual[a]
1	Blanchard & Zucker (1994)	American volunteers from earlier study by Bell et al. (1981).	451	215
2	Zucker & Blanchard (1994)	American psychoanalytic patients from earlier study by Bieber et al. (1962).	85	61
3	Blanchard & Bogaert (1996a)	American volunteers interviewed by Alfred Kinsey and associates from 1938 to 1963 (see Gebhard & Johnson, 1979).	666	3,305
4	Blanchard & Bogaert (1996b)	Canadian volunteers from two groups of 302 probands originally matched on year of birth.	278	285
5	Blanchard et al. (in press)	British and American volunteers, from earlier studies by Siegelman (1972b, 1973, 1974b, 1978, 1981b).	311	188
6	Blanchard & Bogaert (1997b)	American sex offenders against adults, from earlier study by Gebhard et al. (1965).	128	156
7	Blanchard & Bogaert (1997b)	American sex offenders against pubescents, from earlier study by Gebhard et al. (1965).	59	121
8	Blanchard & Bogaert (1997b)	American sex offenders against children, from earlier study by Gebhard et al. (1965).	37	131
9	Bogaert et al. (1997)	Canadian pedophilic patients referred for assessment.	63	55
10	Blanchard & Sheridan (1992)	Canadian outpatients referred for assessment of gender dysphoria (roughly, transsexualism), matched on sibship size and decade of birth.	117	117
11	Blanchard et al. (1995)	Canadian child and adolescent outpatients, matched on age at presentation, sibship size, and year of birth.	156	156
12	Blanchard et al. (1996)	Dutch gender-dysphoric patients, adult and adolescent samples combined.	100	76

[a]Numbers of probands for whom Slater's Index could be calculated, that is, those with at least one sibling. These are the numbers of probands represented by the means in Figure 1.

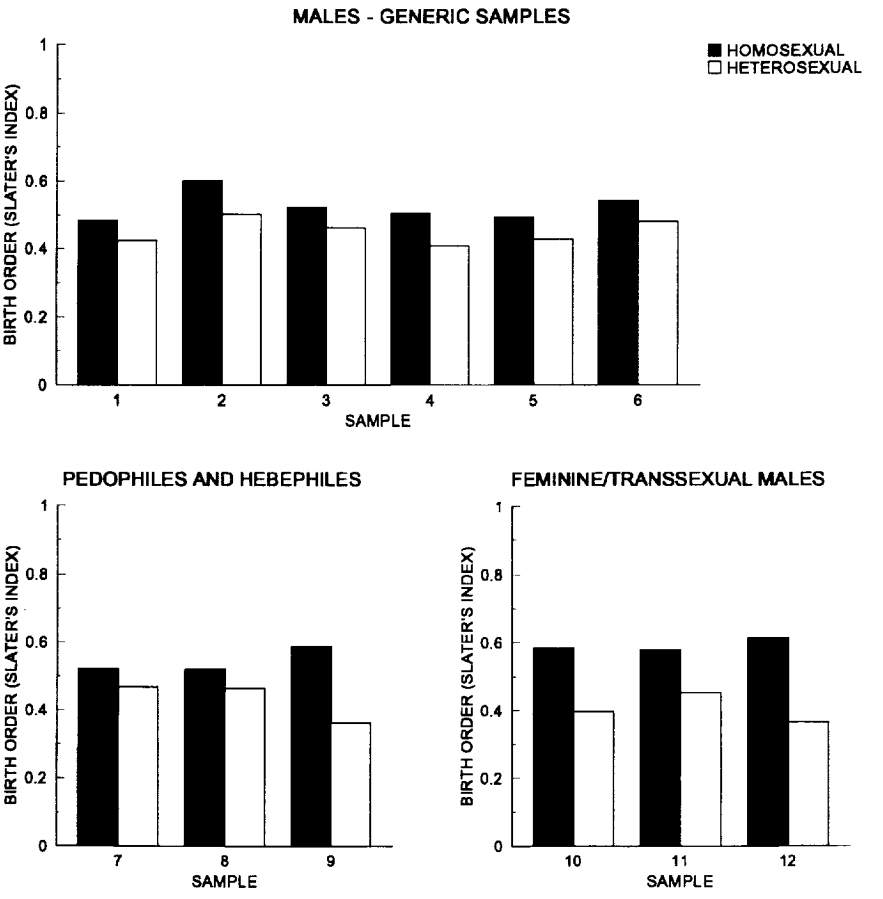

Figure 1. Mean birth orders of homosexual and heterosexual probands from studies in the Clarke research program on biodemographic correlates of sexual orientation. A brief description of the probands in each sample is given in Table 2. The black bars represent the mean birth orders for homosexual probands, and the white bars represent the mean birth orders for heterosexual probands. Taller bars denote later births.

one-sample test comparing the observed Slater's Index for a group of homosexual probands with an assumed mean of .50 for the general population might actually be too conservative. It might be noted that the caveats of demographers regarding Slater's Index (or similar measures) have all concerned shifts in the expected value produced by demographic changes. There is, in fact, another reason why one-sample tests comparing the observed mean score of homosexual men with a theoretical mean of .50 would tend to be too conservative. Assuming complete population stability regarding yearly numbers of births, average family size, and so on, the expected value of Slater's Index for a sample of *persons* selected at random would be .50, but

the expected value for a sample of *men* selected at random would be somewhat less than .50. That is because the sex ratio of human births is weakly correlated with birth order: Men tend to be born earlier in their sibships than women (Chahnazarian, 1988; James, 1987). This could also partly explain why the mean Slater's Index for almost all of our heterosexual control groups was less than .50.

Implications of the birth order phenomenon for sexological classification in males. If birth order—or some factor associated with it—is one determinant of sexual orientation, then homosexual groups that share a late birth order probably have at least one etiological factor in common. This reasoning is, of course, inferential rather than deductive. It is perfectly possible that one etiological factor produces a late birth order and homosexuality in one group; a completely different etiological factor produces a late birth order and homosexuality in a second group; and yet another, distinct etiological factor produces a late birth order and homosexuality in a third group. There is nothing in deductive logic to prohibit such a possibility. The a priori probability, however, of three completely different etiological factors, each of which—through pure coincidence—has identical effects on sexual orientation and identical effects on birth order, is rather less than the a priori probability of a single etiological factor which produces the same effects in all groups of males, regardless of their psychological or demographic differences. The birth order data, therefore, bear on the taxonomic relations of the various types of homosexual males represented in Figure 1.

The "Generic Samples" in Figure 1 are heterosexual and homosexual males selected without regard to any sexological characteristic besides sexual orientation. It can be assumed that all or virtually all of the heterosexuals were gynephiles (males with an erotic preference for physically mature women) and that all or virtually all of the homosexuals were androphiles (males with an erotic preference for physically mature men). It can also be assumed that the overwhelming majority of probands in these samples had a masculine gender identity and were contented with their male anatomic sex.

The second cluster of samples ("Pedophiles and Hebephiles") comprise males sexually attracted to physically immature partners. These may be divided roughly into those most interested in prepubescent boys and girls (homosexual and heterosexual pedophiles, respectively) and those most interested in pubescent boys and girls (homosexual and heterosexual hebephiles, respectively).

The homosexual probands in the third cluster of samples ("Feminine/Transsexual Males") include adult male patients assessed or

treated for gender dysphoria (discontent with one's biological sex) or full-blown transsexualism, as well as boys who were referred for clinical attention because of their extremely feminine behavior, and who may be assumed to be prehomosexual (see Bailey & Zucker, 1995). The heterosexual probands in these samples include male patients who were sexually attracted to women but nonetheless wished to become women themselves, and boys who were referred for clinical attention for reasons other than cross-gender identity, and who may be assumed, on the basis of population prevalence rates, to be about 98% preheterosexual (see, e.g., ACSF Investigators, 1992; Billy, Tanfer, Grady, & Klepinger, 1993; Fay, Turner, Klassen, & Gagnon, 1989; Johnson, Wadsworth, Wellings, Bradshaw, & Field, 1992).

It can be seen in Figure 1 that the feminine and transsexual homosexuals exhibit the same late birth order observed in the "generic" homosexual groups. These findings suggest some common developmental factor in homosexual transsexualism and ordinary homosexuality, despite the views of some theorists that these are etiologically distinct phenomena, and despite the subjective conviction of homosexual transsexuals that "inside" they are really heterosexual women who have nothing in common with homosexual men.

A similar result obtains for the pedophiles and hebephiles, suggesting that at least one factor that determines sexual preference in men attracted to adults also determines sexual preference in men attracted to children. This conclusion should be regarded as tentative, however, because there are three other lines of evidence that argue against it. Firstly, the prevalence of homosexuality among pedophiles is much higher than the prevalence of homosexuality among "adultophiles," suggesting that the dimensions of sex-preference and age-preference are not independent, and that pedophilia is not merely an extreme youth preference superimposed upon a (preexisting) homosexual or heterosexual sexual orientation (see Freund, 1994). Secondly, homosexual pedophiles almost never report that they sometimes acted like females, imagined themselves as females, or wished they were females during childhood; whereas a majority of androphilic men recall such behavior (e.g., Bailey & Zucker, 1995). Thirdly, pedophiles, as a group, show much more bisexuality, as assessed in the laboratory by penile responses to erotic stimuli depicting male and female targets, than do "adultophiles" (Freund & Kuban, 1993; Freund, Watson, Dickey, & Rienzo, 1991).

Because so much evidence argues that sexual preference in pedophiles is determined by factors different from those that determine sexual preference in "adultophiles," the contrary evidence

offered by the birth order findings should be confirmed by further replication studies. It should be stressed that any final conclusion that homosexual hebephilia, homosexual pedophilia, or both are etiologically related to androphilia would not imply that ordinary homosexual men (androphiles) are likely to molest boys, any more than the conclusion that heterosexual hebephilia or pedophilia are related to gynephilia would imply that ordinary heterosexual men (gynephiles) are likely to molest girls.

Fraternal versus sororal birth order.[1] Given that the existence of the birth order phenomenon appears to be established, the most basic research question that can be asked next is whether homosexual men have more older siblings of both sexes or just of one sex. The answer to this question is obviously important for theoretical interpretations of the phenomenon.

The investigation of this issue is a little more complicated than it might seem. A proband's number of older brothers and number of older sisters tend to be positively correlated. Therefore, if Proband A has more older brothers than Proband B, Proband A is also likely to have more older sisters than Proband B. Conversely, if Proband A has more older sisters, Proband A is also likely to have more older brothers. Thus, the researcher's task, in analyzing a sample in which the homosexual probands have greater mean numbers of both older brothers and older sisters, is to determine whether both results represent genuine differences between homosexual and heterosexual men, or whether one result represents a genuine difference and the second result is merely a statistical artifact of the first. In other words, one must establish whether the homosexual probands' greater mean number of older brothers "explains" their greater number of older sisters (or vice versa). This may be accomplished with multivariate statistics.

The problem of fraternal versus sororal birth order was investigated by Blanchard and Bogaert (1996b). The probands in this study were volunteers recruited in southern Ontario in 1994-1995. These

[1]The results of the following research suggested the need for some additional terminology for discussing birth order and sexual orientation. I accordingly coined the terms *fraternal birth order* to denote a proband's birth order among his brothers, *sororal birth order* to denote a proband's birth order among his sisters, and *global birth order* to denote birth order among all his siblings. I have continued to use the familiar terms *older* and *younger siblings* to denote siblings born before and after the proband. I should perhaps have called them *prior-born* and *later-born siblings* in my research, because I have always included in the former siblings who died immediately after birth and who therefore may never have been "older" than the proband, in the sense of achieved age. Other researchers might wish to choose precision over economy of expression and use the *prior-born/later-born* terminology.

comprised 302 homosexual men individually matched on year of birth with 302 heterosexual men. Logistic regression analysis showed that homosexuality was positively correlated with the proband's number of older brothers, but not with older sisters, younger brothers, younger sisters, or parental age at the time of the proband's birth. Each additional older brother increased the odds of homosexuality by 33%.

The finding of Blanchard and Bogaert (1996b) was subsequently confirmed in individual studies by Blanchard and Bogaert (1996a), Blanchard and Bogaert (1997b), Blanchard, Zucker, Siegelman, Dickey, and Klassen (in press), and Bogaert, Bezeau, Kuban, and Blanchard (1997). This finding was also confirmed in a study by Jones and Blanchard (1997), in which all of the samples from Table 2 except the pedophiles and hebephiles were combined, and in which a radically different statistical approach developed specifically for this purpose was used. In brief, Jones and Blanchard derived two theoretical equations for predicting a proband's birth order among his sisters from his observed birth order among his brothers. The first equation applies if sisters have no direct relation to a proband's sexual orientation but brothers do; the second applies if sisters have the same relation to a proband's sexual orientation as do brothers (including no relation). Comparisons with the empirical data showed that the first equation held for homosexual men and the second for heterosexual men.

In summary, the answer to the question posed at the beginning of this section is that homosexual men have a greater number of older brothers than do heterosexual men, but they do not have a greater number of older sisters, once the number of older brothers has been taken into account. This result restricts the range of possible theories of the birth order phenomenon to those that can explain not only why older brothers increase the probability of homosexuality in later-born males but also why older sisters neither enhance this effect nor counteract it.

Females

Older data. As is true in other areas of sexual orientation research, fewer data are available on birth order and homosexuality in women than in men. Summarized in Table 3 are studies in which the probands' birth orders were divided into categories. The results are contradictory, with both early and late births for homosexual women reported.

Table 3

Studies Comparing Homosexual and Heterosexual Females on Categorical Measures of Birth Order

Authors	Description of the sample	Birth order categories	Result/ conclusion
Gundlach & Riess (1967)	"Nation-wide sample of middle-class Lesbians and comparable non-Lesbians." Homosexuals = 217, heterosexuals = 231.	Only child, oldest of 2-4 siblings, youngest of 2-4 siblings, 1st-4th of 5-7 siblings, 5th-7th of 5-7 siblings.	Inconsistent results: Homosexual women more often are only children, early-born in small families, or later-born in large families. No statistical tests.
Kenyon (1968)	Homosexual women recruited through a homophile organization; heterosexual women recruited through an organization for married women. Homosexuals = 123, heterosexuals = 123.	Oldest child, second child, youngest child, other.	No difference. Chi-square test.
Liddicoat (1961)	Homosexual volunteers; heterosexual controls individually matched on age and education. Homosexuals = 50, heterosexuals = 49.	Only child, older or oldest child, middle child, younger or youngest.	Homosexual women more likely to be younger or youngest. Chi-square test.
Martensen-Larsen (1957)	Volunteers from social "clubs" for homosexuals. Homosexuals = 44, heterosexuals = 0.	Upper third of sibship, middle third of sibship, lower third of sibship.	Homosexual women come from upper or lower part of sibship rather than middle. No statistical tests performed.
Wolff (1971, p. 204)	Homosexual volunteers recruited through homophile organization; heterosexual controls from similar socioeconomic backgrounds. Homosexuals = 108, heterosexuals = 123.	Only child, illegitimate child, oldest child, second child, third child, fourth child, fifth child, youngest child.	Homosexual women more often only children or older children. Chi-square test.

A similar number of older studies, analyzed (or reanalyzed) with Slater's method, show equally scattered results. Slater (1962) found a mean birth order index of .63 (i.e., late births) in a series of 32 homosexual female patients at the Maudsley Hospital; he did not report whether the observed departure from .50 was statistically significant. In contrast, Saghir and Robins (1973) obtained a mean score of .43 (i.e., early births) for their sample of 38 homosexual volunteers; this mean did not differ significantly from the theoretical value of .50. A value very close to the theoretical mean (.51) was observed by Hare and Moran (1979) in a second series of 77 homosexual female patients at the Maudsley Hospital; this value was not, of course, statistically significant.

Several years ago I reanalyzed the family-demographic data for the female participants in Bell, Weinberg, and Hammersmith's (1981) large-scale study of male and female homosexuality. The results, which I have never previously published, showed that the 164 White homosexual women with at least one sibling had a mean Slater's Index of .54 (SD = .45), and the 87 White heterosexual women had a mean of .46 (SD = .42). The difference between the groups was not statistically significant. The mean Slater's index for the 51 Black homosexual women (with at least one sibling) was .53 (SD = .41), and that for the 36 Black heterosexual women was .50 (SD = .40). Again, the difference was not statistically significant.

Recent data. It is possible that the foregoing studies failed to uncover any consistent trend toward early or late births for homosexual women because their birth order measures were too crude or their samples too heterogeneous. Two specific possibilities appear likely: (a) Perhaps homosexual and heterosexual women differ only in fraternal or only in sororal birth order, and this difference is obscured in studies that simply examine global birth order. (b) Perhaps only the most masculine homosexual women—those furthest removed from heterosexual women behaviorally and psychologically—differ from the latter in mean birth order. Two recent studies bear on each of these questions.

Bogaert (in press) reanalyzed the birth order data for 257 homosexual and 5,008 heterosexual women interviewed by Kinsey and his associates from 1938 to 1963 (see Gebhard & Johnson, 1979). The measure of global birth order in this study was a variant of Slater's Index devised by Berglin (1982):

$$\textit{Berglin's Index} = \frac{\textit{older siblings} + .5}{\textit{older siblings} + \textit{younger siblings} + 1}.$$

Separate measures of fraternal and sororal birth order were derived from this index:

$$fraternal\ index = \frac{older\ brothers + .5}{older\ brothers + younger\ brothers + 1},$$

$$sororal\ index = \frac{older\ sisters + .5}{older\ sisters + younger\ sisters + 1}.$$

The advantage of using these indices (rather than Slater's Index and its analogous derivatives) is that these indices can be calculated for probands with no siblings, or no brothers, or no sisters. Therefore, between-groups comparisons on global, fraternal, and sororal birth order can all be carried out on one's entire sample (and the statistical tests will have the same degrees of freedom).

Bogaert (in press) found no difference between homosexual and heterosexual women on any of the three birth order measures. These results are particularly noteworthy because of the large size of the sample.

Similar results were obtained by Blanchard et al. (in press) in their reanalysis of data collected by Siegelman (1972a, 1973, 1974a, 1979, 1981a; see also Table 2). In this study, we carried out a logistic regression analysis, identical to the one already described for males, on 162 homosexual and 192 heterosexual women. Sexual orientation was not related to the proband's number of older brothers, older sisters, younger brothers, or younger sisters. In summary, the findings of Bogaert (in press) and Blanchard et al. (in press) indicate that the absence of a consistent trend, in the previous studies, toward early or late births for homosexual women did not result from a failure to investigate fraternal and sororal birth order separately.

The second question was whether significantly early or late birth orders would be observed in the most masculine homosexual females. One recent study bearing on this question was conducted by Zucker, Lightbody, Pecore, Bradley, and Blanchard (in press). The subjects in this study were 22 girls referred for clinical evaluation because of their extreme cross-gender (i.e., masculine) behavior. It is likely that all or most of them were prehomosexual (see Bailey & Zucker, 1995). The controls were 147 girls referred for other clinical problems, group-matched to the prehomosexual girls on age at assessment and number of siblings. The mean Slater's Index of the prehomosexual girls was .27 (i.e., early births), and that of the controls was .48; this difference was statistically significant. The groups were also com-

pared on fraternal and sororal birth order indices derived from Slater's Index. The results indicated that the prehomosexual girls in this sample were born early relative to their sisters but not to their brothers.

Different results were produced by a much larger study (Blanchard & Sheridan, 1992; see also Table 2). In this study, the mean Slater's Index of 117 extremely masculine, gender-dysphoric homosexual females was .49, very close to the theoretical mean for the general population. There is, therefore, no reason to believe that unusually early or late birth orders would be reliably observed in homogeneous samples of highly masculine homosexual women.

Summary and conclusions. The data for females, no matter how they are analyzed, reveal no consistent tendency toward early or late births in homosexual women. In several studies, including the largest available, no difference in mean birth order between homosexual and heterosexual women has been found; the number of studies in which an early birth order for homosexual women has been found is roughly equal to the number in which a late one has been found.

The research on females, considered together with the research on males, indicates that the relation between birth order and sexual orientation pertains only to males. Females do not influence their siblings' sexual orientation, and their siblings do not influence theirs.

Sibling Sex Ratio

Research on the sex ratio of the siblings of homosexual men began around the same time as research on the birth order of homosexual men (e.g., Lang, 1936). Until recently, the two lines of investigation were pursued rather independently, with many authors analyzing only one or the other of these variables. As one might expect, the two research areas developed somewhat differently. The statistical techniques traditionally used to analyze sex ratio data are very different from those used to analyze birth order data. The former were perfected and standardized early on; the latter have not been standardized yet. Early sibling sex ratio studies were also more advanced than early birth order studies in regard to sample size; in some of the early sibling sex ratio studies remarkably large groups of homosexual probands were examined.

The variable, *sibling sex ratio*, is most commonly expressed as the ratio of brothers to sisters collectively reported by a given group of probands. In White populations, the ratio of male live births to female live births is close to 106:100 (Chahnazarian, 1988; James, 1987). The ratio of brothers to sisters reported by any group of

probands drawn at random from the general population should therefore approach 106 brothers per 100 sisters. In the computation of inferential statistics, this value is more conveniently expressed as the proportion of brothers rather than the ratio of brothers to sisters, that is, .5146 (106/206). It should be noted that the calculation of the sibling sex ratio of an empirical sample, whether expressed as a ratio or as a proportion, does not include the proband.

It is important to be clear on the distinction between sibling sex ratio and fraternal birth order. *Sibling sex ratio* concerns a proband's number of brothers compared with the number of sisters; *fraternal birth order* concerns the number of older brothers compared with the number of younger brothers. The two parameters can vary independently. A proband who has a low fraternal birth order (e.g., no older brothers and two younger brothers) might have either a high sibling sex ratio (no sisters) or a low sibling sex ratio (five sisters).

In all types of research concerning the sex ratio at birth—usually called the *secondary* sex ratio, to distinguish it from the sex ratio at conception, or *primary* sex ratio—it is customary to compare the observed sex ratio with the expected value (.5146), using a one-sample statistical test. Because sample sizes are usually too large to make the binomial test practical, this is typically accomplished with the z approximation to the binomial test. Although this test is more powerful than a two-sample test comparing the sex ratio of a study group with the sex ratio of an empirical control group meant to represent the general population, it still requires very large samples to achieve a reasonable probability of detecting a true difference from the expected value of .5146 (see, e.g., Moore & Gledhill, 1988; Suarez & Przybeck, 1980). For this reason, small-scale investigations of sibling sex ratio and sexual orientation are of little value, and such investigations are not included in the review that follows.

Males

Older data. Four previous investigators studied the sibling sex ratio of homosexual men with sample sizes large enough to detect a gross—although not necessarily a subtle—departure from the expected value. Lang (1940) published data on men registered as homosexual by the Hamburg and Munich police departments; he collected further cases after his 1940 article and presented the entire material in summary form in a subsequent publication (Lang, 1960). Lang's combined samples consisted of 1,777 homosexual male probands; these reported 2,878 brothers and 2,287 sisters, yielding a

sibling sex ratio of 126 (males per 100 females). This was significantly higher than the expected ratio of 106.

Early attempts to replicate Lang's work produced variable results. Jensch (1941a, 1941b) similarly studied men registered as homosexual by the police in Breslau and Leipzig. His material included 2,072 probands, who reported 3,794 brothers and 3,333 sisters. The sibling sex ratio of Jensch's cases, 114, was markedly lower than Lang's, but it was still statistically significant because of his very large sample size.

Kallmann (1952) collected data on the siblings of single-born homosexual males and homosexual twins. The combined material consisted of 197 probands, who reported 367 brothers and 291 sisters. The combined sex ratio, 126, is significantly higher than the expected value. His probands, who were sketchily described, included psychiatric inpatients and incarcerated criminals.

A finding similar to that of Jensch (1941b) was obtained by Slater (1958). His 286 male probands were psychiatric inpatients and outpatients diagnosed as homosexual. The patients had 362 brothers and 325 sisters, yielding a sex ratio of 111. This is close to the expected value of 106 in absolute terms, and it did not differ significantly from it.

The variability of the foregoing findings is slightly puzzling, given the large sizes of the samples studied. One possible explanation is that the main types of homosexual men (generic/androphilic, feminine/transsexual, and pedo/hebephilic) differ in regard to sibling sex ratio, and that the samples in these studies differed, from one to another, in their proportions of the three main types. The latter point is certainly plausible, because the probands in the early studies were poorly described, according to current standards of sexology research.

Recent data. Sibling sex ratio has been routinely examined in all of the Clarke studies on biodemographic correlates of sexual orientation. These studies offer the advantage that the gender identity and partner-age preferences of the homosexual samples are either known or can be inferred with greater certainty than in the older samples. The results of our research are summarized in Table 4. It should be noted that this table includes one study not in Table 2, namely, that of Zucker et al. (1997). This is a study of 444 probably prehomosexual feminine boys who were either patients of the authors of the study or else were patients described in the English language case report literature from 1938-1995. This study does not include a comparison group of preheterosexual boys.

Table 4

Studies on Sibling Sex Ratio and Sexual Orientation in Males, from the Clarke Research Program on Biodemographic Correlates of Sexual Orientation

Authors	Homosexuals				Heterosexuals			
	Probands	Brothers	Sisters	Ratio	Probands	Brothers	Sisters	Ratio
Blanchard & Zucker (1994)	575	583	561		284	283	269	
Zucker & Blanchard (1994)	106	86	88		100	83	67	
Blanchard & Bogaert (1996a)	841	1,027	927		4,092	4,669	4,486	
Blanchard & Bogaert (1996b)	302	376	359		434	496	481	
Blanchard et al. (in press)	385	390	338		225	167	190	
Blanchard & Bogaert (1997b) Adultophiles	156	201	200		173	339	321	
Generic Samples Combined	2,365	2,663	2,473	108	5,308	6,037	5,814	104
Blanchard & Bogaert (1997b) Hebephiles	69	128	134		127	324	270	
Blanchard & Bogaert (1997b) Pedophiles	42	78	66		143	301	311	
Bogaert et al. (1997)	68	85	97		57	82	99	
Pedo/Hebephilic Samples Combined	179	291	297	98	327	707	680	104
Blanchard & Sheridan (1992)	193	353	270		273	337	288	
Blanchard et al. (1995)	156	149	106		156	130	125	
Blanchard et al. (1996)	104	161	114		79	108	87	
Zucker et al. (1997)	444	316	241					
Feminine/Transsexual Samples Combined	896	979	731	134*	508	575	500	115

* $p < .0001$, two-tailed. All other $ps > .15$.

In Table 4, our various samples of probands have been organized into six clusters: generic homosexuals, generic heterosexuals, pedo- and hebephilic homosexuals, pedo- and hebephilic heterosexuals, feminine and transsexual homosexuals, and heterosexual controls for feminine/transsexual homosexuals. As previously noted, the last cluster includes male patients who were sexually attracted to women but nonetheless wished to become women themselves, and boys who were referred for clinical attention for reasons other than cross-gender identity, and who may be assumed to be preheterosexual. These con-

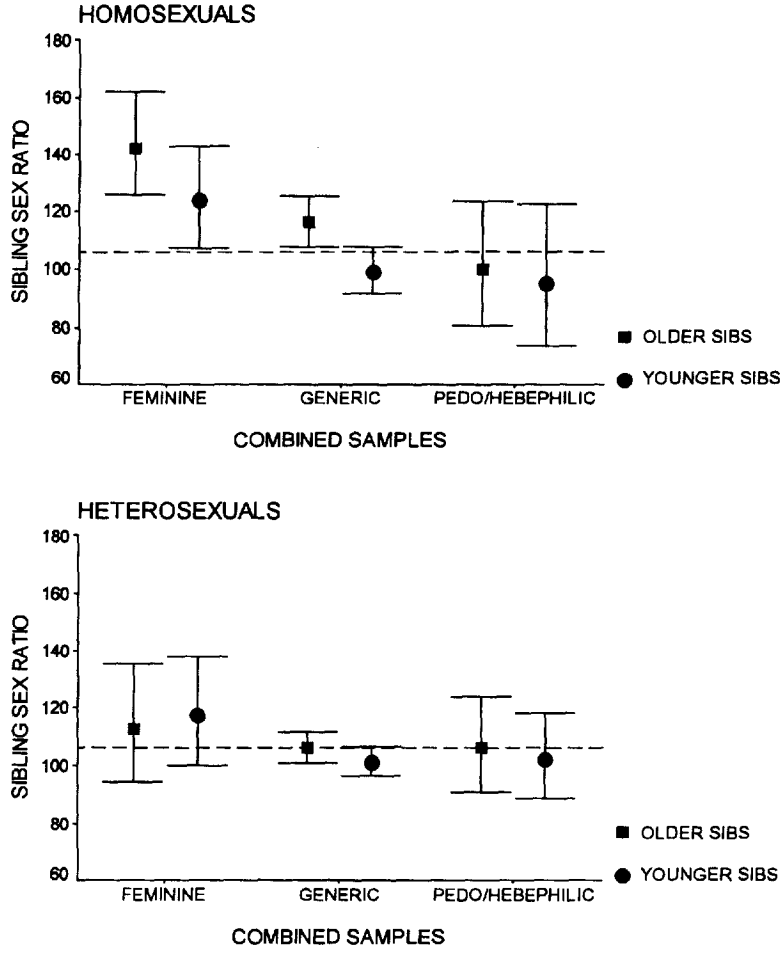

Figure 2. Sex ratios of siblings older than the proband and sex ratios of siblings younger than the proband. The observed sex ratios of older siblings are indicated by black squares; those of younger siblings are indicated by black circles. Each observed ratio is bracketed by a 95% confidence interval. The dashed horizontal reference line represents the expected secondary sex ratio of 106 brothers per 100 sisters.

trols are, therefore, not a homogeneous diagnostic group. The sibling sex ratios presented in Table 4 were based on all the probands from each study—not, in those studies where subsamples were used (Blanchard & Bogaert, 1996b; Blanchard & Sheridan, 1992), on the subsamples.

As shown in Table 4, I computed one sibling sex ratio for each cluster, based on the total numbers of brothers and sisters reported by the probands in that cluster. Only one of the sibling sex ratios differed significantly from the population value of 106: The sibships of the feminine/transsexual homosexuals contained a much higher than expected proportion of brothers.

The data presented in Table 4 reinforce the conclusion, first suggested by Blanchard, Zucker, Bradley, and Hume (1995), that high sibling sex ratios are specific to extremely feminine homosexual male samples. This is consistent with an earlier finding from Jensch (1941b). He examined a selected subsample of 244 highly effeminate homosexuals; the sex ratio of their siblings, 157, was strikingly higher than that of his unselected homosexual probands (114).

The pattern of results in Table 4 suggests that the high sibling sex ratios sometimes observed in earlier samples may have resulted from an admixture of feminine cases in them. The studies by Lang (1940, 1960) and Jensch (1941a, 1941b) illustrate this possibility. Suarez and Przybeck (1980) speculated that the German police may have been more likely to register certain types of homosexuals than others. It is reasonable to suppose that extremely feminine homosexual men would have been more likely to be detected and registered by the police than would masculine homosexual men.

Sex ratios of older and younger siblings. The sibling sex ratios of the feminine/transsexual and generic homosexual samples raise two further questions. First, does the high sibling sex ratio of the feminine/transsexual homosexuals merely reflect a large excess of older brothers? In other words, does the high sibling sex ratio of the feminine/transsexual homosexuals reflect nothing more than a fraternal birth order *dosage effect*? Or does this result suggest another, quite different factor that differentiates the feminine/transsexual from the generic homosexuals? Second, if homosexual men have reliably more older brothers than do heterosexual men, how do the generic homosexual samples end up with almost the same sibling sex ratio (108) as the generic heterosexual samples (104)? These two questions are addressed by the analysis presented in Figure 2.

This figure represents a further analysis of the data presented in Table 4. It shows, for each cluster, the sex ratio of siblings older than

the proband and the sex ratio of siblings younger than the proband. The observed sex ratios are indicated by black circles or squares; each is bracketed by a 95% confidence interval, whose upper and lower limits were computed with the formula,

$$P \pm 1.96\sqrt{\frac{PQ}{N}},$$

where P is the observed proportion of brothers, Q is the observed proportion of sisters, N is the total number of brothers plus sisters, and 1.96 is the z value for a 95% confidence interval. The confidence intervals were computed for proportions, then converted to ratios for plotting in Figure 2.

The dashed horizontal line in Figure 2 represents the secondary sex ratio of 106 brothers per 100 sisters. Thus, an observed sex ratio whose confidence interval crosses this line does not differ from the expected value, and an observed sex ratio whose confidence interval lies completely above the line is significantly higher than the expected value.

The results suggest that the high sibling sex ratio of the feminine/transsexual homosexuals does not merely reflect a large excess of older brothers. These probands also had a greater than expected number of younger brothers, relative to their number of younger sisters. It is, moreover, not likely that the high sex ratio of the younger siblings can be completely explained by the high sex ratio of the older siblings. It is true that the sex ratio of the existing children in a family correlates positively with the sex ratio of children born subsequently (James, 1975). The statistical relationship is small, however, and it does not appear capable of accounting for the sex ratio of the younger siblings in this instance. It therefore seems that the high sibling sex ratio of feminine/transsexual homosexuals is not merely an alternative "view" of their high fraternal birth order, but rather a separate phenomenon requiring its own explanation.

The second question posed above—why the sibling sex ratio of the generic homosexual samples is not higher than it is—is even more clearly answered by Figure 2. The sex ratio of the older siblings is, in fact, significantly higher than the expected value—a result that likely *is* just an alternative view of the fraternal birth order phenomenon. The high sex ratio of the older siblings, however, is counterbalanced by a low sex ratio for the younger siblings, so that the overall sex ratio comes out quite close to the expected value of 106. Why the sex ratio of the younger siblings should drop below 106 is, of course, a

Table 5
Studies on Sibling Sex Ratio and Sexual Orientation in Females

	Homosexuals				Heterosexuals			
Authors	Probands	Brothers	Sisters	Ratio	Probands	Brothers	Sisters	Ratio
Blanchard (unpublished analysis of data on White females from Bell et al., 1981)	229	205	178	115	101	110	102	108
Blanchard & Sheridan (1992)	204	275	289	95				
Blanchard et al. (in press)	162	147	121	121	192	167	177	94
Bogaert (in press)	257	285	293	97	5,008	5,766	5,430	106
Lang (1960)	150	76	101	75*				

* $p < .03$, two-tailed. All other ps > .20.

separate question. It may reflect the operation of stoppage rules whereby parents discontinue procreation after achieving some ideal balance of sons and daughters. This notion cannot be pursued here. The effect of stoppage rules on the sex ratios of completed families is a difficult and technical subject that lies beyond the scope of this paper (see, e.g., Crouchley, Davies, & Pickles, 1984; Goodman, 1961; Yamaguchi, 1989).

Sex ratios of half-siblings. Lang (1960) reported that in his own data and in those of Jensch (1941b), the sex ratios of the maternal half-siblings of homosexual probands were low and the sex ratios of paternal half-siblings were high. James (1971) explained this as a possible result of remarriage and child-custody patterns. This result has not, in any event, been confirmed; therefore it may have been a spurious finding.

Females

Summarized in Table 5 are the largest published studies on sibling sex ratio and sexual orientation in females. In only one study (Lang, 1960) did the observed sibling sex ratio differ from the expected value. The probands in this sample were women who had presented at an outpatient clinic complaining of ego-dystonic homosexuality. Their observed sibling sex ratio was significantly lower than 106. This result is not confirmed by the other homosexual samples, however, two of which had sibling sex ratios that were (nonsignificantly) higher than 106. In brief, there is simply not enough evidence at this

time to justify any conclusion about the sibling sex ratio of homosexual women.

Theories

Explanations of the Birth Order Data

Both psychosocial and biological explanations for the late birth order of homosexual men have been proposed. Little work has been done to develop, and almost none to substantiate, these theories, perhaps because empirical research on the phenomenon itself has so long been neglected.

Psychosocial Explanations

The earlier psychosocial theories were formulated at a time when homosexuality was generally considered a personality disorder by mental health professionals, and they tend to reflect that assumption. Most of these theories were based on psychological clichés about homosexuality from the 1940s and 1950s.

Several authors have advanced psychological explanations of the birth order phenomenon based on the notion that male homosexuality can be caused by an overly protective, possessive, or intimate mother. This view proposes that late-born sons are more prone to develop homosexually because they are more likely to elicit overly protective or possessive maternal behavior (Jonas, 1944; Marmor, 1965; West, 1977; Westwood, 1960). This explanation is implausible, because the available evidence indicates that later-born children receive, if anything, less maternal attention than their earlier-born siblings (see Blanchard et al., 1996).

Other psychological explanations of the birth order effect have been offered. Marmor (1965) remarked that later-born children are more apt to develop feelings of inadequacy in relation to older siblings, implying that feelings of inadequacy are a predisposing factor for male homosexuality. A similar view was expressed by van den Aardweg (1986), who stressed the pathogenic effects of unfavorable self-comparisons with older brothers. The more older brothers there are, the more likely are negative self-concepts to develop. The notion that feelings of inadequacy may lead to homosexuality will likely strike many contemporary readers as a curious one. It is possible that the clinicians who held this view had confused cause and effect. Perhaps their patients did not become homosexual because they felt inadequate; rather, they felt inadequate because they were homosexuals in a society that devalued them.

Nash and Hayes (1965) suggested two separate explanations. The first is that the development of heterosexuality depends upon a boy's identification with his father during his preschool years. With the birth of each son, the father has less attention for each; therefore his influence on his late-born sons is attenuated. The second explanation is that parents, especially mothers, disappointed in their desire for a girl by a succession of boys, might treat one of the late-born boys as a girl. A hypothesis similar to Nash and Hayes' (1965) second explanation was framed by Money (1970), who conjectured that an effeminate gender identity may develop more easily in boys whose families have a shortage of sisters and daughters. Presumably this identity would develop in response to the family's perceived desire for a girl. This hypothesis predicts that homosexual men should show a deficiency of older sisters as well as an excess of older brothers. That prediction is not supported by the available data (e.g., Blanchard & Bogaert, 1996a, 1996b).

More recent theorists have advanced psychological explanations of the birth order phenomenon that do not imply homosexuality is akin to personality disorder. The explanation advanced by Bem (1996) is—except for the implication of psychopathology—rather similar to that of van den Aardweg (1986). On this view, feminine (or perhaps just nonmasculine) boys feel they are different from other, more masculine boys; these feelings of differentness lead to the eroticization of other males (i.e., homosexuality). The more older brothers a boy has, the more likely he is to develop a sense of being different from other males. Bem's theory is meant to explain sexual orientation in the same way for both males and females, and it therefore predicts that homosexual women will have more older sisters than heterosexual women. This, as shown earlier, is not true. Therefore, Bem's theory would require some auxiliary hypothesis to explain the absence of a late sororal birth order in homosexual women.

Sulloway (1996, pp. 433-434, 488) hypothesized that the birth order phenomenon reflects later-borns' greater openness to experience, which makes them more likely to experiment sexually. This theory might explain increased rates of homosexual experimentation, but it cannot explain an increased prevalence of homosexual orientation, unless one assumes that exposure to homosexual intercourse, like exposure to an addictive drug, can implant a permanent desire in persons who otherwise would never have experienced a specific craving for it. This seems improbable. Wellings, Field, Johnson, and Wadsworth (1994, pp. 204-206) found that men who had attended all-male boarding schools were more likely than men who had not

attended such schools to report some homosexual experience, but there was no difference between these groups in the amount of homosexual experience in later life. This suggests that homosexual sex-play in childhood is not an important determinant of sexual orientation in adulthood.

Biological Explanations

There are few biological explanations of the birth order effect per se. Most of the biological theories that have been, or might be, advanced to explain this phenomenon require the presupposition that birth order is really a proxy for some other variable, namely, paternal age, maternal age, or birth interval. They then proceed to explain the relation between sexual orientation and these other variables.

Genetic hypotheses. A proband's birth order naturally correlates with the age of his parents at the time of his birth. This raises the possibility that the seeming association of birth order and sexual orientation is merely a statistical artifact arising from the correlation of both with parental age, and that the important connection is between parental age and sexual orientation. A genetic explanation along these lines was suggested by Raschka (1995), who argued that a higher paternal age might reflect an increased mutation rate in the spermatogenesis of older fathers. This view implies that male homosexuality is, at least in some instances, the result of a genetic mutation.

Whatever the merits of Raschka's (1995) hypothesis, it cannot be used to explain the birth order phenomenon. Multivariate analysis has shown that the correlation between birth order and sexual orientation remains after one controls for paternal age (Blanchard & Bogaert, 1996b). We have not ruled out the possibility that paternal age makes some separate (and smaller) contribution to sexual orientation, but we have ruled out the possibility that the birth order phenomenon is merely a statistical artifact of paternal age.

Another hypothesis involving paternal age and genetic factors was suggested by Abe and Moran (1969), who noted the possibility that in both fathers and sons there is a genetic predisposition to "sexual deviance," manifesting in the fathers as a tendency to marriage at a later age than the norm. It might seem, at a casual reading, that this hypothesis could also be used to explain the birth order phenomenon, but further consideration shows that that is not the case. In the (most unlikely) event that this hypothesis were true, homosexual men would have older fathers than heterosexual men but the same mean birth order.

Endocrinologic hypotheses. Martin and Gugelchuk (1997), arguing from the premise that maternal age rather than birth order is the true correlate of sexual orientation, proposed that maternal age-related changes in androgenic, estrogenic, and progestin balance might result in higher rates of homosexuality in boys born toward the end of their sibships. The main problem with this explanation of the birth order phenomenon is that its initial premise is incorrect. The correlation between birth order and sexual orientation remains after one controls for maternal age (Blanchard & Bogaert, 1996b; see also Blanchard & Bogaert, 1997c), whereas there is no evidence of a difference in mean maternal age between homosexual and heterosexual men, with or without controlling for birth order (Abe & Moran, 1969; Blanchard & Bogaert, 1996a; Blanchard & Zucker, 1994; Hare & Moran, 1979).

A very different type of hormonal hypothesis was suggested by Blanchard et al. (1995). Theirs is the only explanation of the birth order phenomenon—biological or psychosocial—that has ever been subjected to a formal empirical test. Blanchard et al. (1995) suggested that one possible explanation for the correlation between birth order and sexual orientation relates to findings by Maccoby, Doering, Jacklin, and Kraemer (1979). Maccoby et al. assayed sex hormones in samples of umbilical cord blood from human newborns. They found that later-born males have lower levels of testosterone, estradiol, and progesterone than firstborn males. The finding that testosterone levels in cord blood decrease in later-born males, in combination with the finding that rates of homosexuality increase in later-born males, seems to support the theory that male homosexuality results from an insufficiency of fetal androgen (Dörner, 1972; Dörner, Rohde, Stahl, Krell, & Masius, 1975).

In a finer grained analysis of their data, Maccoby et al. (1979) showed that the apparent effect of birth order on hormone levels was really an effect of birth *interval*. They found that later-born males who are closely spaced in relation to their next-older siblings have lower concentrations of hormones; whereas infants born 4 or more years after their next-older siblings have hormone levels equal to, or higher than, those of firstborns.

The findings of Maccoby et al. (1979) suggest that the apparent effect of birth order on male sexual orientation may also really be an effect of birth interval, and that the increased prevalence of homosexuality in later-born males is completely attributable to those individuals with short birth intervals and attendant low fetal hormone levels. If this hypothesis is correct, then one should find that homo-

sexual men are, on average, born a shorter time after their next-older siblings than are heterosexual men. Blanchard and Bogaert (1997d) tested this prediction. They focused their investigation on *closed* birth intervals, that is, birth intervals beginning with the birth of one child and ending with the birth of another—in this case, a male proband of known sexual orientation.

The results were that the mean birth intervals preceding heterosexual and homosexual males are virtually identical. There was, therefore, no support for Blanchard et al.'s (1995) hypothesis that the correlation of cord blood hormone levels and birth interval reported by Maccoby et al. (1979) is related to the development of sexual orientation. In summary, the effect of birth order on male sexual orientation is not merely a disguised effect of birth interval.

Immunologic hypotheses. Two immunologic hypotheses have been offered to explain the late fraternal birth order of homosexual men. These are the only biological explanations of the birth order phenomenon that attempt to explain it directly, rather than in terms of parental age or birth interval.

Because of the finding that older sisters have no influence on the sexual orientation of later-born males, Blanchard and Bogaert (1996b) conjectured that male homosexuality may result from a maternal immune reaction, which is provoked only by male fetuses, and which becomes stronger after each pregnancy with a male fetus. Their hypothesis was based partly on the argument that a woman's immune system would appear the biological system most capable of "remembering" the number of male (but not female) fetuses that she has previously carried and of progressively altering its response to the next fetus according to the current tally of preceding males. It should be stressed that Blanchard and Bogaert (1996b) did not hypothesize that maternal immune reactions are the only, or the most important, cause of homosexuality in men.

MacCulloch and Waddington (1981), the first authors to propose a maternal immune hypothesis of homosexuality, suggested that the relevant fetal antigen is testosterone. They speculated that antibodies to testosterone, produced by a woman pregnant with a male fetus and passed through the placenta from the mother to the fetus, could reduce the hormone's biological activity and thus compromise the sexual differentiation of the fetal brain.

MacCulloch and Waddington's (1981) candidate for the immunizing agent seems unlikely because steroid hormones are not ordinarily antigenic. Therefore, Blanchard and Bogaert (1996b) theorized that the relevant fetal antigen might be one of the male-specific, Y-linked,

minor histocompatibility antigens, often referred to collectively as H-Y antigen (for a review, see Müller, 1996). H-Y antigen almost certainly has some role or roles in the sexual differentiation of vertebrates (Wachtel, 1983) because it is usually present in the heterogametic and absent in the homogametic sex—in mammals, present in males and absent in females—and because it has been highly conserved throughout vertebrate evolution (Nakamura, Wachtel, Lance, & Beçak, 1987; Wachtel, Koo, & Boyse, 1975). Various lines of indirect evidence supporting the hypothesis that maternal antibodies to H-Y might influence sexual orientation have been summarized by Blanchard and Klassen (1997). Such evidence includes, for example, the finding that male mice whose mothers were immunized to H-Y prior to pregnancy are much less likely to mate successfully with receptive females (Singh & Verma, 1987).

The maternal immune hypothesis does not predict a high mean birth order for homosexual females, because female fetuses do not produce H-Y antigen, and they would not be targets of H-Y antibodies. Thus, the epidemiology of female homosexuality is critical for the maternal immune hypothesis of male homosexuality: A finding that homosexual females also have a high mean birth order would effectively refute this hypothesis, suggesting instead some psychosocial mechanism that operates in the same way for males and females. As shown earlier, the maternal immune hypothesis appears to have cleared this particular hurdle. That does not, of course, mean that it has now been proven. Many alternative explanations may be possible. Psychosocial hypotheses, for example, might somehow explain the finding that homosexuality relates to sibship composition in men, but not in women, in terms of the different socialization of boys and girls.

Unlike the prenatal hormone theory of sexual orientation, which is based partly on the example of intersex conditions, such as congenital adrenal hyperplasia (e.g., Zucker et al., 1996), the maternal immune hypothesis lacks a well-known human model. It is therefore worth noting that neither the notion that male and female fetuses may have different effects on sex-dimorphic traits in subsequent fetuses nor the notion that maternal antibodies may affect sexual differentiation in utero is completely unprecedented. The possibility that male and female fetuses may have different effects on the outcome of subsequent pregnancies is demonstrated by the finding that newborns with older brothers tend to weigh less than newborns with older sisters (Magnus, Berg, & Bjerkedal, 1985; Trotnow, Bregulla, & Flügel, 1976). Birth weight is sex-dimorphic, with male newborns, on

average, weighing substantially more than female newborns. The possibility that a maternal immune reaction may affect fetal sexual development is demonstrated by evidence that maternal antibodies to gonadotropin are one cause of cryptorchidism, that is, undescended testes (Job et al., 1988).

Ascertainment Bias Explanation

The last possibility to consider is that there actually is no relation between birth order and sexual orientation, merely the appearance of one caused by a methodological flaw. This hypothesis can be stated as follows: Early-born homosexual men have more trouble accepting and being open about their sexual orientation than do homosexual men who have older brothers, perhaps because of the family expectations that are imposed on early-born sons. Therefore, surveys underreport the prevalence of homosexuality among early-born sons, because early-born homosexuals are less likely to volunteer for such studies than are late-born homosexuals.

The foregoing explanation might seem plausible in regard to some samples, but it does not seem very plausible when applied to others. Consider, for example, our studies of consecutive series of Dutch and Canadian gender-dysphoric patients (Blanchard & Sheridan, 1992; Blanchard et al., 1996). In both studies we found that homosexual gender dysphorics have a significantly later birth order than do heterosexual gender dysphorics (see Figure 1). In order to explain these findings as ascertainment bias, one would have to propose that late-born homosexual gender dysphorics are more likely to "come out of the closet" than early-born homosexual gender dysphorics, but early-born and late-born heterosexual gender dysphorics are equally likely to come out of the closet. This explanation seems rather convoluted, especially because there is no rationale for proposing it in the first place.

One more example will suffice. Blanchard et al. (1995) studied a consecutive series of feminine (i.e., probably prehomosexual) boys who were referred for clinical assessment because of their persistent cross-gender behavior. These boys, who had a mean age of 8.46 years, were individually matched to a comparison group of boys referred for psychiatric evaluation for other reasons. The prehomosexual boys had a significantly later birth order than the psychiatric comparison group (see Figure 1). The ascertainment bias hypothesis implies that late-born homosexual males are overrepresented in birth order studies because they self-select for these studies. It is difficult to see how that could apply to this study of prehomosexual boys. These children

were not self-selected in any sense; they were referred by their parents, teachers, or other concerned adults.

In summary, the samples studied to date include paid and unpaid community volunteers, consecutive series of self-referred patients, and consecutive series of patients referred by others. The great diversity of these groups, in particular, their dissimilar routes of entry into the study-samples, is the best possible guarantee against the birth order findings being caused by some superficial factor like ascertainment bias.

Explanations of the Sibling Sex Ratio Data

There are no published theories to explain the emerging finding that high sibling sex ratios are seen in feminine homosexual males and only in feminine homosexual males—or, to put it differently, that homosexual males with a high proportion of brothers are more likely to have a feminine gender identity. It is, however, possible to see what form such theories might take.

A correlation between excess brothers and femininity in homosexual males could arise in two ways. A predominantly male sibship might be a risk factor for cross-gender identification in prehomosexual boys, but be unrelated to the development of sexual orientation per se. Alternatively, a predominantly male sibship might be associated with a specific developmental pathway to homosexuality—a pathway more likely to entail cross-gender identification than other developmental routes leading to a homosexual orientation.

A Psychosocial Explanation

One possible hypothesis is a psychosocial explanation of the risk-factor type. Over 50% of prehomosexual boys exhibit significant amounts of girl-like behavior (Bailey & Zucker, 1995). In the majority of homosexual males, such behavior disappears by early adolescence, probably partly under the impact of socialization and pressures toward gender conformity. The extent to which parents actively discourage feminine behavior (or encourage masculine behavior) may depend on the number of other boys in the family. For example, a father who attempts to interest an initially indifferent son in team sports or hunting may desist after fewer efforts if there are other boys in the family who respond with alacrity to the father's overtures. Only sons, to give a second example, may detect a parental message that they are especially valued specifically because of their male sex. Parents with several sons might even unwittingly contribute to a prehomosexual boy's gender identity confusion. For

example, Brody and Steelman (1985) found that as the number of sons in a family increases (holding constant the number of daughters), parents are less likely to sex-type traditionally feminine household tasks. The assignment of traditionally feminine chores might have no effect on a masculine boy but exacerbate feminine identification in a prehomosexual boy whose gender identity is already unstable. Thus, prehomosexual boys with no or few brothers might be more likely to undergo secondary masculinization by the end of puberty; conversely, prehomosexual boys with several brothers might be more likely to reach adolescence with feminine behaviors or self-concepts that could develop into full-blown transsexualism.

A Biological Explanation

An alternative, remote possibility may also be considered. In studies on animals, reviewed by Blanchard and Klassen (1997), it has been shown that the immunization of females to H-Y antigen can, under certain conditions, increase the proportion of males in their offspring. Thus, the elevated sex ratios sometimes observed in the sibships of homosexual men could also be a result of maternal immunization to H-Y antigen.

If the basic notion that immune reactions to H-Y are related to high sibling sex ratios is true, then a further, more elaborate hypothesis could be explored: Low (but nonzero) maternal immune reactions produce a female-typical sexual orientation in male fetuses but have no other notable effects on sex-typed behavior. Strong maternal immune reactions produce more generalized brain feminization, leading to pervasive cross-gender behavior or full-blown transsexualism. (It seems reasonable to assume that sexual orientation is more readily affected than other forms of sex-typed behavior because homosexuality often occurs without conspicuously feminine behavior in childhood, but such behavior rarely occurs in the absence of homosexuality.)

Strong immune reactions also increase the sex ratio of a woman's offspring. The latter result occurs as follows: Within limits, zygotes that elicit stronger maternal immune reactions are favored at implantation (Clarke & Kirby, 1966). Thus, a factor that increases maternal immune reactions to male zygotes relative to female zygotes should increase the proportion of males implanted and subsequently delivered. H-Y is a weak antigen, and its contribution to the total antigenicity of a male zygote would normally be much overshadowed by the contributions of other, stronger antigens. Therefore, a weak maternal reaction to H-Y would not add noticeably to the prob-

ability of implantation of a male zygote, but a strong reaction might produce a detectable increase in the proportion of males implanted. In summary, this hypothesis proposes that weak (but nonzero) maternal immune reactions to H-Y produce homosexuality only, whereas strong reactions produce homosexuality, cross-gender identity, and high sibling sex ratios. In this way, it answers a question posed by Blanchard et al. (1996), namely, why couples who produce a high proportion of male offspring also produce a high proportion of feminized male offspring.

Miscellaneous Points

Birth Order and Familiality

Researchers have shown that the prevalence of homosexuality is higher in the brothers of homosexual probands than in the brothers of heterosexual probands (Bailey & Bell, 1993; Bailey, Willerman, & Parks, 1991; Pillard, Poumadere, & Carretta, 1981; Pillard & Weinrich, 1986). Such familial clustering is consistent with the hypothesis that genes influence sexual orientation, at least in some men, although it does not exclude shared environmental explanations. Blanchard and Bogaert (1997a) investigated whether this between-families effect and the within-families birth order effect are additive.

The subjects were 717 full siblings over age 40 reported by 205 heterosexual and 138 homosexual male probands examined in southern Ontario in 1994-1995. The sibling's history of legal marriage or cohabitation in a heterosexual relationship was taken as a proxy variable for sexual orientation. There were no significant findings for the female siblings. As expected, the never-married male siblings were more likely to come from the sibships of the homosexual probands, and they had a greater average number of older brothers. A bootstrapped logistic regression analysis showed that an additive model best explained the male siblings' data. The results suggest that older brothers and family membership reflect separate influences on sexual orientation or sexual-orientation-correlated behavior.

Numerous theorists have expressed the view that sexual orientation is likely to be influenced by multiple factors. Blanchard and Bogaert (1997a), however, are among the few—perhaps the only—researchers to demonstrate this directly.

Birth Order and Effect Size

The magnitude of the birth order effect has never been very great in any given sample. In the study by Blanchard et al. (in press), for example, the effect size for older brothers, calculated as the mean number of older brothers for the homosexual men minus the mean number of older brothers for the heterosexual men, divided by the pooled standard deviation for these means, was 0.26. An effect of this magnitude is, by convention, designated as small (Cohen, 1988, p. 25). Previous studies in our research program have yielded effect sizes for older brothers in the same range (e.g., Blanchard & Bogaert, 1996a, 1996b; Blanchard et al., 1996, Study 1).

At least two different situations might underlie consistent, but small, effects for birth order. The first is that all boys born in all families increase the probability of homosexuality in their younger brothers to the same—and rather slight—extent. The second is that some boys increase the probability of homosexuality in their younger brothers substantially, whereas others do not increase this probability at all. The second situation could also result in low observed effect sizes, when these are calculated over all older brothers in all families.

If the maternal immune hypothesis is correct, the second situation is somewhat more likely. In mice (Wachtel, Gasser, & Silvers, 1973) and rats (Desquenne-Clark, Chen, & Silvers, 1987), the ability of a female to respond to H-Y is determined by immune response genes situated in the major histocompatibility complex (MHC), and the ability of H-Y to induce a response varies according to the MHC haplotype of the male. There is also some evidence that the MHC background of the male influences H-Y effects in humans (Goulmy, Termijtelen, Bradley, & van Rood, 1977). If these findings are applicable to the present case, it is possible that only some pregnant women can respond to fetal H-Y, that only some male fetuses can stimulate a maternal response, or that both are true. Thus, a birth order study in which the probands were men whose mothers were known "responders," and the birth order variable was the number of older brothers with MHC backgrounds on which H-Y is immunogenic, might suggest that birth order has a potent effect on sexual orientation in appropriately defined subgroups.

The foregoing discussion illustrates how little is currently understood about the birth order phenomenon, even at the purely epidemiological level. In this circumstance, attempts to interpret the effect

size of the birth order phenomenon as an index of its theoretical importance may be more misleading than illuminating.

Conclusions

The birth order phenomenon is the observable manifestation of one cause of male homosexuality. It may not be the most important cause, but it is probably also not the least important—the extraordinary diversity of samples in which the birth order phenomenon has been demonstrated attests to that. A comprehensive account of male sexual orientation, therefore, will have to include the influence of birth order.

Our findings indicate that the sibling sex ratio and birth order phenomena are distinct, because some homosexual groups have a late average birth order but not an elevated sibling sex ratio. Our findings further suggest that high sibling sex ratios are limited to extremely feminine homosexual groups. The latter point requires additional research before it can be accepted with confidence, however, because it is unclear whether the findings of other investigators (e.g., Lang, 1940, 1960) followed the same pattern.

The birth order and sibling sex ratio data are essentially epidemiological in nature, and both are open to biological and psychosocial interpretations. There are, therefore, opportunities for theorists of all backgrounds to contribute to the explanation of these phenomena.

Acknowledgments

Preparation of this article was supported in part by a grant from the Social Sciences and Humanities Research Council of Canada (410-95-0003). Drs. Anthony F. Bogaert, Martin L. Lalumière, and Kenneth J. Zucker commented on an earlier draft of the article.

References

ABE, K., & MORAN, P. A. P. (1969). Parental age of homosexuals. *British Journal of Psychiatry, 115*, 313-317.

ACSF INVESTIGATORS. (1992). AIDS and sexual behaviour in France. *Nature, 360*, 407-409.

ALLEN, L. S., & GORSKI, R. A. (1992). Sexual orientation and the size of the anterior commissure in the human brain. *Proceedings of the National Academy of Sciences of the United States of America, 89*, 7199-7202.

BAILEY, J. M., & BELL, A. P. (1993). Familiality of female and male homosexuality. *Behavior Genetics, 23*, 313-322.

BAILEY, J. M., & PILLARD, R. C. (1991). A genetic study of male sexual orientation. *Archives of General Psychiatry, 48*, 1089-1096.

BAILEY, J. M., WILLERMAN, L., & PARKS, C. (1991). A test of the maternal stress theory of human male homosexuality. *Archives of Sexual Behavior, 20*, 277-293.

BAILEY, J. M., & ZUCKER, K. J. (1995). Childhood sex-typed behavior and sexual orientation: A conceptual analysis and quantitative review. *Developmental Psychology, 31*, 43-55.

BELL, A. P., WEINBERG, M. S., & HAMMERSMITH, S. K. (1981). *Sexual preference: Its development in men and women.* Bloomington, IN: Indiana University Press.

BEM, D. J. (1996). Exotic becomes erotic: A developmental theory of sexual orientation. *Psychological Review, 103*, 320-335.

BENE, E. (1965). On the genesis of male homosexuality: An attempt at clarifying the role of the parents. *British Journal of Psychiatry, 111*, 803-813.

BERGLIN, C.-G. (1982). Birth order as a quantitative expression of date of birth. *Journal of Epidemiology and Community Health, 36*, 298-302.

BIEBER, I., DAIN, H. J., DINCE, P. R., DRELLICH, M. G., GRAND, H. G., GUNDLACH, R. H., KREMER, M. W., RIFKIN, A. H., WILBUR, C. B., & BIEBER, T. B. (1962). *Homosexuality: A psychoanalytic study.* New York: Basic Books.

BILLY, J. O. G., TANFER, K., GRADY, W. R., & KLEPINGER, D. H. (1993). The sexual behavior of men in the United States. *Family Planning Perspectives, 25*, 52-60.

BIRTCHNELL, J. (1971). Birth rank and mental illness. *Nature, 234*, 485-487.

BLANCHARD, R., & BOGAERT, A. F. (1996a). Biodemographic comparisons of homosexual and heterosexual men in the Kinsey interview data. *Archives of Sexual Behavior, 25*, 551-579.

BLANCHARD, R., & BOGAERT, A. F. (1996b). Homosexuality in men and number of older brothers. *American Journal of Psychiatry, 153*, 27-31.

BLANCHARD, R., & BOGAERT, A. F. (1997a). Additive effects of older brothers and homosexual brothers in the prediction of marriage and cohabitation. *Behavior Genetics, 27*, 45-54.

BLANCHARD, R., & BOGAERT, A. F. (1997b). *Birth order in homosexual versus heterosexual sex offenders against children, pubescents, and adults.* Manuscript submitted for publication.

BLANCHARD, R., & BOGAERT, A. F. (1997c). Drs. Blanchard and Bogaert reply [Letter to the editor]. *American Journal of Psychiatry, 154*, 137.

BLANCHARD, R., & BOGAERT, A. F. (1997d). The relation of closed birth intervals to the sex of the preceding child and the sexual orientation of the succeeding child. *Journal of Biosocial Science, 29,* 111-118.

BLANCHARD, R., & KLASSEN, P. (1997). H-Y antigen and homosexuality in men. *Journal of Theoretical Biology, 185*, 373-378.

BLANCHARD, R., & SHERIDAN, P. M. (1992). Sibship size, sibling sex ratio, birth order, and parental age in homosexual and nonhomosexual gender dysphorics. *Journal of Nervous and Mental Disease, 180*, 40-47.

BLANCHARD, R., & ZUCKER, K. J. (1994). Reanalysis of Bell, Weinberg, and Hammersmith's data on birth order, sibling sex ratio, and parental age in homosexual men. *American Journal of Psychiatry, 151*, 1375-1376.

BLANCHARD, R., ZUCKER, K. J., BRADLEY, S. J., & HUME, C. S. (1995). Birth order and sibling sex ratio in homosexual male adolescents and probably prehomosexual feminine boys. *Developmental Psychology, 31*, 22-30.

BLANCHARD, R., ZUCKER, K. J., COHEN-KETTENIS, P. T., GOOREN, L. J. G., & BAILEY, J. M. (1996). Birth order and sibling sex ratio in two samples of Dutch gender-dysphoric homosexual males. *Archives of Sexual Behavior, 25*, 495-514.

BLANCHARD, R., ZUCKER, K. J., SIEGELMAN, M., DICKEY, R., & KLASSEN, P. (in press). The relation of birth order to sexual orientation in men and women. *Journal of Biosocial Science.*

BOGAERT, A. F. (in press). Birth order and sexual orientation in women. *Behavioral Neuroscience.*

BOGAERT, A. F., BEZEAU, S., KUBAN, M., & BLANCHARD, R. (1997). Pedophilia, sexual orientation, and birth order. *Journal of Abnormal Psychology, 106*, 331-335.

BRAATEN, L. J., & DARLING, C. D. (1965). Overt and covert homosexual problems among male college students. *Genetic Psychology Monographs, 71*, 269-310.

BRODY, C. J., & STEELMAN, L. C. (1985). Sibling structure and parental sex-typing of children's household tasks. *Journal of Marriage and the Family, 47*, 265-273.

CHAHNAZARIAN, A. (1988). Determinants of the sex ratio at birth: Review of recent literature. *Social Biology, 35*, 214-235.

CLARKE, B., & KIRBY, D. R. S. (1966). Maintenance of histocompatibility polymorphisms. *Nature, 211*, 999-1000.

COBB, J. A. (1914). The alleged inferiority of the first-born. *Eugenics Review, 5*, 357-359.

COHEN, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

CROUCHLEY, R., DAVIES, R. B., & PICKLES, A. R. (1984). Methods for the identification of Lexian, Poisson and Markovian variations in the secondary sex ratio. *Biometrics, 40*, 165-175.

DESQUENNE-CLARK, L., CHEN, H.-D., & SILVERS, W. K. (1987). Influence of the major histocompatibility complex (MHC) on the response to and expression of H-Y in rats. *Developmental Genetics, 8*, 189-194.

DIAMOND, M., & SIGMUNDSON, H. K. (1997). Sex reassignment at birth: Long-term review and clinical implications. *Archives of Pediatric and Adolescent Medicine, 151*, 298-304.

DÖRNER, G. (1972). *Sexualhormonabhängige gehirndifferenzierung und sexualität* [Sex hormone dependent brain differentiation and sexuality]. New York: Springer-Verlag.

DÖRNER, G., ROHDE, W., STAHL, F., KRELL, L., & MASIUS, W.-G. (1975). A neuroendocrine predisposition for homosexuality in men. *Archives of Sexual Behavior, 4*, 1-8.

EVANS, R. B. (1969). Childhood parental relationships of homosexual men. *Journal of Consulting and Clinical Psychology, 33*, 129-135.

FAY, R. E., TURNER, C. F., KLASSEN, A. D., & GAGNON, J. H. (1989). Prevalence and patterns of same-gender sexual contact among men. *Science, 243*, 338-348.

FREUND, K. (1994). In search of an etiological model of pedophilia. *Sexological Review, 2*, 171-184.

FREUND, K., & KUBAN, M. (1993). Deficient erotic gender differentiation in pedophilia: A follow-up. *Archives of Sexual Behavior, 22*, 619-628.

FREUND, K., WATSON, R., DICKEY, R., & RIENZO, D. (1991). Erotic gender differentiation in pedophilia. *Archives of Sexual Behavior, 20*, 555-566.

GEBHARD, P. H., GAGNON, J. H., POMEROY, W. B., & CHRISTENSON, C. V. (1965). *Sex offenders: An analysis of types.* New York: Harper & Row.

GEBHARD, P. H., & JOHNSON, A. B. (1979). *The Kinsey data: Marginal tabulations of the 1938-1963 interviews conducted by the Institute for Sex Research*. Philadelphia: W. B. Saunders.

GOODMAN, L. A. (1961). Some possible effects of birth control on the human sex ratio. *Annals of Human Genetics, 25*, 75-81.

GOULMY, E., TERMIJTELEN, A., BRADLEY, B. A., & VAN ROOD, J. J. (1977). Y-antigen killing by T cells of women is restricted by HLA. *Nature, 266*, 544-545.

GUNDLACH, R. H., & RIESS, B. F. (1967). Birth order and sex of siblings in a sample of lesbians and non-lesbians. *Psychological Reports, 20*, 61-62.

HAMER, D. H., HU, S., MAGNUSON, V. L., HU, N., & PATTATUCCI, A. M. L. (1993). A linkage between DNA markers on the X-chromosome and male sexual orientation. *Science, 261*, 321-327.

HARE, E. H., & MORAN, P. A. P. (1979). Parental age and birth order in homosexual patients: A replication of Slater's study. *British Journal of Psychiatry, 134*, 178-182.

HARE, E. H., & PRICE, J. S. (1969). Birth order and family size: Bias caused by changes in birth rate. *British Journal of Psychiatry, 115*, 647-657.

HARE, E. H., & PRICE, J. S. (1974). Birth order and birth rate bias: Findings in a representative sample of the adult population of Great Britain. *Journal of Biosocial Science, 6*, 139-150.

JAGERS, P. (1982). How probable is it to be first born? and other branching-process applications to kinship problems. *Mathematical Biosciences, 59*, 1-15.

JAMES, W. H. (1971). Sex ratios of half-sibs of male homosexuals. *British Journal of Psychiatry, 118*, 93-94.

JAMES, W. H. (1975). Sex ratio and the sex composition of the existing sibs. *Annals of Human Genetics, 38*, 371-378.

JAMES, W. H. (1987). The human sex ratio. Part 1: A review of the literature. *Human Biology, 59*, 721-752.

JENSCH, K. (1941a). Zur genealogie der homosexualität [Regarding the genetics of homosexuality]. *Archiv für Psychiatrie und Nervenkrankheiten, 112*, 527-540.

JENSCH, K. (1941b). Weiterer beitrag zur genealogie der homosexualität [A further contribution regarding the genetics of homosexuality]. *Archiv für Psychiatrie und Nervenkrankheiten, 112*, 679-696.

JOB, J.-C., TOUBLANC, J.-E., CHAUSSAIN, J.-L., GENDREL, D., GARNIER, P., & ROGER, M. (1988). Endocrine and immunological findings in cryptorchid infants. *Hormone Research, 30*, 167-172.

JOHNSON, A. M., WADSWORTH, J., WELLINGS, K., BRADSHAW, S., & FIELD, J. (1992). Sexual lifestyles and HIV risk. *Nature, 360*, 410-412.

JONAS, C. H. (1944). An objective approach to the personality and environment in homosexuality. *Psychiatric Quarterly, 18*, 626-641.

JONES, M. B., & BLANCHARD, R. (1997). *Birth order and male homosexuality: An extension of Slater's Index.* Manuscript submitted for publication.

KALLMANN, F. J. (1952). Twin and sibship study of overt male homosexuality. *American Journal of Human Genetics, 4*, 136-146.

KENYON, F. E. (1968). Studies in female homosexuality: IV. Social and psychiatric aspects. *British Journal of Psychiatry, 114*, 1337-1350.

LANG, T. (1936). Beitrag zur Frage nach der genetischen bedingtheit der homosexualität [A contribution regarding the question of the genetic determination of homosexuality]. *Zeitschrift für die gesamte Neurologie und Psychiatrie, 155*, 702-713.

LANG, T. (1940). Studies on the genetic determination of homosexuality. *Journal of Nervous and Mental Disease, 92*, 55-64.

LANG, T. (1960). Die homosexualität als genetisches problem [Homosexuality as a genetic problem]. *Acta Geneticae Medicae et Gemellologiae, 9*, 370-381.

LEVAY, S. (1991). A difference in hypothalamic structure between heterosexual and homosexual men. *Science, 253*, 1034-1037.

LIDDICOAT, R. (1961). A study of non-institutionalized homosexuals. *Journal of the National Institute for Personnel Research, 8*, 217-249.

MACCOBY, E. E., DOERING, C. H., JACKLIN, C. N., & KRAEMER, H. (1979). Concentrations of sex hormones in umbilical-cord blood: Their relation to sex and birth order of infants. *Child Development, 50*, 632-642.

MACCULLOCH, M. J., & WADDINGTON, J. L. (1981). Neuroendocrine mechanisms and the aetiology of male and female homosexuality. *British Journal of Psychiatry, 139*, 341-345.

MAGNUS, P., BERG, K., & BJERKEDAL, T. (1985). The association of parity and birth weight: Testing the sensitization hypothesis. *Early Human Development, 12*, 49-54.

MANOSEVITZ, M. (1970). Early sexual behaviors in adult homosexual and heterosexual males. *Journal of Abnormal Psychology, 76*, 396-402.

MARMOR, J. (1965). Introduction. In J. Marmor (Ed.), *Sexual inversion: The multiple roots of homosexuality* (pp. 1-24). New York: Basic Books.

MARTENSEN-LARSEN, O. (1957). The family constellation and homosexualism. *Acta Genetica et Statistica Medica, 7*, 445-446.

MARTIN, J. T., & GUGELCHUK, G. (1997). [Letter to the editor]. *American Journal of Psychiatry, 154*, 136.

MONEY, J. (1970). Sexual dimorphism and homosexual gender identity. *Psychological Bulletin, 74*, 425-440.

MOORE, D. H., & GLEDHILL, B. L. (1988). How large should my study be so that I can detect an altered sex ratio? *Fertility and Sterility, 50*, 21-25.

MÜLLER, U. (1996). H-Y antigens. *Human Genetics, 97*, 701-704.

NAKAMURA, D., WACHTEL, S. S., LANCE, V., & BEÇAK, W. (1987). On the evolution of sex determination. *Proceedings of the Royal Society of London, 232*, 159-180.

NASH, J., & HAYES, F. (1965). The parental relationships of male homosexuals: Some theoretical issues and a pilot study. *Australian Journal of Psychology, 17*, 35-43.

PILLARD, R. C., POUMADERE, J., & CARRETTA, R. A. (1981). Is homosexuality familial? A review, some data, and a suggestion. *Archives of Sexual Behavior, 10*, 465-475.

PILLARD, R. C., & WEINRICH, J. D. (1986). Evidence of familial nature of male homosexuality. *Archives of General Psychiatry, 43*, 808-812.

PRICE, J. S., & HARE, E. H. (1969). Birth order studies: Some sources of bias. *British Journal of Psychiatry, 115*, 633-646.

RABOCH, J., & RABOCH, J. (1986). Number of siblings and birth order of sexually dysfunctional males and sexual delinquents. *Journal of Sex and Marital Therapy, 12*, 73-76.

RASCHKA, L. B. (1995). On older fathers [Letter to the editor]. *American Journal of Psychiatry, 152*, 1404.

SAGHIR, M. T., & ROBINS, E. (1973). *Male and female homosexuality: A comprehensive investigation.* Baltimore, MD: Williams & Wilkins.

SCHOFIELD, M. (1965). *Sociological aspects of homosexuality*. London: Longmans, Green.

SCHUBERT, H. J., WAGNER, M. E., & RIESS, B. F. (1976). Sibship size, sibsex, sibgap, and homosexuality among male outpatients. *Transnational Mental Health Research Newsletter, 18*, 3-8.

SIEGELMAN, M. (1972a). Adjustment of homosexual and heterosexual women. *British Journal of Psychiatry, 120*, 477-481.

SIEGELMAN, M. (1972b). Adjustment of male homosexuals and heterosexuals. *Archives of Sexual Behavior, 2*, 9-25.

SIEGELMAN, M. (1973). Birth order and family size of homosexual men and women. *Journal of Consulting and Clinical Psychology, 41*, 164.

SIEGELMAN, M. (1974a). Parental background of homosexual and heterosexual women. *British Journal of Psychiatry, 124*, 14-21.

SIEGELMAN, M. (1974b). Parental background of male homosexuals and heterosexuals. *Archives of Sexual Behavior, 3*, 3-18.

SIEGELMAN, M. (1978). Psychological adjustment of homosexual and heterosexual men: A cross-national replication. *Archives of Sexual Behavior, 7*, 1-11.

SIEGELMAN, M. (1979). Adjustment of homosexual and heterosexual women: A cross-national replication. *Archives of Sexual Behavior, 8*, 121-125.

SIEGELMAN, M. (1981a). Parental backgrounds of homosexual and heterosexual women: A cross-national replication. *Archives of Sexual Behavior, 10*, 371-378.

SIEGELMAN, M. (1981b). Parental backgrounds of homosexual and heterosexual men: A cross national replication. *Archives of Sexual Behavior, 10*, 505-513.

SINGH, J., & VERMA, I. C. (1987). Influence of major histo(in)compatibility complex on reproduction. *American Journal of Reproductive Immunology and Microbiology, 15*, 150-152.

SLATER, E. (1958). The sibs and children of homosexuals. In D. R. Smith & W. M. Davidson (Eds.), *Symposium on nuclear sex* (pp. 79-83). London: Heinemann Medical Books.

SLATER, E. (1962). Birth order and maternal age of homosexuals. *Lancet, i*, 69-71.

STEPHAN, W. G. (1973). Parental relationships and early social experiences of activist male homosexuals and male heterosexuals. *Journal of Abnormal Psychology, 82,* 506-513.

SUAREZ, B. K., & PRZYBECK, T. R. (1980). Sibling sex ratio and male homosexuality. *Archives of Sexual Behavior, 9,* 1-12.

SULLOWAY, F. J. (1996). *Born to rebel: Birth order, family dynamics, and creative lives.* New York: Pantheon Books.

TERMAN, L. M., & MILES, C. C. (1936). *Sex and personality: Studies in masculinity and femininity.* New York: McGraw-Hill.

TROTNOW, S., BREGULLA, K., & FLÜGEL, K. (1976). Untersuchung über die körpergröße und das körpergewicht von neugeborenen in abhängigkeit vom paritätsstatus [Research on the body size and body weight of newborns as a function of maternal parity]. *Geburtshilfe und Frauenheilkunde, 36,* 744-750.

TSOI, W. F., KOK, L. P., & LONG, F. Y. (1977). Male transsexualism in Singapore: A description of 56 cases. *British Journal of Psychiatry, 131,* 405-409.

VAN DEN AARDWEG, G. J. M. (1986). On the origins and treatment of homosexuality: A psychoanalytic reinterpretation. New York: Praeger.

WACHTEL, S. S. (1983). H-Y antigen and the biology of sex determination. New York: Grune & Stratton.

WACHTEL, S. S., GASSER, D. L., & SILVERS, W. K. (1973). Male-specific antigen: Modification of potency by the H-2 locus in mice. *Science, 181,* 862-863.

WACHTEL, S. S., KOO, G. C., & BOYSE, E. A. (1975). Evolutionary conservation of H-Y ('male') antigen. *Nature, 254,* 270-272.

WELLINGS, K., FIELD, J., JOHNSON, A., & WADSWORTH, J. (1994). *Sexual behaviour in Britain: The national survey of sexual attitudes and lifestyles.* London: Penguin Books.

WEST, D. J. (1977). *Homosexuality re-examined.* Minneapolis, MN: University of Minnesota Press.

WESTWOOD, G. (1960). *A minority: A report on the life of the male homosexual in Great Britain.* London: Longmans, Green and Co.

WHITAM, F. L., DIAMOND, M., & MARTIN, J. (1993). Homosexual orientation in twins: A report on 61 pairs and three triplet sets. *Archives of Sexual Behavior, 22,* 187-206.

WHITENER, R. W., & NIKELLY, A. (1964). Sexual deviation in college students. *American Journal of Orthopsychiatry, 34,* 486-492.

WOLFF, C. (1971). *Love between women.* London: Duckworth.

YAMAGUCHI, K. (1989). A formal theory for male-preferring stopping rules of childbearing: Sex differences in birth order and in the number of siblings. *Demography, 26,* 451-465.

ZUCKER, K. J. (1987). Commentary on Kohlberg, Ricks, and Snarey's (1984) "Childhood Development as a Predictor of Adaptation in Adulthood." *Genetic, Social, and General Psychology Monographs, 113,* 127-130.

ZUCKER, K. J., & BLANCHARD, R. (1994). Reanalysis of Bieber et al.'s 1962 data on sibling sex ratio and birth order in male homosexuals. *Journal of Nervous and Mental Disease, 182,* 528-530.

ZUCKER, K. J., BRADLEY, S. J., OLIVER, G., BLAKE, J., FLEMING, S., & HOOD, J. (1996). Psychosexual development of women with congenital adrenal hyperplasia. *Hormones and Behavior, 30,* 300-318.

ZUCKER, K. J., GREEN, R., COATES, S., ZUGER, B., COHEN-KETTENIS, P. T., ZECCA, G. M., LERTORA, V., MONEY, J., HAHN-BURKE, S., BRADLEY, S. J., & BLANCHARD, R. (1997). Sibling sex ratio of boys with gender identity disorder. *Journal of Child Psychology and Psychiatry, 38,* 543-551.

ZUCKER, K. J., LIGHTBODY, S., PECORE, K., BRADLEY, S. J., & BLANCHARD, R. (in press). Birth order in girls with gender identity disorder. *European Child & Adolescent Psychiatry.*