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# Interaction of fraternal birth order and handedness in the development of male homosexuality

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**Abstract**

The present study investigated evidence for an interaction between two of the best established etiologic factors, or markers of etiologic factors, in the literature on male homosexuality: fraternal birth order and hand preference. By combining five samples, the authors produced study groups of 1774 right-handed heterosexuals, 287 non-right-handed heterosexuals, 928 right-handed homosexuals, and 157 non-right-handed homosexuals. The results showed a significant ($P = 0.004$) handedness by older brothers interaction, such that (a) the typical positive correlation between homosexuality and greater numbers of older brothers holds only for right-handed males, (b) among men with no older brothers, homosexuals are more likely to be non-right-handed than heterosexuals; among men with one or more older brothers, homosexuals are less likely to be non-right-handed than heterosexuals, and (c) the odds of homosexuality are higher for men who have a non-right hand preference or who have older brothers, relative to men with neither of these features, but the odds for men with both features are similar to the odds for men with neither. These findings have at least two possible explanations: (a) the etiologic factors associated with non-right-handedness and older brothers–hypothesized to be hyperandrogenization and anti-male antibodies, respectively–counteract each other, yielding the functional equivalent of typical masculinization, and (b) the number of non-right-handed homosexuals with older brothers is smaller than expected because the combination of the older brothers factor with the non-right-handedness factor is toxic enough to lower the probability that the affected fetus will survive.


*Keywords:* Androgen; Antibody; Birth order; Handedness; Homosexuality; Sexual orientation

## Introduction

Most researchers who study the origins of sexual orientation believe that homosexuality in human males has multiple causes. Some researchers also acknowledge the possibility that the various etiologic factors that contribute to homosexuality may interact with each other (e.g., Mustanski et al., 2002b)—that the effect of two or more factors together may be quite different from the sum of their effects in isolation. Although such interaction is recognized as a theoretical possibility, it has never been demonstrated empirically in a large-scale study with variables having well established individual effects. The present study therefore investigated evidence for interaction between two of the best established etiologic factors, or markers of etiologic factors, in the literature on male homosexuality: fraternal birth order and hand preference.

A meta-analysis of aggregate data from 14 samples representing 10,143 male subjects has shown that homosexuality in human males is predicted by higher numbers of older brothers, but not by higher numbers of older sisters, younger brothers, or younger sisters (Blanchard, 2004). The relation between number of older brothers and sexual orientation holds only for males. This phenomenon has therefore been called the *fraternal birth order effect*.

Blanchard (2004) included in his meta-analysis only studies in which he had participated and in which there was an appropriate control group. The fraternal birth order effect has also been demonstrated in a number of other studies (Bogaert, 2003; Poasa et al., 2004; Purcell et al., 2000; Zucker and

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Blanchard, 2003; Zucker et al., 1997), including six by investigators working independently of Blanchard and his colleagues (Camperio-Ciani et al., 2004; Green, 2000; King et al., 2005; Rahman, 2005; Robinson and Manning, 2000; Williams et al., 2000). One methodologically similar study (Rahman et al., 2004) did not confirm the effect, perhaps because of inadequate statistical power. The bulk of studies outside Blanchard's (2004) meta-analysis, therefore, bolster the conclusion that the fraternal birth order effect is a reliable one.

Blanchard and Bogaert (1996) hypothesized that the fraternal birth order effect reflects the progressive immunization of some mothers to male-specific antigens by each succeeding male fetus and the concomitantly increasing effects of anti-male antibodies on the sexual differentiation of the brain in each succeeding male fetus. This notion has been called the *maternal immune hypothesis*. In later articles (Blanchard and Klassen, 1997; Blanchard, 2004), Blanchard speculated on the mechanisms by which anti-male antibodies might block full masculinization of the fetal brain, for example, by binding to, and thus inactivating, male-specific molecules located on the surface of fetal brain cells. The recent finding that biological brothers increase the odds of homosexuality in later-born males, even if they were reared in different households, whereas stepbrothers or adoptive brothers have no effect on sexual orientation (Bogaert, 2005) reinforces the notion that the fraternal birth order effect, whatever its precise mechanism, relates to changes in the uterine environment.

A meta-analysis by Lalumière et al. (2000) has established hand preference as another reliable correlate of sexual orientation. That study was carried out to resolve the conflicting conclusions that had been produced by narrative reviews of the relation between handedness and homosexuality. Lalumière et al. computed the rates of non-right-handedness (i.e., preferential use of the left hand, or equal use of both hands, in common tasks) in 20 comparisons of homosexual and heterosexual men. The odds of non-right-handedness were 34% higher for homosexual than for heterosexual men.

Lalumière et al. considered several possible explanations for why homosexual men show an excess of non-right-handedness despite that non-right-handedness is associated with masculinization (Oldfield, 1971) and that male homosexuality is commonly associated with undermasculinization (e.g., Bailey and Zucker, 1995). One explanation was developmental instability: a compromised ability to compensate for perturbations of development. According to this theory, homosexuality and non-right-handedness co-occur in the same individuals because susceptibility to one perturbation implies susceptibility to others. Lalumière et al. (2000) also considered Geschwind and Galaburda's (1985) modification of Dörner's (1972) prenatal androgen hypothesis: homosexual men are exposed to elevated levels of testosterone during some developmental periods in utero but to reduced levels during others. According to Geschwind and Galaburda, elevated testosterone occurs during a critical period for the development of handedness, and reduced testosterone occurs during a critical period for sexual orientation. An alternate formulation of the prenatal androgen hypothesis was suggested by Lindesay (1987): that homosexuality results from elevated levels–and not from reduced levels–of testosterone, and that elevations in testosterone in utero increase the probability both of homosexuality and of non-right-handedness.

Research published after the Lalumière et al. meta-analysis has continued the pattern of inconsistent results from individual studies, with the preponderance of evidence for higher non-right-handedness in homosexual men. Mustanski et al. (2002a) found very similar rates of non-right-handedness for homosexual and heterosexual men, whereas Lippa (2003) found that the odds of non-right-handedness were 82% higher for homosexual men. Zucker et al. (2001) found higher rates of non-right-handedness in boys with gender identity disorder than in control boys; the former group may, for present purposes, be considered a subtype of homosexual males (see Bailey and Zucker, 1995). The relation between handedness and sexual orientation may therefore also be regarded as reliable.

The specific objective of this study was to determine whether fraternal birth order and hand preference interact in their effects on sexual orientation. This question might be stated more concretely in several ways. For example, do older brothers have a greater, lesser, or equal effect on sexual orientation in right-handed and non-right-handed men? The study required a large number of subjects in order to obtain a sufficient number of men in the rarest category: non-right-handed homosexuals. The present authors therefore pooled their data from several studies that happened to include the variables needed for this analysis.

## Method

### *Subjects*

The all-male subjects comprised 1774 right-handed heterosexuals, 287 non-right-handed heterosexuals, 928 right-handed homosexuals, and 157 non-right-handed homosexuals. These came from five extremely diverse samples, here called Ellis, Breedlove, Blanchard, Bogaert (Non-biological Families), and Bogaert (Other). These samples represent a mixture of archival data from published studies, unpublished data from studies currently in preparation, and data retrieved specifically for the present study. The samples will be described separately. Each of the samples was collected with approval from the original investigator's institutional research review board. The sizes and demographics of the samples are presented in Table 1.

In this article, we use the word *subject* rather than *participant*, for two reasons: (a) in many cases, the person who actually participated in the study was not the subject but instead his mother, and (b) it is confusing, in the case of re-analyzed archival data, to use language implying that the subjects were recruited to participate in the later study.

#### *Ellis*

A detailed description of this sample is given in Ellis and Blanchard (2001), among other places. The sample was collected to investigate numerous potential prenatal and perinatal influences on adult human behavior. The homosexual subjects were university students and sons of P-FLAG members (Parents and Friends of Lesbians and Gays). The heterosexual subjects were university students. The respondents were recruited through numerous universities and P-FLAG chapters in the USA and Canada from 1988 to 1997. Respondents were not given any reward for participating.