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The association between the fraternal birth order effect in male homosexuality and other markers of human sexual orientation

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Later fraternal birth order (FBO) is a well-established correlate of homosexuality in human males and may implicate a maternal immunization response in the feminization of male sexuality. This has led to the suggestion that FBO may relate to other markers of male sexual orientation which are robustly sexually dimorphic. If so, among homosexual males the number of older brothers should strongly correlate with traits such as spatial ability and psychological gender, indicative of greater behavioural feminization, compared to heterosexual males. The present study failed to find significant associations between number of older brothers and these traits.

Keywords: fraternal birth order; older brothers; homosexuality; mental rotation; psychological gender; maternal immune hypothesis

1. INTRODUCTION

Studies in community and national probability samples in several countries have found that later birth order as a consequence of greater number of older brothers, is one of the most reliable correlates of homosexuality in human males (for review see Blanchard 2004). This is referred to as the 'fraternal birth order effect' (FBO). There is no effect of birth order or sibling sex composition in female sexual orientation (Blanchard 2004), thus any theory accounting for it applies only to males. It has been proposed that the FBO effect in male sexual orientation may be due to the progressive immunization of some mothers to male-specific antigens by carrying successive male foetuses. This 'maternal immunity hypothesis' maintains that the accumulating antibodies to male-specific antigens may affect sexual differentiation of the male foetal brain in a feminizing direction leading to homosexuality (Blanchard & Bogaert 1996). Supportive of the hypothesis are indirect lines of evidence demonstrating that male foetuses are more likely to evoke maternal rhesus factor immune responses than are female foetuses (Gualtieri & Hicks 1985); that certain known male-linked antigens, such as H–Y, are well represented in neural tissue, thus providing major targets for maternal antibodies (Blanchard & Klassen 1997); and that 90% of the male offspring of female mice actively immunized against foetal H–Y show reduced male-typical reproductive performance (Singh & Verma 1987).

Studies have also calculated that approximately one in seven homosexual males owe their sexual orientation to the FBO effect (Cantor *et al.* 2002; Blanchard & Bogaert 2004), and that it would exceed all other causes of homosexuality in males with three or more older brothers (such as exposure to differential levels of prenatal testosterone: Ellis & Ames 1987; Rahman & Wilson 2003*a*). Blanchard and colleagues have demonstrated that homosexual males (and probably 'pre-homosexual' feminine boys) with older brothers have significantly lower birth weights than homosexual males without older brothers and heterosexual males (and non-effeminate boys) with older brothers (Blanchard & Ellis 2001; Blanchard *et al.* 2002). Additionally, a homosexual orientation is most likely to occur among men with older brothers and shorter stature (Bogaert 2003*a*). Animal studies indicate that maternal immunization may lower birth weight, while work in humans shows that later born males have lower birth weights and larger placentas (Vernier 1975; Zuckerman & Head 1985). This evidence strongly locates (temporally speaking) the mechanisms by which older brothers increase the odds of homosexuality within the prenatal environment.

Following from the birth weight findings, the question posed here was whether FBO could account for behavioural markers known to be robustly associated with male sexual orientation. If empirical data (of which there are none at present) were to demonstrate this, it would support a relationship between a putatively prenatal neurodevelopmental mechanism and adult neurobehavioural correlates of male homosexuality (see Rahman & Wilson 2003*a*). To this end, the present study employed two measures strongly associated with male sexual orientation: spatial ability as measured by the mental rotation test (Vandenberg & Kuse 1978) and psychological gender as measured by the masculinity–femininity scale of the Eysenck personality profiler (EPP; Eysenck *et al.* 1996) in a large sample of heterosexual and homosexual males (plus a group of heterosexual females for comparison). Performance on mental rotations is highly sexually dimorphic with males outperforming females by a large magnitude (Kimura 1999), while independent studies demonstrate that heterosexual males outperform homosexual males (who show female-typical scores) by a modest to large magnitude (e.g. Rahman & Wilson 2003*b*). Psychological gender also follows a similar sexually dimorphic pattern with respect to sex and sexual orientation (Eysenck *et al.* 1996; Rahman *et al.* 2004; for review see Lippa 2002). If the FBO effect relates to adult neurobehavioural markers of male sexual orientation, then the number of older brothers should strongly correlate with spatial ability and psychological gender among homosexual males compared to heterosexual males.

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Table 1. Correlations between number of younger and older siblings of each sex, mental rotation and psychological gender scores for each group.
(Figures in bold are significant with $p<0.05$ but not after Bonferroni corrected for multiple comparisons.)

	older brothers	younger brothers	older sisters	younger sisters
heterosexual males:				
mental rotation	−0.04 $p=0.664$ ($n=80$)	0.01 $p=0.898$ ($n=80$)	**−0.23** $\mathbf{p=0.036}$ **($n=80$)**	−0.16 $p=0.138$ ($n=80$)
psychological gender	−0.07 $p=0.487$ ($n=80$)	−0.07 $p=0.522$ ($n=80$)	0.09 $p=0.419$ ($n=80$)	−0.12 $p=0.282$ ($n=80$)
homosexual males:				
mental rotation	−0.05 $p=0.626$ ($n=80$)	−0.11 $p=0.303$ ($n=80$)	−0.07 $p=0.520$ ($n=80$)	−0.20 $p=0.074$ ($n=80$)
psychological gender	−0.09 $p=0.407$ ($n=80$)	−0.02 $p=0.863$ ($n=80$)	−0.20 $p=0.064$ ($n=80$)	**−0.24** $\mathbf{p=0.026}$ **($n=80$)**
heterosexual females:				
mental rotation	−0.11 $p=0.403$ ($n=54$)	−0.01 $p=0.897$ ($n=54$)	−0.10 $p=0.471$ ($n=54$)	−0.10 $p=0.432$ ($n=54$)
psychological gender	−0.02 $p=0.883$ ($n=54$)	−0.11 $p=0.410$ ($n=54$)	−0.01 $p=0.890$ ($n=54$)	−0.01 $p=0.915$ ($n=54$)

2. MATERIAL AND METHODS

(a) *Participants*

Two hundred and fourteen participants (80 heterosexual males, 80 homosexual males and 54 heterosexual females; age range: 18–41 years), were recruited by convenience and snowball sampling (and screened to ensure good general health and no history of psychiatric/neurological illness). Heterosexual subjects were recruited from the local community via newspaper advertisements while homosexual men were recruited face-to-face from areas with large concentrations of gay men and lesbians, such as the Soho district of London and university sources. Sexual orientation was assessed using self-identification ('gay', 'heterosexual/straight' or 'bisexual'), and a single-item question about sexual feelings (attractions and fantasies) on a 7-point scale (ranging from 0=*exclusively heterosexual* to 6=*exclusively homosexual*). Only participants who responded either 0 or 1 (heterosexual), or 5 or 6 (homosexual), and checked either 'gay' or 'heterosexual/straight' on self-identification took part (bisexual respondents were excluded). All subjects provided written informed consent before taking part. One must bear in mind that ascertainment biases may be operating in the present sample insofar as the homosexual men recruited were those who are 'visible' in the gay community and are open about their sexuality. These may not be representative of homosexual men at the population level; thus caution needs to be exercised when interpreting any FBO effect and interactions with other variables (e.g. Camperio-Ciani *et al.* 2004). Nonetheless, one must note that the FBO effect is robustly found in both community samples (those using opportunistic and snowball sampling methods as utilised here) and national probability studies (see Blanchard 2004).

(b) *Sibling sex composition*

Participants were asked their age, years spent in full-time education (since the age of 5), and their numbers of older brothers, older sisters, younger brothers and younger sisters that their mothers had given birth to. This included (as far as participants were able to recall) siblings who were carried by the mother but not brought to term because of obstetric complications (e.g. miscarriage or still birth).

(c) *Spatial ability*

All participants completed the mental rotations test. This 10 min, 20 item test (Vandenberg & Kuse 1978) required participants to view and match a target object (a two-dimensional representation of a three-dimensional cuboid) with four test stimuli. Each item had two correct test stimuli and two incorrect foils. For each item, participants received two points if they checked both correct responses and one point if they checked one correct response. Thus the maximum score was out of 40.

(d) *Psychological gender*

All participants completed the 20 item sub-scale ('masculinity–femininity') of the EPP, which has UK based norms (Eysenck *et al.* 1996). It comprises items that, empirically, show maximum separation between men and women, ranging from concern about crawling insects, to interest in children and clothes, and willingness to express emotion (e.g. by crying publicly). Participants responded either 'yes,' 'no,' or 'can't decide' to each item. Each response was given zero, one, or two points depending on the item, and produced a score ranging from 0 to 40. High scores are 'masculine' and low scores are 'feminine.'

3. RESULTS AND DISCUSSION

One-way ANOVA revealed that heterosexual females were significantly younger than both male groups (heterosexual females: mean (M)=26.22, s.d.=5.85; heterosexual males: $M=29.32$, s.d.=6.69; homosexual males: $M=30.68$, s.d.=6.47, $F_{2,213}=7.933$, $p<0.001$). There were no group differences in the number of years spent in full-time education, $F_{2,213}=0.760$, $p=0.469$. A significant FBO effect (homosexual males predicted to have more older brothers than heterosexual males) was apparent when the data were cast in a two-by-two table (wherein the present sample 52 heterosexual males had zero older brothers, 28 heterosexual men had one or more older brothers, 41 homosexual men had zero older brothers, and 39 homosexual men had one or more older brothers) and analysed using a t-test for proportions, $t_{57=}1.78$, $p=0.038$. However, independent samples t-test revealed no significant difference for the continuous variable, number of older brothers, although the expected trend was apparent (heterosexual males: $M=0.47$, s.d.=0.74; homosexual males: $M=0.61$, s.d.=0.73, $t_{158}=-1.172$, $p=0.243$).

There were significant group differences in mental rotation scores, $F_{2,213}=17.714$, $p<0.001$. *Post hoc* comparisons (Bonferroni corrected to $p<0.01$) revealed that heterosexual males scored significantly higher ($M=30.37$, s.d.=7.64) than heterosexual females ($M=22.50$, s.d.=7.58, $p<0.001$) and homosexual males ($M=25.80$, s.d.=7.81, $p=0.001$), while there was no significant difference at the adjusted alpha level between heterosexual females and homosexual males ($p=0.047$). There were significant differences in psychological gender scores, $F_{2,213}=35.098$, $p<0.001$, with heterosexual males scoring higher (more masculine: $M=22.26$, s.d.$=$4.51) than heterosexual females ($M=14.98$, s.d.$=$5.30, $p<0.001$) and homosexual males ($M=17.26$, s.d.$=$5.81, $p<0.001$). Again the difference between heterosexual females and homosexual males (the latter scoring higher) was not significant ($p=0.042$).

Pearson's product–moment correlations were used to examine the relationships between number of siblings, mental rotation and psychological gender scores for each group separately. Number of younger and older siblings of each sex did not correlate with any measure among the groups (see table 1). Neither were there any relationships for when the sample was examined as a whole (all ps>0.05). There was a significant positive correlation between mental rotation and psychological scores among homosexual males ($r=0.359$, $n=80$, $p=0.001$) but no significant associations among these variables for the other groups (ps>0.05).

While these findings confirm the robust cross-sex shift (female-typical) shown by homosexual males in mental rotation and psychological gender compared to heterosexual males (e.g. Lippa 2002; Rahman & Wilson 2003*b*), they show that FBO is unrelated to these traits in both groups (and thus unrelated to the typical behavioural feminization observed among homosexual males). This is consistent with one previous study examining childhood sex-typed behaviour, sibling characteristics and male sexual orientation in the Kinsey data archives (Bogaert 2003*b*). It is perplexing as to why this should be given the strong association between FBO and male sexual orientation (Blanchard 2004). There are two possible explanations. Maternal immunity could be responsible for lower birth weight, stature (Blanchard *et al.* 2002: Bogaert 2003*a*) and perhaps direction of sexual preference but this mechanism may not extend to neural circuitry responsible for the two traits examined here. Alternatively, these data could point to a neurodevelopmental pathway that acts independently of the FBO effect (such as prenatal androgen exposure; Ellis & Ames 1987). Although two traits were examined (and future work should endeavour to expand this), this study had sufficient power to detect their sensitivity to male sexual orientation. The two variables also correlated with each other among homosexual males, suggesting that more masculine gay men show elevated male-typical spatial scores. These data point to *within*-sexual orientation variation in sexually dimorphic cognition, and that not all neurobehavioural group differences necessarily originate from the same factors (e.g. FBO). These findings add to the puzzle of the FBO effect and suggest it does not account for two reliable sexually dimorphic features of sexual orientation in human males.

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