

# Finger-length ratios and sexual orientation

Measuring people's finger patterns may reveal some surprising information.

**A**nimal models have indicated that androgenic steroids acting before birth might influence the sexual orientation of adult humans. Here we examine the androgen-sensitive pattern of finger lengths<sup>1</sup>, and find evidence that homosexual women are exposed to more prenatal androgen than heterosexual women are; also, men with more than one older brother, who are more likely than first-born males to be homosexual in adulthood<sup>2</sup>, are exposed to more prenatal androgen than eldest sons. Prenatal androgens may therefore influence adult human sexual orientation in both sexes, and a mother's body appears to 'remember' previously carried sons, altering the fetal development of subsequent sons and increasing the likelihood of homosexuality in adulthood.

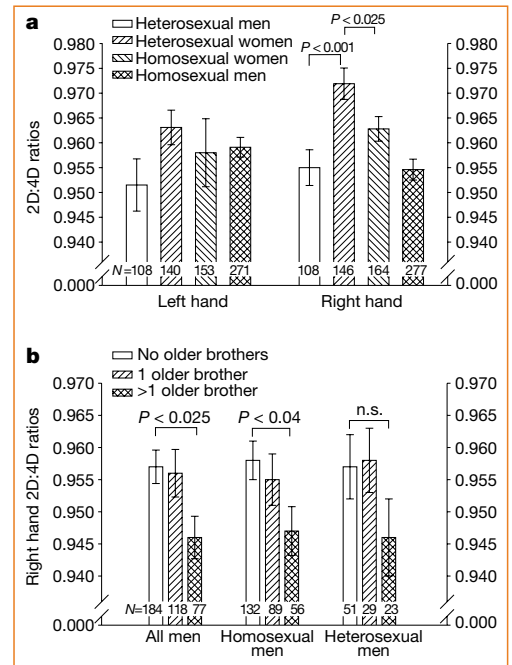
In women, the index finger (2D, second digit) is almost the same length as the fourth digit (4D), although it may be slightly longer or shorter; in men, the index finger is more often shorter than the fourth. The greater 2D:4D ratio in females is established in two-year-olds<sup>1</sup>. Because all nongonadal somatic sex differences in humans appear to be the result of fetal androgens that masculinize males<sup>3</sup>, the sex difference in the 2D:4D ratio probably reflects the prenatal influence of androgen on males<sup>4</sup>.

In an anonymous survey, 720 adults who were attending public street fairs in the San Francisco area were asked their gender, age, sexual orientation, handedness, and the number and gender of children their mother had carried before them. As expected, men have significantly longer fingers than women ( $P < 0.001$ ), and we confirmed reports that the 2D:4D ratio is greater in women than it is in men.

This sex difference in 2D:4D is greater on the right hand than on the left (Fig. 1a), indicating that the right-hand 2D:4D is more sensitive to fetal androgens than the left-hand ratio. The right-hand 2D:4D ratio of homosexual women was significantly more masculine (that is, smaller) than that of heterosexual women, and did not differ significantly from that of heterosexual men. Thus finger ratios, like otoacoustic emissions<sup>5</sup>, suggest that at least some homosexual women were exposed to greater levels of fetal androgen than heterosexual women.

The 2D:4D ratio of homosexual men was not significantly different from that of heterosexual men for either hand ( $P > 0.09$ ). However, segregating male subjects based on birth order provided support for the role of fetal androgens in male sexual orientation. The more older brothers a boy

**Figure 1** Finger-length patterns vary with gender, sexual orientation and birth order. **a**, Among heterosexuals, the mean 2D:4D ratio is larger in women than in men, especially on the right hand. The right-hand 2D:4D ratio of homosexual women is more masculine (that is, smaller) than that of heterosexual women. **b**, Men with more than one older brother are more likely to be homosexual<sup>2</sup> and have a significantly more masculine right-hand 2D:4D ratio than men without older brothers. Subjects were offered lottery 'scratcher' tickets for their participation. Age and handedness were not significantly different between heterosexual and homosexual subjects; we found no relation between handedness or age and finger measures. Finger lengths were measured blindly from photocopies of subjects' hands. Repeated measurements from 381 subjects were highly correlated ( $r$  was +0.95 to +0.99). Standard errors of the means are depicted. All  $P$  values, from Student's  $t$ -tests, are two-tailed. n.s., Not significant.



has, the more likely he is to develop a homosexual orientation<sup>2</sup>. Confirming these reports, we also found that only homosexual men had a greater than expected proportion of brothers ( $P < 0.01$ ) among their older siblings (229 brothers: 163 sisters) compared with the general population (106 males: 100 females<sup>6</sup>).

We found that the male 2D:4D ratio, which is unlikely to be influenced by social factors, also varies with the number of older brothers. The ratio was significantly more masculine in men with two or more older brothers than in men with no older brothers (Fig. 1b). There is also a significant correlation ( $r = -0.104$ ;  $P < 0.05$ ) between the number of older brothers and the right-hand 2D:4D ratio in men. If male subjects are divided by sexual orientation, the same pattern of later-born men displaying a more masculine 2D:4D is seen. Having older sisters has no apparent influence on male sexual orientation<sup>2</sup>, or on the 2D:4D ratio in men. No effect of older brothers or sisters on 2D:4D in women was observed, consonant with reports that older siblings exert no effect on female sexual orientation<sup>7</sup>.

Our results suggest that events before birth (or even before conception in the case of older brothers) influence human sexual orientation. The masculinized right-hand 2D:4D ratio in homosexual women may reflect fetal androgen levels that are slightly higher than in heterosexual women. Homosexual men without older brothers have 2D:4D ratios indistinguishable from hetero-

sexual eldest sons, indicating that factors other than fetal androgen (such as genetic influences<sup>8,9</sup>) also contribute to sexual orientation. Finger measures indicate that men with more elder brothers, including those men who develop a homosexual orientation, might be exposed to greater than normal levels of prenatal androgen.

Although hyper-androgenization of homosexual men might not fit some cultural expectations<sup>10</sup>, homosexual men display several hyper-masculine characteristics, including a greater mean number of sexual partners in a lifetime than heterosexual men, who in turn report more sexual partners than do women of either orientation. Furthermore, reports that adult homosexual men have more circulating androgens (ref. 11, but see ref. 12), larger genitalia<sup>13</sup> and more 'masculine' auditory evoked potentials than heterosexual men<sup>14</sup>, are consistent with at least some homosexual men being hyper-androgenized.

Although it is possible that the maternal influence on finger growth of subsequent sons occurs after birth, a prenatal influence seems more likely because of the extensive physiological pairing of mother and fetus. The locus of the maternal 'memory' for previous sons, and the mechanisms by which fetal development of subsequent sons is altered, remain unknown.

Terrance J. Williams, Michelle E. Pepitone, Scott E. Christensen, Bradley M. Cooke, Andrew D. Huberman, Nicholas J. Breedlove, Tessa J. Breedlove, Cynthia L. Jordan,