

## **Excess of Counterclockwise Scalp Hair-Whorl Rotation in Homosexual Men**

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**While most men prefer women as their sexual partners, some are bisexual and others are homosexuals. It has been debated for a long time whether a person's sexual preference is innate, learned or due to a combination of both causes. It was recently discovered that the human right- versus left-hand-use preference and the direction of scalp hair-whorl rotation develop from a common genetic mechanism (1). Such a mechanism controls functional specialization of brain hemispheres. Whether the same mechanism specifying mental makeup influences sexual preference was determined here by comparing the hair-whorl rotation of groups enriched with homosexual men with that of males at large. Only a minority of 8.2% (n = 207) unselected "control" group of males developed counterclockwise rotation. In contrast, all three samples enriched with homosexual men exhibited highly significant ( $P < 0.0001$ ), 3.6-fold excess (29.8%, n = 272), counterclockwise rotation. These results suggest that sexual preference may be influenced in a significant proportion of homosexual men by a biological/genetic factor that also controls direction of hair-whorl rotation.**

Key words: sexual orientation / men homosexuality / human behaviour / hair-whorl orientation / behaviour biology

## **Introduction**

Factors determining the variation in human sexual preference are unknown. Since sexual preference is considered to be a “complex trait,” both multiple genetic and environmental factors are thought to be involved. Most models for biological explanations of sexual orientation have focused on genes and/or prenatal hormone environments influencing the neuronal circuitry on which sexual preference is presumably inscribed (2-4). Studies using families and twin methodologies have favoured genetic influences on sexual orientation (5, 6). However, relatively little effort has been devoted to identifying specific genes. Two molecular studies suggested a putative X-linked gene in the Xq28 region for male homosexuality (7, 8), but two follow-up studies failed to replicate this finding (9, 10). Thus far, neither family pedigree nor molecular research has provided compelling evidence for the nature and number of inherited factors affecting sexual preference. Furthermore, homosexuality concerns both “gay” men and “lesbian” women; it is difficult to determine whether the same factors confer homosexuality to men as well as to women. To avoid the compounding sex-specific affects, this study addresses the etiology of sexual preference of gay men only. The goal is to determine to what extent, if any, genetics influences the gay men’s orientation by exploiting a newly discovered biological trait that is genetically determined and is also clearly associated with the specification of human hand preference, and by inference, with the development of functional asymmetry between the brain hemispheres (1).

Many studies have investigated the relationship between handedness preference and homosexual behaviour. Some have suggested that homosexual men are more likely to be Non-Right-Handed (NRH, i.e., left- or ambidextrous-handed) to varying degrees, in comparison with

heterosexual men (11-15), while other studies (16-18) have not found a significant difference. Thus, the literature highlights inconsistencies regarding the relationship between hand preference and sexual orientation. Complicating the interpretation of this possible association, thus far the etiology of hand preference also has been considered as a complex trait, and therefore thought to be influenced by a combination of genetic and non-genetic factors (1). Thus, the finding of increased incidence of NRH in some studies does not necessarily support a genetic basis for gay men's homosexuality. A considerable amount of literature is available on the topic but studies lack consensus on the causes of the homosexual behaviour.

An interesting relationship of handedness with the orientation of scalp hair-whorl rotation developed on the top of a person's head was recently discovered (1). Most individuals exhibit a single hair whorl that rotates Clockwise (C, Fig. 1) or Counterclockwise (CC). The hair-whorl study concluded that a single locus separates Right-Handers (RH) from NRH and that the locus also controls the direction of hair-whorl rotation. Individuals carrying the hypothesized dominant locus, termed *RGHT1* (for *RiGHT*-handed), are RH, presumably due to specification of language processing in the left hemisphere of the brain and coupling it to both the development of dominant hand on the contra-lateral, right side, and to the development of C crown hair-whorl. According to this "Random-recessive model," homozygous individuals with the nonfunctional, recessive *r* (for *random*) allele do develop these traits, but they are independently and randomly distributed to the left versus the right side of the person. Notably, this model also explained handedness discordance of monozygotic twins by genetics due to their *r/r* genotype.

## **Materials and Methods**

The data on the first and second sample was collected in September 2003, when the author by chance happened to be vacationing at a beach where the preponderance of gay men was fortuitously noticed. The subjects were considered to be homosexuals because of their public display of stereotypical interpersonal relationship deemed of homosexual men. This assessment was further fortified because of dearth of females and children present on the beach. More importantly, after the first serendipitous observation of preponderance of gay men was made serendipitously, it was discovered that the Rehoboth Beach is a well-known gay men's vacation spot in the state of Delaware, USA. Conveniently, the gay men were highly concentrated in one area at the beach. Such considerations made it relatively easy to collect the data on groups of predominantly gay men with great confidence even though the subjects were not asked for their sexual preference. Results of the third sample of gay men were collected from the same beach a year later on May 30, 2004. As a control of men vacationing at a conventional beach, observations were made by visiting beach at Atlantic City, New Jersey, on June 12, 2004. According to the National Institutes of Health guidelines for research with humans, informed consent from subjects is not required if the subjects are anonymous, and additionally, if the observations are made discreetly and unobtrusively, without the subjects knowledge. This procedure was observed in the study.

## **Results**

It should be noted that one is born with a specific hair-whorl rotation, its orientation does not change with aging, and over 96% individuals support a single hair whorl. Certainly the environment does not influence the hair-whorl orientation, including the direction the way the hair is combed. This realization provides one with an opportunity to unambiguously define the

contribution, if any, of hair-whorl genetics to the gay men's sexual preference by investigating the rotation of their hair whorls. Incidentally, since the hair whorl is found at the top ("crown") of the head and thereby it is difficult to observe one's own whorl, combined with the direction of orientation seemingly an unimportant feature, most people are oblivious to the direction of their hair-whorl rotation. It requires two mirrors to observe one's own hair-whorl.

In this study the author collected the data on hair whorls of predominantly gay men relaxing on the beach in the town of Rehoboth Beach, Delaware State, USA, in the summer of 2003. The phenotype of hair-whorl orientation is easy to score by unobtrusively and discreetly observing the heads of subjects with short scalp hair (Fig. 1). Obviously, bald individuals, those with long hair or wearing a sun cap were not incorporated in the study. To avoid repeated counting of persons in each sample, the author investigated the men by walking through the area only once. In the first sample enriched of gay men, 50 C and 24 CC (Table 1) rotations were recorded. The preponderance of nearly one-third CC rotation in the first sample was vastly different from the value of 8.4% CC rotation found in the public at large that included both males and females (1). To make the study scientifically sound and to test reproducibility, it was thought essential to collect data of two other samples. Therefore, another visit to the same beach was made three weeks later by the investigator. The third sample was collected one year later. Confirming an excess of CC whorls finding in the first sample, the second and third samples were also enriched with individuals exhibiting CC orientation (Table 1). Altogether, in a combined sample of 272 mostly gay men observed, 29.8% of them exhibited CC hair-whorl orientation (Table 1). It is possible that a minority of the men included in this sample might not be gays, as they might have been visiting a friend; therefore, the number of 29.8% CC should be taken as a minimum value for hair-whorl rotation of homosexual men.

Clearly the combined value of 29.8% CC orientation of three samples concerning predominantly gay men should not be compared to the 8.4% value described previously for the combined sample of both males and females (1). To avoid the possibility of gay men also present in men relaxing at other areas of the beach, the data on unselected, control group of males was not collected from same beach. Rather, visits were made to local shopping malls, grocery stores, barbershops, gas stations, fast-food restaurants, gyms, and three airports in the States of Maryland, New Hampshire and Massachusetts to collect data on males (both men and boys) randomly chosen from the general public, without enquiring about their sexual orientation; a minority of them are expected to be gays. Only 8.2% of the males in the control group exhibited the CC pattern (Table 1), a percentage strikingly similar to the 8.4% value recently reported for the combined male and female population at large (1).

It is formally possible that men with counterclockwise orientation prefer to visit the beach more often than those with the clockwise orientation for reasons unrelated to their sexual orientation. Therefore, as another control, data on men relaxing at another beach frequented by general public, at Atlantic City, in the nearby State of New Jersey, was collected. In this sample only 10.7% men supported counterclockwise orientation, a result not significantly different from the sample of males at large (Table 1).

These results indicated that three samples enriched with homosexual men exhibited a remarkably increased level of 3.6-fold CC rotation in comparison to that of males in the general public. Using the standard chi-square test, the  $\chi^2$ -value of each sample of gays differs from the value of control males with a very high level of significance ( $P < 0.0001$ , Table 1). Although we cannot exclude the possibility that few of the men were the same men present in more than one

sample, the value of combined samples also differs from the control sample with a very high level of statistical significance ( $\chi^2 = 174$ , d. f. = 1,  $P < 0.0001$ , Table 1).

## **Discussion**

The increased incidence of CC rotation in gay men may be explained by one of two different genetic possibilities. One possibility is that some other unknown genetic factor(s), unrelated to the handedness trait, increases the proportion of CC rotation and also causes homosexuality. Although still unresolved issue as stated above, several studies have reported a significantly increased proportion of left-handers among gay men (11-15). Also, it was recently suggested that handedness discordance of monozygotic twins results from random distribution of the trait to the left/right body axis owing to their  $r/r$  genotype according to the Random-recessive model (1). Similar to this random distribution feature of the  $r/r$  handedness genetics, approximately 50% monozygotic co-twin brothers of gay men are themselves gay (19). This value of gay twins discordance is consistent with the thesis of association between sexual preference and handedness genetics, rather than to some other genetic factor also causing discordance in one-half of the co-twins. Therefore, perhaps the second possibility more compatible with the data is that the hair-whorl genetics, and by inference, handedness genetics, constitutes one of the predisposing factors influencing the development of gay men's sexual preference. According to this latter possibility, one can calculate what fraction of all instances of male homosexuality should be attributed to the hair-whorl/handedness genetics. Due to random rotation of  $r/r$  individuals, 50% of them develop the C and 50% CC pattern (1). Accordingly, the value of at least 29.8% CC orientation in enriched sample of gays suggests that at least  $29.8\% \times 2 = 59.6\%$

of gays possess the *r/r* genetic constitution. Thus, the majority (59.6%) of gays' sexual preference may be associated with the gene controlling hair-whorl orientation. As the present study only dealt with samples enriched in gay men, the value of CC rotation is likely to go up when the data with self-reporting gay men is obtained in follow-up studies.

As noted above, most biological explanations of sexual orientation have considered multiple genes and/or prenatal hormone environments influencing neuronal circuitry. This study and others do not support a causal relationship between prenatal hormone level and sexual orientation, as men and women experiencing defects in hormone metabolism do not exhibit an increased homosexual behaviour (20). A different possibility invoking male homosexuality caused by maternal stress during pregnancy was already discounted by another study (21). Likewise, two new theories to effect sexual orientation of men, one proposing pre-conceptual programming of gametes by genomic imprinting (2), and another one postulating genomic imprinting for regulating sex-specific genes (4), are not easily applicable to the 59.6% men in these samples if their orientation results from the *r/r* genotype. This is not to say that all men with the CC hair whorls, and only individuals with CC rotation, should become homosexuals. Rather, we suggest that their *r/r* genetic constitution predisposes (i.e., increases chances) them to develop homosexual orientation, in comparison to those exhibiting the C hair whorls. It should be noted that even in the samples of homosexual men reported here, the 70.2% majority exhibited the C hair whorls. This indicates an imperfect relationship between hair-whorl orientation and homosexuality, both of which occur at a low rate in the population. Consequently, the trait of hair-whorl rotation in itself is not a definitive indicator of a man's sexual preference.

Considering the hair-whorl/handedness genetic possibility further, how can a partial association between the traits be explained? The results presented here lend support to one among the several possibilities considered previously, specifically the one concerning the development of cerebral laterality (14, 22). Although the two hemispheres of the brain are overall mirror images of each other, morphological differences in certain areas do exist. More importantly, the two hemispheres perform very different cognitive functions. The so-called “dominant” hemisphere processes language and hand-use motor functions, while the “automatic” hemisphere handles spatial and other non-verbal functions. Moreover, which side acquires which cognitive function is related to one’s hand preference, albeit with a complex correlation (1). Clearly, functionally important morphological differences do exist in the two hemispheres of most RH men. But curiously, decreased or reversed cerebral asymmetry is found in NRH singletons and both members of discordant monozygotic twin pairs [(23), and references therein]. Based on the increased incidence of the inferred *r/r* genotype of gays in the present study, it therefore follows that the development of less asymmetric brain hemispheres, or reversed asymmetry, increases their chances to develop homosexual orientation. As sexual orientation is a non-pathological behavioural phenomenon, by following the partial hair-whorl relationship presented here it should be fruitful in future studies to compare possible differences of brain hemispheric lateralization among homosexual and heterosexual men.

But, what does the hair-whorl orientation has to do with the trait of sexual preference? As our scalp, brain and handedness traits derive from the ectoderm layer of embryonic cells, it was recently suggested that the *RGHT1* gene may have evolved in humans to control non-random distribution of these traits to our left/right body axis (1). A challenge for future studies is to determine how brain laterality development could influence sexual preference. Perhaps a primary

possibility to consider is that less asymmetric hemispheres may allow additional neuronal connections between different parts of the brain, thereby predisposing individuals to develop homosexuality preference, in contrast to the restricted possibilities allowed for the more common asymmetric hemispheric arrangement. This study implies that specification of male homosexuality developed as a non-pathological trait is likely not due to influence on sex organs development. Rather, the preference is dictated by the person's mental makeup owing to the naturally occurring genetic variation in brain laterality development. In support of genetic etiology, scientists have delineated the genetic specification of sex-specific neuronal behaviour in model experimental organisms. For example, the *fruitless* gene mutant males of the *Drosophila* fruit fly prefer to sexually court males rather than their female counterparts (24).

Last, as this initial study was limited to determining the rotation of hair-whorls of gay men, and several previous studies were limited to handedness determination, in future it will be informative to ascertain both traits in the same sample of gay men to further scrutinize the connection between these traits. Moreover, considering the important biological and socio-political implications of this initial study, once these results are publicly available we would not have to wait long for other investigators to scrutinize conclusions of this study by independent and systematic studies involving self-reporting groups of gay men, also involving different geographical regions and races. Also, it should be equally interesting to compare the ratio of C and CC hair-whorl orientation in lesbian women with that of females at large. Like the similar correlation between monozygotic co-twin brothers of gay men, ~50% of the twin sisters of lesbian women are themselves lesbian (19). Therefore, an analogous contribution of hair-whorl/handedness genetics may be expected for women's homosexuality as well. An important implication of this study is that the trait of hair-whorl orientation, which does not change with

age and cannot be altered, should replace handedness as it can be culturally changed, as a phenotypic marker for cerebral hemispheric lateralization. Therefore, similar relationship studies employing the easily discernable, definitive trait of hair-whorl rotation should be conducted for defining the role of brain hemispheric asymmetry on the etiology of other human behavioural traits such as autism, schizophrenia and bipolar diseases, cognitive deficiency and speech dysfluency. Although some previous studies have hypothesized biological factors in the etiology of homosexuality, while other studies have contradicted it, clear evidence has been lacking. This is the first study that shows a highly significant association of biologically specified CC hair-whorl rotation and homosexuality in a considerable proportion of men in samples enriched of gays. Thus, a genetic factor that controls the direction of hair-whorl rotation contributes to a significant proportion of gay man's sexual preference.

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References:

1. Klar, A.J. (2003) Human handedness and scalp hair-whorl direction develop from a common genetic mechanism. *Genetics*, **165**, 269-76.
2. Pollard, I. (1996) Preconceptual programming and sexual orientation: a hypothesis. *J Theor Biol*, **179**, 269-73.
3. Mustanski, B.S., Chivers, M.L. and Bailey, J.M. (2002) A critical review of recent biological research on human sexual orientation. *Annu Rev Sex Res*, **13**, 89-140.
4. Bocklandt, S. and Hamer, D.H. (2003) Beyond hormones: a novel hypothesis for the biological basis of male sexual orientation. *J Endocrinol Invest*, **26**, 8-12.
5. Pillard, R.C. and Weinrich, J.D. (1986) Evidence of familial nature of male homosexuality. *Arch Gen Psychiatry*, **43**, 808-12.
6. Bailey, J.M. and Pillard, R.C. (1991) A genetic study of male sexual orientation. *Arch Gen Psychiatry*, **48**, 1089-96.
7. Hamer, D.H., Hu, S., Magnuson, V.L., Hu, N. and Pattatucci, A.M. (1993) A linkage between DNA markers on the X chromosome and male sexual orientation. *Science*, **261**, 321-7.
8. Hu, S., Pattatucci, A.M., Patterson, C., Li, L., Fulker, D.W., Cherny, S.S.,

- Kruglyak, L. and Hamer, D.H. (1995) Linkage between sexual orientation and chromosome Xq28 in males but not in females. *Nat Genet*, **11**, 248-56.
9. Bailey, J.M., Pillard, R.C., Dawood, K., Miller, M.B., Farrer, L.A., Trivedi, S. and Murphy, R.L. (1999) A family history study of male sexual orientation using three independent samples. *Behav Genet*, **29**, 79-86.
  10. Rice, G., Anderson, C., Risch, N. and Ebers, G. (1999) Male homosexuality: absence of linkage to microsatellite markers at Xq28. *Science*, **284**, 665-7.
  11. Gotestam, K.O., Coates, T.J. and Ekstrand, M. (1992) Handedness, dyslexia and twinning in homosexual men. *Int J Neurosci*, **63**, 179-86.
  12. Halpern, D.F. and Cass, M. (1994) Laterality, sexual orientation, and immune system functioning: is there a relationship? *Int J Neurosci*, **77**, 167-80.
  13. Holtzen, D.W. (1994) Handedness and sexual orientation. *J Clin Exp Neuropsychol*, **16**, 702-12.
  14. Lalumiere, M.L., Blanchard, R. and Zucker, K.J. (2000) Sexual orientation and handedness in men and women: a meta-analysis. *Psychol Bull*, **126**, 575-92.
  15. Lippa, R.A. (2003) Handedness, sexual orientation, and gender-related personality traits in men and women. *Arch Sex Behav*, **32**, 103-14.
  16. Satz, P., Miller, E.N., Selnes, O., Van Gorp, W., D'Elia, L.F. and Visscher, B. (1991) Hand preference in homosexual men. *Cortex*, **27**, 295-306.
  17. Bogaert, A.F. and Blanchard, R. (1996) Handedness in homosexual and heterosexual men in the Kinsey interview data. *Arch Sex Behav*, **25**, 373-8.
  18. Mustanski, B.S., Bailey, J.M. and Kaspar, S. (2002) Dermatoglyphics, handedness, sex, and sexual orientation. *Arch Sex Behav*, **31**, 113-22.
  19. Bailey, J.M., Pillard, R.C., Neale, M.C. and Agyei, Y. (1993) Heritable factors influence sexual orientation in women. *Arch Gen Psychiatry*, **50**, 217-23.
  20. Banks, A. and Gartrell, N.K. (1995) Hormones and sexual orientation: a questionable link. *J Homosex*, **28**, 247-68.
  21. Bailey, J.M. (1989) A test of the maternal stress hypothesis for male homosexuality. *Behav Genet*, **19**, 744-744.
  22. McCormick, C.M., Witelson, S.F. and Kingstone, E. (1990) Left-handedness in homosexual men and women: neuroendocrine implications. *Psychoneuroendocrinology*, **15**, 69-76.
  23. Geschwind, D.H., Miller, B.L., DeCarli, C. and Carmelli, D. (2002) Heritability of lobar brain volumes in twins supports genetic models of cerebral laterality and handedness. *Proc Natl Acad Sci U S A*, **99**, 3176-81.
  24. Hall, J.C. (2002) Courtship lite: a personal history of reproductive behavioral neurogenetics in *Drosophila*. *J. Neurogenet*, **16**, 135-163.

**Table 1. Comparison of hair-whorl rotation of males at large with men at a standard beach and with samples enriched with gay men.**

Whorl orientation	Control males	Standard beach men control	Gay men samples:			
			1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	Total
—						
Clockwise	190	108	50	70	71	191
Counterclockwise (CC)	17	13	24	27	30	81
Total sample size	207	121	74	97	101	272
% CC	8.2	10.7	32.4	27.8	29.7	29.8
Fold CC increase in gay men	1.0	1.3	3.9	3.4	3.6	3.6
$\chi^2$ value	----	0.98	58.7	49.1	65.7	172.1
<i>P</i> -value	----	>0.30	<0.0001	<0.0001	<0.0001	
						<0.0001

The numbers in the table represent number of males observed in the indicated category.

**Fig. 1.** The hair-whorl phenotype. The picture shows scalp hair-whorl of an anonymous man selected from the general public depicting the clockwise orientation. By holding the picture in front of a mirror and looking at its image, the reader can appreciate the counterclockwise orientation.

