genes in a diagnostic setting: genotype–phenotype correlations and comparison of diagnostic DNA techniques in tuberous sclerosis complex. *Eur J Human Genet* 2005; **13**: 731–741.
2 Jones AC, Shyamsundar MM, Thomas MW *et al*: Comprehensive mutation analysis of TSC1 and TSC2-and phenotypic correlations in 150 families with tuberous sclerosis. *Am J Hum Genet* 1999; **64**: 1305–1315.
3 Dabora SL, Jozwiak S, Franz DN *et al*: Mutational analysis in a cohort of 224 tuberous sclerosis patients indicates increased severity of TSC2, compared with TSC1, disease in multiple organs. *Am J Hum Genet* 2001; **68**: 64–80.
4 Sampson JR, Maheshwar MM, Aspinwall R *et al*: Renal cystic disease in tuberous sclerosis: role of the polycystic kidney disease 1 gene. *Am J Hum Genet* 1997; **61**: 843–851.
5 Roberts PS, Dabora S, Thiele EA, Franz DN, Jozwiak S, Kwiatkowski DJ: Somatic mosaicism is rare in unaffected parents of patients with sporadic tuberous sclerosis. *J Med Genet* 2004; **41**: e69.
6 Mayer K, Ballhausen W, Leistner W, Rott H: Three novel types of splicing aberrations in the tuberous sclerosis TSC2 gene caused by mutations apart from splice consensus sequences. *Biochim Biophys Acta* 2000; **1502**: 495–507.
7 Li Y, Corradetti MN, Inoki K, Guan KL: TSC2: filling the GAP in the mTOR signaling pathway. *Trends Biochem Sci* 2004; **29**: 32–38.

Twin Research

Exploring female sexuality

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European Journal of Human Genetics (2005) **13,** 696–697.
doi:10.1038/sj.ejhg.5201420
Published online 6 April 2005

Two recent twin studies provide some fascinating insights into just how much of a role genes play in determining variation in female sexual behavior and debunk the common assumption that such behaviors are not heritable.

Twin researchers have always shown a keen interest in exploring the causes of variation in a broad range of human traits and disorders. Two papers in the December 2004 and February 2005 issues of *Twin Research & Human Genetics* that might attract some attention from a wider audience focus on the heritability of infidelity in a large sample of female twins from the UK, and on orgasm in Australian women.

Both papers go some way beyond the simple estimation of heritability. Specifically they include multivariate measures of the behavior under study and try to come up with evolutionary explanations for their findings. Moreover the UK paper reports on a genome-wide linkage scan, and examines the association of infidelity with a candidate gene suggested by animal studies.

In the UK study, Cherkas *et al*[1] surveyed over 1600 pairs of female twins about episodes of infidelity, lifetime number of sexual partners and their attitudes towards infidelity. The average age of the women was 50 years and a quarter of these were divorced. Around 40% of the variation in the number of sexual partners and infidelity was due to genetic factors. The genetic correlation between the two traits was estimated at 0.47. Interestingly, genes influenced the variation in actual behavior, but genetic factors did not appear to influence women's attitudes to infidelity. Women who had been faithful had about four sexual partners, compared to eight in the infidelity group. This number is quite large compared to a previous study's estimate of the number of lifetime partners that women desire.[2] For a time interval of the next 30 years, women worldwide averaged a desire for 2.5 partners (by contrast men expressed a desire for an average of 13 partners).

Based on research in pair-bonding animals, the authors tested for association with a single tandem repeat marker in one of the exons of the argentine vasopressin 1A receptor gene in 149 dizygotic pairs. No significant results were found. However, given that there are 18 alleles at this marker the power of these tests might be limited so the lack of significant associations might not be so surprising. The linkage scan (in 515 dizygotic twin pairs) showed a maximum LOD score of 2.46 to chromosome 7 for number of sexual partners and a LOD of 1.93 at chromosome 20 for infidel behavior.

Dawood *et al*[3] surveyed an even larger sample of twins from the Australian twin register. In a truly anonymous study (twins from the same pair had to agree together on a 10-digit number that served as an identifier) 3080 women responded to three questions about the frequency with which they reached orgasm during sexual intercourse, during other activities with their partner and during masturbation. Significant twin correlations were found for all three variables with correlations in monozygotic twins higher than in dizygotic twins. Broad-sense heritabilities were between 29% (orgasm during intercourse) and 40% (masturbation). Correlations among the three phenotypes were not very high, and neither were genetic correlations, which may be derived from the path diagrams that summarize the multivariate analyses.

Both sets of authors discussed their findings in the context of sexual behavior as a fitness trait and addressed the common assumption that such traits should show zero heritabilities. Previous papers from the Australian twin register have already demonstrated that this is not necessarily true.[4] However, it is surprising that neither paper tried to relate their phenotype to fitness indicators such as number of offspring.

Remarkably, after the demonstration of significant heritability in females, neither paper in its discussion, speculates on the possible expression of these genes in males. It is unlikely that the UK study has collected data in males, as the UK twin register consists almost entirely of female twins, but the Australian study might have collected data in male twins, including twins from opposite-sex pairs. Nonetheless, as the first studies to show significant

heritability for individual differences in female sexual behavior these papers are likely to be widely read and cited. The reactions that these findings will provoke in those that read them will doubtless be diverse. As suggested by the UK study, the diversity in attitudes shows no genetic basis, whereas actual behavior does■

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References

1 Cherkas LF, Oelsner EC, Mak YT, Valdes A, Spector TD: Genetic influences on female infidelity and number of sexual partners in humans: a linkage and association study of the role of the vasopressin receptor gene (AVPR1A). *Twin Res* 2004; **7**: 649–658.
2 Schmitt DP, 188 members of the International Sexuality Description Project: Universal sex differences in the desire for sexual variety: tests from 52 nations, 6 continents, and 13 islands. *J Personality Social Psychol* 2003; **85**: 85–104.
3 Dawood K, Kirk KM, Bailey JM, Andrews PW, Martin NG: Genetic and environmental influences on the frequency of orgasm in women. *Twin Res Hum Genet* 2005; **8**: 27–33.
4 Kirk KM, Blomberg SP, Duffy DL, Heath AC, Owens IPF, Martin NG: Natural selection and quantitative genetics of life-history traits in Western women: a twin study. *Evolution* 2001; **55**: 423–435.